WORK ORDER NO. 15037

CONTRACT NO. N62470-11-D-1008

P4019 DENTAL CLINIC REPLACEMENT
CAMP LEJEUNE

At the
CAMP LEJEUNE, NC

EBS Final Submittal Specifications

PREPARED BY:
RLF-TransSystems LLC
4750 New Broad Street
Orlando, Florida 32814

A/E Contract

Architectural: Tim Williams
Civil: James Lambeth
Structural: Marcia Bolton
Landscape: Karina Veaudry

Mechanical: Barry Fiedler
Electrical: Nick Zubrzycki
Fire Protection: Jennifer Lovett
Interiors: Debbie Sellers

Submitted By: Date: 04/26/2017

APPROVED BY:

Specifications:

For Commander, NAVFAC:
Date:
# Project Table of Contents

## Division 00 - Procurement and Contracting Requirements

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 01 15</td>
<td>List of Drawings</td>
</tr>
<tr>
<td>00 22 13.00 20</td>
<td>Supplementary Instructions to Offerors</td>
</tr>
</tbody>
</table>

## Division 01 - General Requirements

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 11 00</td>
<td>Summary of Work</td>
</tr>
<tr>
<td>01 14 00</td>
<td>Work Restrictions</td>
</tr>
<tr>
<td>01 20 00.00 20</td>
<td>Price and Payment Procedures</td>
</tr>
<tr>
<td>01 30 00</td>
<td>Administrative Requirements</td>
</tr>
<tr>
<td>01 32 17.00 20</td>
<td>Network Analysis Schedules (NAS)</td>
</tr>
<tr>
<td>01 33 00</td>
<td>Submittal Procedures</td>
</tr>
<tr>
<td>01 33 29</td>
<td>Sustainability Reporting</td>
</tr>
<tr>
<td>01 35 16.00 50</td>
<td>Cutting and Patching Procedures</td>
</tr>
<tr>
<td>01 35 26</td>
<td>Governmental Safety Requirements</td>
</tr>
<tr>
<td>01 42 00</td>
<td>Sources for Reference Publications</td>
</tr>
<tr>
<td>01 45 00.00 20</td>
<td>Quality Control</td>
</tr>
<tr>
<td>01 45 35</td>
<td>Special Inspections</td>
</tr>
<tr>
<td>01 50 00</td>
<td>Temporary Construction Facilities and Controls</td>
</tr>
<tr>
<td>01 57 19.00 20</td>
<td>Temporary Environmental Controls</td>
</tr>
<tr>
<td>01 57 19.01 20</td>
<td>Supplemental Temporary Environmental Controls</td>
</tr>
<tr>
<td>01 58 00</td>
<td>Project Identification</td>
</tr>
<tr>
<td>01 60 00.00 22</td>
<td>Requirements for Pesticide and Herbicide Coordination</td>
</tr>
<tr>
<td>01 73 19</td>
<td>Installation of Government-Furnished Medical Equipment</td>
</tr>
<tr>
<td>01 74 19</td>
<td>Construction and Demolition Waste Management</td>
</tr>
<tr>
<td>01 78 00</td>
<td>Closeout Submittals</td>
</tr>
<tr>
<td>01 78 23</td>
<td>Operation and Maintenance Data</td>
</tr>
<tr>
<td>01 78 24.00 20</td>
<td>Facility Electronic Operation and Maintenance Support Information (eOMSI)</td>
</tr>
<tr>
<td>01 78 30.00 22</td>
<td>GIS Data Deliverables</td>
</tr>
<tr>
<td>01 91 13.00 50</td>
<td>General Commissioning Requirements</td>
</tr>
</tbody>
</table>

## Division 02 - Existing Conditions

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>02 41 00</td>
<td>Demolition</td>
</tr>
<tr>
<td>02 81 00</td>
<td>Transportation and Disposal of Hazardous Materials</td>
</tr>
<tr>
<td>02 82 33.13 20</td>
<td>Removal/Control and Disposal of Paint with Lead</td>
</tr>
<tr>
<td>02 84 16</td>
<td>Handling of Lighting Ballasts and Lamps Containing PCBs and Mercury</td>
</tr>
</tbody>
</table>

## Division 03 - Concrete

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>03 30 00</td>
<td>Cast-In-Place Concrete</td>
</tr>
<tr>
<td>03 49 00.00 50</td>
<td>Glass-Fiber-Reinforced-Concrete (GFRC)</td>
</tr>
</tbody>
</table>

## Division 04 - Masonry

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>04 20 00</td>
<td>Unit Masonry</td>
</tr>
</tbody>
</table>

## Division 05 - Metals

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>05 12 00</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>05 30 00</td>
<td>Steel Decks</td>
</tr>
<tr>
<td>05 40 00</td>
<td>Cold-Formed Metal Framing</td>
</tr>
<tr>
<td>05 43 13.00 50</td>
<td>Slotted Channel Equipment Support Framing</td>
</tr>
<tr>
<td>05 44 00.00 50</td>
<td>Cold-Formed Metal Trusses</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>05 50 13</td>
<td>MISCELLANEOUS METAL FABRICATIONS</td>
</tr>
<tr>
<td>05 51 00</td>
<td>METAL STAIRS</td>
</tr>
<tr>
<td>05 51 33</td>
<td>METAL LADDERS</td>
</tr>
<tr>
<td>05 52 00</td>
<td>METAL RAILINGS</td>
</tr>
<tr>
<td>05 73 00.00 50</td>
<td>DECORATIVE METAL RAILINGS</td>
</tr>
<tr>
<td>06 10 00</td>
<td>ROUGH CARPENTRY</td>
</tr>
<tr>
<td>06 41 16.00 10</td>
<td>PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS</td>
</tr>
<tr>
<td>06 61 16</td>
<td>SOLID SURFACING FABRICATIONS</td>
</tr>
<tr>
<td>06 64 00.00 50</td>
<td>PLASTIC PANELING FABRICATIONS</td>
</tr>
<tr>
<td>06 16 16.00 50</td>
<td>CRISTALLINE WATERPROOFING</td>
</tr>
<tr>
<td>06 17 00</td>
<td>BENTONITE WATERPROOFING</td>
</tr>
<tr>
<td>06 21 00.00 50</td>
<td>THERMAL INSULATION (SPRAY-APPLIED)</td>
</tr>
<tr>
<td>06 21 13</td>
<td>BOARD AND BLOCK INSULATION</td>
</tr>
<tr>
<td>06 21 16</td>
<td>MINERAL FIBER BLANKET INSULATION</td>
</tr>
<tr>
<td>06 22 00</td>
<td>ROOF AND DECK INSULATION</td>
</tr>
<tr>
<td>06 27 13.00 50</td>
<td>MODIFIED BITUMINOUS SHEET AIR BARRIERS</td>
</tr>
<tr>
<td>06 27 26.00 50</td>
<td>FLUID-APPLIED MEMBRANE AIR BARRIERS</td>
</tr>
<tr>
<td>06 42 13</td>
<td>METAL WALL PANELS</td>
</tr>
<tr>
<td>06 46 46.00 50</td>
<td>FIBER-CEMENT BOARDS AND SIDING</td>
</tr>
<tr>
<td>06 52 00</td>
<td>MODIFIED BITUMINOUS MEMBRANE ROOFING</td>
</tr>
<tr>
<td>06 60 00</td>
<td>FLASHING AND SHEET METAL</td>
</tr>
<tr>
<td>06 61 14.00 20</td>
<td>STEEL STANDING SEAM ROOFING</td>
</tr>
<tr>
<td>06 72 00.00 50</td>
<td>ROOF ACCESSORIES</td>
</tr>
<tr>
<td>06 81 00.00 50</td>
<td>SPRAY-APPLIED AND BOARD FIREPROOFING SYSTEMS</td>
</tr>
<tr>
<td>06 84 00</td>
<td>FIRESTOPPING</td>
</tr>
<tr>
<td>06 92 00</td>
<td>JOINT SEALANTS</td>
</tr>
<tr>
<td>06 95 00.00 50</td>
<td>EXPANSION CONTROL</td>
</tr>
<tr>
<td>08 11 13</td>
<td>STEEL DOORS AND FRAMES</td>
</tr>
<tr>
<td>08 14 00</td>
<td>WOOD DOORS</td>
</tr>
<tr>
<td>08 31 13.00 50</td>
<td>ACCESS DOORS AND FRAMES</td>
</tr>
<tr>
<td>08 32 13.01 50</td>
<td>ALUMINUM SLIDING SYSTEMS</td>
</tr>
<tr>
<td>08 33 13.00 50</td>
<td>COILING COUNTER DOORS</td>
</tr>
<tr>
<td>08 33 23</td>
<td>OVERHEAD COILING DOORS</td>
</tr>
<tr>
<td>08 34 59</td>
<td>VAULT DOORS AND DAY GATES</td>
</tr>
<tr>
<td>08 41 13</td>
<td>ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS</td>
</tr>
<tr>
<td>08 42 29.23 50</td>
<td>SLIDING AUTOMATIC ENTRANCE DOORS</td>
</tr>
<tr>
<td>08 51 13</td>
<td>ALUMINUM WINDOWS</td>
</tr>
<tr>
<td>08 71 00</td>
<td>DOOR HARDWARE</td>
</tr>
<tr>
<td>08 81 00</td>
<td>GLAZING</td>
</tr>
<tr>
<td>08 91 00</td>
<td>METAL WALL AND DOOR LOUVERS</td>
</tr>
<tr>
<td>09 22 00</td>
<td>SUPPORTS FOR PLASTER AND GYPSUM BOARD</td>
</tr>
<tr>
<td>09 24 23</td>
<td>CEMENT STUCCO</td>
</tr>
<tr>
<td>09 29 00</td>
<td>GYPSUM BOARD</td>
</tr>
<tr>
<td>09 30 10</td>
<td>TILING</td>
</tr>
<tr>
<td>09 51 00</td>
<td>ACOUSTICAL CEILINGS</td>
</tr>
<tr>
<td>09 65 00</td>
<td>RESILIENT FLOORING</td>
</tr>
<tr>
<td>09 68 00</td>
<td>CARPETING</td>
</tr>
</tbody>
</table>
09 90 00  PAINTS AND COATINGS
09 96 00  HIGH-PERFORMANCE COATINGS

DIVISION 10 - SPECIALTIES

10 11 00  VISUAL DISPLAY UNITS
10 14 00.10  EXTERIOR SIGNAGE
10 14 00.10 50  EXTERIOR EDUCATIONAL SIGNAGE
10 14 00.20  INTERIOR SIGNAGE
10 14 53  TRAFFIC SIGNAGE
10 21 13  TOILET COMPARTMENTS
10 21 23.16  CUBICLE TRACK AND HARDWARE
10 22 39  FOLDING PANEL PARTITIONS
10 26 00  WALL AND DOOR PROTECTION
10 28 13  TOILET ACCESSORIES
10 44 00.00 50  FIRE EXTINGUISHERS AND CABINETS
10 90 00.00 50  MISCELLANEOUS SPECIALTIES

DIVISION 11 - EQUIPMENT

11 53 00  LABORATORY EQUIPMENT AND FUMEHOODS
11 71 00  WARMING CABINETS, STERILIZERS, AND ASSOCIATED EQUIPMENT
11 74 00  DENTAL EQUIPMENT

DIVISION 12 - FURNISHINGS

12 24 13  ROLLER WINDOW SHADES
12 35 70  HEALTHCARE CASework
12 36 00.00 20  MANUFACTURED VANITIES
12 48 13  ENTRANCE FLOOR MATS AND FRAMES
12 56 53.00 50  MODULAR LABORATORY FURNITURE
12 93 00  SITE FURNISHINGS

DIVISION 13 - SPECIAL CONSTRUCTION

13 49 19  X-RAY SHIELDING

DIVISION 14 - CONVEYING EQUIPMENT

14 24 23  HYDRAULIC PASSENGER ELEVATORS

DIVISION 21 - FIRE SUPPRESSION

21 08 00.00 50  COMMISSIONING OF FIRE SUPPRESSION SYSTEMS
21 13 13.00 20  WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

DIVISION 22 - PLUMBING

22 00 70  PLUMBING, HEALTHCARE FACILITIES
22 08 00.00 50  COMMISSIONING OF PLUMBING SYSTEMS
22 60 70  GAS AND VACUUM SYSTEMS FOR HEALTHCARE FACILITIES

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

23 00 00  AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS
23 03 00.00 20  BASIC MECHANICAL MATERIALS AND METHODS
23 05 48.00 40  VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT
23 05 93  TESTING, ADJUSTING, AND BALANCING FOR HVAC
23 07 00  THERMAL INSULATION FOR MECHANICAL SYSTEMS
COMMISSIONING OF HVAC SYSTEMS
BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC
FACILITY GAS PIPING
REFRIGERANT PIPING
LOW PRESSURE WATER HEATING BOILERS (OVER 800,000 BTU/HR OUTPUT)
WATER CHILLERS, AIR COOLED TYPE
CHILLED AND HEATING HOT WATER PIPING SYSTEMS
UNITARY AIR CONDITIONING EQUIPMENT
TERMINAL HEATING UNITS

DIVISION 25 - INTEGRATED AUTOMATION

DIVISION 26 - ELECTRICAL

DIVISION 27 - COMMUNICATIONS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

DIVISION 31 - EARTHWORK

DIVISION 32 - EXTERIOR IMPROVEMENTS
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 13 13.06</td>
<td>PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES</td>
</tr>
<tr>
<td>32 13 73</td>
<td>COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS</td>
</tr>
<tr>
<td>32 16 13</td>
<td>CONCRETE SIDEWALKS AND CURBS AND GUTTERS</td>
</tr>
<tr>
<td>32 16 15</td>
<td>CONCRETE BLOCK PAVEMENTS</td>
</tr>
<tr>
<td>32 17 23</td>
<td>PAVEMENT MARKINGS</td>
</tr>
<tr>
<td>32 31 13</td>
<td>CHAIN LINK FENCES AND GATES</td>
</tr>
<tr>
<td>32 31 19</td>
<td>ORNAMENTAL METAL FENCING SYSTEM</td>
</tr>
<tr>
<td>32 32 23</td>
<td>SEGMENTAL CONCRETE BLOCK RETAINING WALL</td>
</tr>
<tr>
<td>32 39 00</td>
<td>MISCELLANEOUS SITE IMPROVEMENTS</td>
</tr>
<tr>
<td>32 84 29</td>
<td>TREE ROOT FEEDER SYSTEM</td>
</tr>
<tr>
<td>32 92 23</td>
<td>SODDING</td>
</tr>
<tr>
<td>32 93 00</td>
<td>EXTERIOR PLANTS</td>
</tr>
</tbody>
</table>

**DIVISION 33 - UTILITIES**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>33 11 00</td>
<td>WATER UTILITY DISTRIBUTION PIPING</td>
</tr>
<tr>
<td>33 11 23</td>
<td>NATURAL GAS AND LIQUID PETROLEUM PIPING</td>
</tr>
<tr>
<td>33 30 00</td>
<td>SANITARY SEWERS</td>
</tr>
<tr>
<td>33 40 00</td>
<td>STORM DRAINAGE UTILITIES</td>
</tr>
<tr>
<td>33 46 16</td>
<td>SUBDRAINAGE PIPING</td>
</tr>
<tr>
<td>33 71 02</td>
<td>UNDERGROUND ELECTRICAL DISTRIBUTION</td>
</tr>
<tr>
<td>33 82 00</td>
<td>TELECOMMUNICATIONS OUTSIDE PLANT (OSP)</td>
</tr>
</tbody>
</table>

-- End of Project Table of Contents --
PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)


ASTM C 580 (2002; R 2008) Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

ASTM D 4258 (2012) Standard Practice for Surface Cleaning Concrete for Coating

ASTM D 4259 (1988; R 2006) Standard Practice for Abrading Concrete

ASTM D4260 Standard Practice for Liquid and Gelled Acid Etching of Concrete

ASTM D4261 Standard Practice for Surface Cleaning Concrete Masonry Units for Coating

1.2 SUMMARY

Section includes crystalline waterproofing for application to negative side concrete and concrete unit masonry surfaces of elevator pits, and elsewhere as indicated on drawings.

1.3 SUBMITTALS

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

SD-03 Product Data

Crystalline waterproofing; G

Patching compound; G
Plugging compound; G
Include material descriptions and installation instructions.

SD-07 Certificates
Applicator qualifications; G
Field quality control reports; G

Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for crystalline waterproofing.

1.4 QUALITY ASSURANCE
1.4.1 Applicator Qualifications

A firm experienced in applying crystalline waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and that employs workers trained and approved by manufacturer.

1.4.2 Preinstallation Conference

Conduct conference at Project site.

1.5 PROJECT CONDITIONS
1.5.1 Weather Limitations

Proceed with application only when existing and forecasted weather conditions permit crystalline waterproofing to be performed according to manufacturer's written instructions. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

1.5.2 Ambient Conditions

Proceed with waterproofing work only if temperature is maintained at 40 deg F or above during work and cure period, and space is well ventilated and kept free of water.

PART 2 PRODUCTS
2.1 WATERPROOFING MATERIALS

2.1.1 Crystalline Waterproofing

Prepackaged, gray-colored proprietary blend of portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; that has VOC content complying with limits of authorities having jurisdiction; with properties
meeting or exceeding the criteria specified below.

a. Adhesion: Minimum 175 psi per ASTM C 952.
b. Tensile Strength: Minimum 330 psi per ASTM C190 at 100 percent RH.
c. Flexural Strength: Minimum 470 psi per ASTM C 580.

2.2 ACCESSORY MATERIALS

2.2.1 Patching Compound

Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.

2.2.2 Plugging Compound

Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.

2.2.3 Portland Cement

ASTM C 150, Type I.

2.2.4 Sand

ASTM C 144.

2.2.5 Polymer Admixture for Protective Topping

Polymer bonding agent and admixture designed to improve adhesion to prepared substrates and not to create a vapor barrier.

2.2.6 Water

Potable.

2.3 MIXES

2.3.1 Crystalline Waterproofing

Add prepackaged dry ingredients to water according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied. Proceed with application only after unsatisfactory conditions have been corrected.
Notify Architect in writing of active leaks or defects that would affect system performance.

3.2 PREPARATION

Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to ensure adequate ambient temperatures and ventilation conditions for application. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves. Stop active water leaks with plugging compound according to waterproofing manufacturer's written instructions. Repair damaged or unsatisfactory substrate with patching compound according to manufacturer's written instructions.

3.2.1 Surface Preparation

Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.

Clean concrete surfaces according to ASTM D 4258.

a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic (hydrochloric) acid solution according to ASTM D4260.

b. Prepare smooth-formed and trowel-finished concrete by mechanical abrading or abrasive-blast cleaning according to ASTM D 4259.

Clean concrete unit masonry surfaces according to ASTM D4261.

a. Lightweight Concrete Unit Masonry: Etch with 10 percent muriatic (hydrochloric) acid solution or abrade surface by wire brushing. Remove acid residue until pH readings of water after rinse are not more than 1.0 pH lower or 2.0 pH higher than pH of water before rinse.

b. Medium- and Normal-Weight Concrete Unit Masonry: Sandblast or bushhammer to a depth of 1/16 inch.

3.2.2 Concrete Joints

Clean reveals according to waterproofing manufacturer's written instructions.

3.3 APPLICATION

3.3.1 General

Comply with waterproofing manufacturer's written instructions for application and curing.

a. Saturate surface with water for several hours prior to application and maintain damp condition until applying waterproofing. Remove standing water.

b. Number of Coats: Minimum, two.
c. Application Method: Brush. Apply to ensure that each coat fills voids and is in full contact with substrate or previous coat.

d. Dampen surface between coats.

3.3.2 Curing

Moist-cure waterproofing for minimum three days immediately after final coat has set, followed by air drying, unless otherwise recommended in writing by manufacturer.

3.3.3 Protective Topping

Apply where recommended by product manufacturer.

3.4 FIELD QUALITY CONTROL

3.4.1 Inspection

Manufacturer's representative to inspect completed application and provide a written report that application complies with manufacturer's written instructions.

3.5 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 D 1557 (2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)


ASTM D 4632 (2015a) Grab Breaking Load and Elongation of Geotextiles

1.2   SUBMITTALS

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

SD-03 Product Data

Materials; G

SD-08 Manufacturer's Instructions

Application

Protection

Corrections

1.3   DELIVERY, STORAGE, AND HANDLING

Do not place bentonite waterproofing materials in flooded areas or during precipitation. Provide bentonite panels and containers with manufacturer's labels intact, identifying the materials. Keep materials dry prior to use with polyethylene or canvas covering for sides and top and chocks or skids underneath, of sufficient height to maintain separation from ground water. Protect materials from moisture. Remove materials which show evidence of damage, deterioration, or contamination.
PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Bentonite Waterproofing System

2.1.1.1 Geotextile/Bentonite Sheets

Minimum 1.0 lb/ sq. ft. of bentonite clay granules between two layers of geotextile polypropylene fabric, one woven and one nonwoven, needle punched and heat fused together. Use at vertical and horizontal applications.

2.1.1.2 Puncture Resistance

100 lbf according to ASTM D 4833.

2.1.1.3 Grab Tensile Strength

95 lfb according to ASTM D4632.

2.1.1.4 Granular Bentonite

Sodium bentonite clay containing a minimum of 90 percent montmorillonite (hydrated aluminum silicate), with a minimum of 90 percent passing a No. 20 sieve.

2.2 ACCESSORIES

2.2.1 Bentonite Mastic

Trowelable consistency, bentonite compound, specifically formulated for application at joints and penetrations.

2.2.2 Bentonite Tubes

Manufacturer's standard 2-inch-diameter, water-soluble tube containing approximately 1.5 lb/ft. of bentonite; hermetically sealed; designed specifically for placing on wall footings at line of joint with exterior base of wall.

2.2.3 Termination Bar

Extruded-aluminum or formed-stainless-steel bars with upper flange to receive sealant.

2.2.4 Plastic Protective Sheet

Polyethylene sheeting complying with ASTM D 4397; thickness recommended by waterproofing manufacturer to suit application but at least 6 mils thick.

2.2.5 Cement Grout Patching Material

Manufacturer's recommended grout mix compatible with substrate being patched.

2.2.6 Masonry Fasteners

Case-hardened nails or hardened-steel, powder-actuated fasteners.
Depending on manufacturer's written requirements, provide 1/2- or 1-inch-diameter washers under fastener heads.

2.2.7 Sealants

As recommended in writing by waterproofing manufacturer. Comply with requirements specified in Section 07 92 00 JOINT SEALANTS.

2.2.8 Tapes

Waterproofing manufacturer's recommended tape for joints between sheets, membranes, or panels.

2.2.9 Adhesive

Water-based adhesive used to secure waterproofing to both vertical and horizontal surfaces.

2.2.10 Drainage Mat

Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per foot.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Examine surfaces prior to treatment, eliminating irregularities and removing loose and foreign material. Point cracks and honeycombs in concrete surfaces. Surfaces of finished patches shall be flush with adjacent concrete surfaces. Allow cement mortar to dry for minimum of 72 hours prior to application of bentonite panels.

3.2 APPLICATION

Apply bentonite waterproofing system on exterior surfaces of all below grade structures, including elevator pits, sump pits, and elsewhere as indicated on drawings; apply where indicated, in accordance with manufacturer's printed instructions. Securely fasten panels over all construction joints and all expansion joints. Thoroughly pack all through-wall openings and penetrations with bentonite gel or granular bentonite, or both, prior to placement of bentonite panels.

3.3 PROTECTION

Provide protection to bentonite panels during backfilling and compaction as recommended by manufacturer of bentonite materials. If backfill is not immediately applied, protect panels against precipitation by covering temporarily with polyethylene. Replace damaged panels with new panels before and during backfilling and compaction. Compact backfill to at least 95 percent of ASTM D 1557 maximum density.

3.4 CORRECTIONS

Repair leaks and defective areas in accordance with manufacturer's recommendations.
Place and secure molded-sheet drainage panels, with geotextile facing away from wall substrate. Use adhesives or mechanical fasteners that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.5 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 1029  ((2007) Spray-Applied Cellular Polyurethane Thermal Insulation


U.S. GREEN BUILDING COUNCIL (USGBC)


INTERNATIONAL CODE COUNCIL (ICC)


1.2   SUMMARY

1.2.1   Section Includes

a. Spray applied polyurethane foam insulation.

1.2.2   Related Sections

a. Section 07 84 00 FIRESTOPPING for insulation installed as part of a perimeter fire-resistive joint system.

1.3   SUBMITTALS

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

SD-03 Product Data

For each type of product indicated.

SD-06 Test Reports
Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

SD-07 Certificates

For spray polyurethane foam insulation system, certifying compatibility of spray polyurethane foam insulation system and accessory materials with Project materials that connect to or that come in contact with the spray polyurethane foam insulation system; signed by product manufacturer.

Qualification Data: For Applicator.

1.4 QUALITY ASSURANCE

1.4.1 Surface-Burning Characteristics

As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.4.2 Applicator Qualifications

A firm experienced in applying spray polyurethane foam insulation materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.4.3 Preinstallation Conference

Conduct conference at Project site.

a. Include installers of other construction connecting to spray polyurethane foam insulation system, including air barriers, architectural precast concrete, masonry, sealants, windows, glazed curtain walls, door frames and as required.

b. Review spray polyurethane foam insulation system requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 LEED™ DOCUMENTATION for additional sustainable design and LEED requirements and definitions.
PART 2   PRODUCTS

2.1   REGIONAL MATERIALS OF PRODUCTS

Raw (or recycled) materials in polyurethane foam insulation shall be extracted, harvested, or recovered and manufacturer or processed within 500 miles (by air) of the project site.

2.2   SPRAY POLYURETHANE FOAM INSULATION

2.2.1   Closed-Cell Polyurethane Foam Insulation

ASTM C 1029, Type II with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

a. Minimum density of 1.9 lb/cu. ft., thermal resistivity of 6.4 deg F x h x sq. ft./Btu/ x in. at 75 deg F.

b. Maximum Permeability: 0.95 @ 2 inches thick.

c. Insulation R-value as noted on drawings.

2.3   IGNITION BARRIER

Barrier have ICC-ES documentation for use as an ignition barrier on spray applied insulation. Barrier shall provide protection as required by the ICC IBC.

PART 3   EXECUTION

3.1   PREPARATION

Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

3.2   INSTALLATION

3.2.1   General

a. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

b. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

3.3   INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

3.3.1   Spray-Applied Insulation

Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. Install (minimum 1-1/2 inches thick) in all locations, except as otherwise indicated.
3.3.2 Miscellaneous Voids

Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

   a. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.4 IGNITION BARRIER

apply to foam insulation that will be exposed as defined by the ICC IBC.

3.5 PROTECTION

Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.6 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

   -- End of Section --
PART 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 272  (2001; R 2007) Water Absorption of Core Materials for Structural Sandwich Constructions


ASTM E 136  (2011) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


NFPA 70  (2011; Errata 2 2012) National Electrical Code

U.S. GREEN BUILDING COUNCIL (USGBC)


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

29 CFR 1910.134  Respiratory Protection
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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

Board insulation; G
Pressure sensitive tape
Protection board or coating
Accessories
Recycled Content (LEED Credit MR 4); G

Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content included in this Section. Include a statement indicating material only costs for each product having recycled content. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-08 Manufacturer's Instructions

Board Insulation
Adhesive

SD-11 Closeout

All approved LEED Submittals specified under SD-03 Product Data; S

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

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

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

1.4 SAFETY PRECAUTIONS

1.4.1 Respirators

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

1.4.2 Other Safety Considerations

Consider safety concerns and measures as outlined in ASTM C 930.

1.5 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT OF PRODUCTS

Provide products with post-consumer recycled content plus one-half of pre-consumer recycled content to the greatest extent possible.

2.2 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.3 BOARD INSULATION

Provide only thermal insulating materials recommended by manufacturer for type of application indicated. Provide board thermal insulation conforming to the following standards and the physical properties listed below:

a. Extruded Preformed Cellular Polystyrene: ASTM C 578, Type IV, 1.60 pcf, unless otherwise indicated.

2.3.1 Thermal Resistance

R-Value and/or thickness as indicated.

2.3.2 Fire Protection Requirement

a. Flame spread index of 75 or less when tested in accordance with ASTM E 84.

b. Smoke developed index of 200 or less when tested in accordance with ASTM E 84.
2.3.3 Other Material Properties

Provide thermal insulating materials with the following properties:

- **a.** Rigid cellular plastics: Compressive Resistance at Yield: Not less than 25 pounds per square inch (psi) when measured according to ASTM D 1621.

- **b.** Water Absorption: Not more than 0.3 percent by total immersion, by volume, when measured according to ASTM C 272.

2.3.4 Prohibited Materials

Do not provide materials containing more than one percent of asbestos.

2.4 AIR AND VAPOR BARRIER

2.4.1 Air and Vapor Barrier for Masonry Cavity Walls

Refer to Section 07 27 13.00 50 MODIFIED BITUMINOUS SHEET AIR BARRIERS or Section 07 27 26.00 50 FLUID-APPLIED MEMBRANE AIR BARRIERS, as applicable.

2.5 PRESSURE SENSITIVE TAPE

As recommended by manufacturer of vapor retarder and having a water vapor permeance rating of one perm or less when tested in accordance with ASTM D 3833/D 3833M.

2.6 PROTECTION BOARD OR COATING

As recommended by insulation manufacturer.

2.7 ACCESSORIES

2.7.1 Adhesive

As recommended by insulation manufacturer.

2.7.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that all areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If installing perimeter or under slab insulation, check that the fill is flat, smooth, dry, and well tamped. If moisture or other conditions are found that do not allow the proper installation of the insulation, do not proceed but notify the Contracting Officer of such conditions.
3.2 PREPARATION

3.2.1 Blocking Around Heat Producing Devices

Unless using insulation board that passes ASTM E 136 in addition to the requirements in Part 2, install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless certified for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.

b. Gas Fired Appliances: Clearances as required in NFPA 54.

3.3 INSTALLATION

3.3.1 Insulation Board

Install and handle insulation in accordance with the manufacturer's installation instructions. Keep material dry and free of extraneous materials. Observe safe work practices.

3.3.2 Electrical Wiring

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

3.3.3 Cold Climate Requirement

Place insulation to the outside of pipes.

3.3.4 Continuity of Insulation

Butt tightly against adjoining boards, studs, rafters, joists, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating any thermal bridges or voids.

3.4 INSTALLATION ON WALLS

3.4.1 Installation on Masonry Walls

Apply board directly to masonry with adhesive or fasteners as recommended by the insulation manufacturer. Fit between obstructions without impaling board on ties or anchors. Apply in parallel courses with joints breaking midway over course below. Put ends in moderate contact with adjoining insulation without forcing. Cut and shape as required to fit around wall penetrations, projections or openings to accommodate conduit or other services. Seal around cut-outs with sealant. Install board in wall cavities so that it leaves at least a nominal one inch free air space outside of the insulation to allow for cavity drainage.

3.4.2 Adhesive Attachment to Concrete and Masonry Walls

Apply adhesive to wall and completely cover wall with insulation.
a. Full back bed method or
b. Spot method: Provide at least six spots having diameter of approximately 4 inches, located at each corner and mid-points of each of the longer sides of each board.
c. As recommended by the insulation manufacturer.
d. Use only full back method for pieces of one square foot or less.
e. Butt all edges of insulation and seal edges with tape.

3.4.3 Mechanical Attachment on Concrete and Masonry Walls

Cut insulation to cover walls. Apply adhesive to wall and set clip or other mechanical fastener in adhesive as recommended by manufacturer. After curing of adhesive, install insulation over fasteners, bend split prongs flush with insulation. Butt all edges of insulation and seal with tape.

3.5 PERIMETER AND UNDER SLAB INSULATION

Install perimeter thermal insulation where indicated on Drawings in accordance with manufacturer's written instructions.

3.5.1 Insulation on Vertical Surfaces

Install insulation on exterior of foundation walls as indicated. Fasten insulation with adhesive or mechanical fasteners.

3.5.2 Insulation Under Slab

Provide insulation horizontally under slab on grade as indicated. Install insulation on top of vapor barrier and turn vapor barrier up over the outside edge of insulation to top of slab.

3.6 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 07 21 16
MINERAL FIBER BLANKET INSULATION

PART 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)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


NFPA 70  (2011; Errata 2 2012) National Electrical Code

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

29 CFR 1910.134  Respiratory Protection

1.2   SUBMITTALS

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

SD-03 Product Data

Blanket insulation; G

Accessories

SD-08 Manufacturer's Instructions

Insulation
1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

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

1.3.2 Storage

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

1.4 SAFETY PRECAUTIONS

1.4.1 Respirators

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

1.4.2 Smoking

Do not smoke during installation of blanket thermal insulation.

1.4.3 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BLANKET INSULATION

ASTM C 665, Type I, blankets without membrane coverings; flame spread rating of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E 84.

2.1.1 Thermal Resistance

R-Value and/or thickness as indicated.

2.1.2 Prohibited Materials

Do not provide asbestos-containing materials.

2.1.3 Sound Attenuation Blankets

See Section 09 29 00 GYPSUM BOARD.
2.2 ACCESSORIES

2.2.1 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

2.2.2 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

3.2.1 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless these are certified by the manufacturer for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.

b. Vents and vent connectors used for venting the products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.

c. Gas Fired Appliances: Clearances as required in NFPA 54.

3.3 INSTALLATION

3.3.1 Insulation

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

3.3.1.1 Electrical wiring

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

3.3.1.2 Continuity of Insulation

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

3.3.1.3 Installation at Bridging and Cross Bracing

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

3.3.1.4 Cold Climate Requirement

Place insulation to the outside of pipes.

3.3.1.5 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.

3.4 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

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

ASTM INTERNATIONAL (ASTM)


FM GLOBAL (FM)

FM AS 4470  (1986; R 1992) Class I Roof Covers


UNDERWRITERS LABORATORIES (UL)


1.2   SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:
SD-02 Shop Drawings

Tapered roof insulation system; G
Taper cants and crickets

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

SD-03 Product Data

Fasteners; G
Insulation; G

Include minimum thickness of insulation and fastener pattern for specified wind uplift resistance for insulation on steel decks.

SD-05 Design Data

Performance Requirements Validation; G

For products and systems indicated to validate compliance with specified wind load performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

SD-06 Test Reports

Flame spread and smoke developed ratings
Submit in accordance with ASTM E 84.

SD-07 Certificates

Installer qualifications

SD-08 Manufacturer's Instructions

Nails and fasteners
Roof insulation, including field of roof and perimeter attachment requirements.

1.3 MANUFACTURER'S CERTIFICATE

Submit certificate from the insulation manufacturer attesting that the installer has the proper qualifications for installing tapered roof insulation systems.
1.4 QUALITY ASSURANCE

1.4.1 Insulation on Steel Decks

Roof insulation shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E 84. Insulation bearing the UL label and listed in the UL Bld Mat Dir as meeting the flame spread and smoke developed ratings will be accepted in lieu of copies of test reports. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the type used for this project and the construction is listed as fire-classified in the UL Bld Mat Dir or listed as Class I roof deck construction in the FM APP GUIDE. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

1.4.2 Wind Load Performance Requirements

Wind Loads: As indicated on Structural Drawings in accordance with International Building Code (IBC) and ASCE 7 requirements for Components and Cladding.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials to site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

a. Name of manufacturer;

b. Brand designation;

c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification; and

Deliver materials in sufficient quantity to allow continuity of the work.

1.5.2 Storage and Handling

Store and handle materials in a manner to protect from damage, exposure to open flame or other ignition sources, and from wetting, condensation or moisture absorption. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. Store felt rolls on ends. For the 24 hours immediately before application of felts, store felts in an area maintained at a temperature no lower than 50 degrees F above grade and having ventilation around all sides. Replace damaged material with new material.

1.6 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 40 degrees F and interior humidity is 45 percent or greater, or when there is visible ice, frost, or moisture on the roof deck.
1.7 PROTECTION OF PROPERTY

1.7.1 Special Protection

Provide special protection approved by the insulation manufacturer, or avoid heavy traffic on completed work when ambient temperature is above 80 degrees F.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

Roof insulation shall be the following material and compatible with attachment methods for the specified insulation and roof membrane:

a. Polyisocyanurate Board: ASTM C 1289 Type II, fibrous felt or glass mat membrane both sides, except minimum compressive strength shall be 20 pounds per square inch (psi).

2.1.2 Insulation Thickness

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

2.1.3 Tapered Roof Insulation

One layer of the tapered roof insulation assembly shall be factory tapered to slopes as indicate on drawings. Provide starter and filler blocks as required to provide the total thickness of insulation necessary to meet the specified slope and thermal conductance. Mitered joints shall be factory fabricated and shall consist of two diagonally cut boards or one board shaped to provide the required slopes. Identify each piece of tapered insulation board by color or other identity coding system, allowing the identification of different sizes of tapered insulation board required to complete the roof insulation system.

2.1.4 Cants and Tapered Edge Strips

Provide preformed cants and tapered edge strips of the same material as the roof insulation; or, when roof insulation material is unavailable, provide pressure-preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the roofing manufacturer, unless otherwise indicated. Face of cant strips shall have incline of 45 degrees and vertical height of 4 inches. Taper edge strips at a rate of one to 1 1/2 inch per foot down to approximately 1/8 inch thick.

2.2 PROTECTION BOARD

For use as a protection board for hot-mopped, torched-down, or adhesively-applied roofing membrane over roof insulation.
2.2.1 Glass Mat Gypsum Roof Board

ASTM C 1177/C 1177M, 0 Flame Spread and 0 Smoke Developed when tested in accordance with ASTM E 84, 500 psi, Class A, non-combustible, 1/2 inch thick, 4 by 8 feet board size.

2.3 ADHESIVE

2.3.1 Asphalt Roof Cement

ASTM D 4586, Type I for horizontal surfaces and for surfaces sloped from 0 to 3 inches per foot, Type II for vertical and surfaces sloped more than 3 inches per foot.

2.4 FASTENERS

Flush-driven through flat round or hexagonal steel or plastic plates. Steel plates shall be zinc-coated, flat round not less than 1 3/8 inch diameter or hexagonal not less than 28 gage. Plastic plates shall be high-density, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 3 inches in diameter. Fastener head shall recess fully into the plastic plate after it is driven. Plates shall be formed to prevent dishing. Do not use bell-or cup-shaped plates. Fasteners shall conform to insulation manufacturer's recommendations to meet wind load criteria indicated on Structural drawings, and shall conform to FM APP GUIDE for Class I roof deck construction.

2.4.1 Fasteners for Steel Decks

Approved hardened penetrating fasteners or screws conforming to FM AS 4470 and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement as required to meet specified wind load performance requirements.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Surfaces shall be clean, smooth, and dry. Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work.

The Contractor shall inspect and approve the surfaces immediately before starting installation. Prior to installing insulation, perform the following:

   a. Examine steel decks to ensure that panels are properly secured to structural members and to each other and that surfaces of top flanges are flat or slightly convex.

3.1.2 Surface Preparation

Correct defects and inaccuracies in roof deck surface to eliminate poor drainage and hollow or low spots and perform the following:

   a. Install wood nailers as indicated on the Drawings.
b. Cover steel decks with a layer of insulation board of sufficient thickness to span the width of a deck rib opening, and conforming to fire safety requirements. Secure with piercing or self-drilling, self-tapping fasteners of quantity and placement conforming to FM APP GUIDE. Insulation joints parallel to ribs of deck shall occur on solid bearing surfaces only, not over open ribs.

3.2 INSULATION INSTALLATION

Apply insulation in accordance with manufacturer's written instructions. Apply in two layers with staggered joints when total required thickness of insulation exceeds 1/2 inch. Lay insulation so that continuous longitudinal joints are perpendicular to direction of roofing, as specified in Section 07 52 00 MODIFIED BITUMINOUS MEMBRANE ROOFING and end joints of each course are staggered with those of adjoining courses. When using multiple layers of insulation, joints of each succeeding layer shall be parallel and offset in both directions with respect to layer below. Keep insulation 1/2 inch clear of vertical surfaces penetrating and projecting from roof surface. Gaps between insulation shall not exceed 1/4 inch.

3.2.1 Installation Using Only Mechanical Fasteners

Secure total thickness of insulation including protection board with penetrating type fasteners.

3.2.2 Special Precautions for Installation of Foam Insulation

3.2.2.1 Polyisocyanurate Insulation

Where polyisocyanurate foam board insulation is provided, install specified protection board over top surface of foam board insulation. Stagger joints of insulation with respect to foam board insulation below.

3.2.3 Cant Strips

Where indicated, provide cant strips at intersections of roof with walls, parapets, and curbs extending above roof. Fit cant strips flush against vertical surfaces. Where possible, nail cant strips to adjoining surfaces. Where cant strips are installed against non-nailable materials, install in an approved adhesive.

3.2.4 Tapered Edge Strips

Where indicated, provide edge strips in the right angle formed by junction of roof and wood nailing strips that extend above level of roof. Install edge strips flush against vertical surfaces of wood nailing strips. Where possible, nail edge strips to adjoining surfaces. Where installed against non-nailable materials, install in an approved adhesive.

3.3 PROTECTION

3.3.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with the finished roofing on same day. Do not permit phased construction. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are
applied. Do not permit storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight to conform to indicated live load limits of roof construction. Exposed edges of the insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be 2 layers of bituminous-saturated felt set in plastic bituminous cement set in roof cement. Fill all profile voids in cut-offs to prevent entrapping of moisture into the area below the membrane. Cutoffs shall be removed when work is resumed.

3.3.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

3.4 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roof insulation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.

b. Verification of certification, listing or label compliance with FM P9513.

c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.

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

e. Coordination with other materials, cants, sleepers, and nailing strips.

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

g. Installation of cutoffs and proper joining of work on subsequent days.

h. Continuation of complete roofing system installation to cover insulation installed same day.

3.5 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 D 6135 (2005) Practice for Application of Self-Adhering Modified Bituminous Waterproofing


1.2   SUBMITTALS

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

SD-02 Shop Drawings

Self-Adhering Sheet Air Barrier; G

a. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
b. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
c. Include details of interfaces with other materials that form part of air barrier.

SD-03 Product Data

Self-Adhering Sheet Air Barrier; G
SD-06 Test Reports

Self-Adhering Sheet Air Barrier; G

Certify compliance with performance requirements specified herein.

SD-07 Certificates

Self-Adhering Sheet Air Barrier; G

Installer Qualifications; G

1.3 QUALITY ASSURANCE

1.3.1 Installer Qualifications

An entity that employs installers and supervisors who are trained and approved by manufacturer. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

1.4 PREINSTALLATION CONFERENCE

Prior to starting application of barrier membrane system, arrange and attend a preinstallation conference to ensure a clear understanding of drawings and specifications. Give the Contracting Officer 10 days advance written notice of the time and place of meeting. Ensure that the mechanical and electrical subcontractor, flashing and sheetmetal subcontractor, and other trades that may perform other types of work on or over the membrane after installation, attend this conference.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver and store materials out of the weather, in manufacturer's original packaging with brand name and product identification clearly marked. Do not permit uncertified materials in the work area.

1.6 ENVIRONMENTAL CONDITIONS

Do not apply air and vapor barrier during inclement weather or when there is ice, frost, surface moisture, or visible dampness on the surface to receive air and vapor barrier and when ambient and surface temperatures are 40 degrees F or below. The restriction on the application of air and vapor barrier materials when ambient and surface temperatures are below 40 degrees F will be waived if the Contractor devises a means, approved by the Contracting Officer, of maintaining the surface and ambient temperatures above 40 degrees F.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.1.1 Air-Barrier Performance

Air-barrier assembly and seals with adjacent construction shall be capable
of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.1.2 Air-Barrier Assembly Air Leakage

Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357

2.2 SELF-ADHERING SHEET AIR BARRIER, VAPOR RETARDING

Modified bituminous sheet consisting of rubberized asphalt, nominal 40-mils thick, and cross laminated, high density polyethylene film, nominal 4-mils thick.

2.2.1 Modified Bituminous, Self-Adhering Sheeting Performance Requirements

a. Tensile Strength, ASTM D 412, Die C: 250 psi minimum;

b. Ultimate Elongation, ASTM D 412, Die C: 200 percent minimum;

c. Vapor Permeance, ASTM E96 Desiccant Method 0.01 perm maximum;

d. Air Permeance, ASTM E 2178: 0.004 cfm/sq. ft. of surface at 1.57-lbf/sq. ft. pressure difference;

e. Water Absorption, ASTM D 570; 0.15% maximum.

2.2.2 Accessory Materials

Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

2.2.3 Mastic

Polymer modified asphalt in suitable solvent of trowel-grade consistency and as recommended by the membrane manufacturer.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Before starting the work, verify that surfaces to be receive air and vapor barrier are in satisfactory condition. Notify the Contracting Officer of defects or conditions that will prevent a satisfactory application. Do not start application until defects and conditions have been corrected.

3.2 SURFACE PREPARATION

Ensure surfaces to be treated are clean, dry, smooth, and free from
deleterious materials and projections. Thoroughly wet holes, joints, cracks, and voids in masonry or concrete with water and fill with Portland cement mortar, strike flush, and permit to dry. Cut off high spots or grind smooth. Finish top surfaces of projecting masonry or concrete ledges below grade, except footings, to a steep bevel with Portland cement mortar. Sweep surfaces to be covered before applying barrier to remove dust and foreign matter. Cure concrete by a method compatible with the barrier system.

3.3 APPLICATION

Follow manufacturer's printed installation instructions and according to recommendations of ASTM D 6135. Carry barrier to abutting surfaces as indicated and adhere solid to the substrate. Avoid wrinkles and buckles in applying membrane and joint reinforcement.

   a. Self-Adhering Membrane: Apply self-adhering membrane on surfaces primed at a uniform coverage rate in accordance with membrane manufacturer's printed instructions. Remove release sheet and apply with tacky surface in contact with dried primer.

3.4 Modified Bituminous, Self-Adhering Membrane

Lap sheets at edges and ends a minimum of 2 1/2 inches over the preceding sheet. All side laps shall be minimum 2 1/2 inches and end laps shall be 5 inches. Laps shall be self adhesive, mastic as per manufacturer's recommendation. Roll or firmly press to adhere membrane to substrate. Cover corners and joints with a 12 inch width of membrane centered along the axis. Flash projections with a second ply of membrane for a distance of 6 inches from the projection. Finish exposed, terminated edges of membrane with a troweled bead of mastic. Apply mastic around edges of membrane, and projections. Apply mastic at end of each work day.

3.5 FLASHING

Flash penetrations through membrane. Ensure that penetrations are sealed with the appropriate sealant or mastic flashing component. Continuous metal reglets shall be installed, horizontally on footing and vertically on intersecting and connecting walls. Metal reglets shall receive exposed edges of membrane. Secure membrane into reglets by lead wedges and fill with cement as recommended by manufacturer of materials. Counterflash upper edge of membrane in compliance with, manufacturer's.

3.6 FIELD QUALITY CONTROL

Inspections: Air and vapor barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

   a. Continuity of membrane system has been achieved throughout the building envelope with no gaps or holes.
   b. Continuous structural support of membrane system has been provided.
   c. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
   d. Site conditions for application temperature and dryness of substrates have been maintained.
   e. Maximum exposure time of materials to UV deterioration has not been exceeded.
   f. Surfaces have been primed.
g. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
h. Termination mastic has been applied on cut edges.
i. Air barrier has been firmly adhered to substrate.
j. Compatible materials have been used.
k. Transitions at changes in direction and structural support at gaps have been provided.
l. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
m. All penetrations have been sealed.

Air and vapor barriers will be considered defective if they do not pass inspections.

a. Apply additional membrane material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
b. Remove and replace deficient membrane components for retesting as specified above.

3.7 PROTECTION

Protect membrane system from damage during application and remainder of construction period, according to manufacturer's written instructions.

3.7.1 Ultraviolet

Protect membrane from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace membrane or install additional, full-thickness, membrane application after repairing and preparing the overexposed membrane according to membrane manufacturer's written instructions.

3.7.2 Incompatible Material

Protect membrane from contact with incompatible materials and sealants not approved by membrane manufacturer. From contact with incompatible materials and sealants not approved by membrane manufacturer.

3.8 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 D 4258  (1999) Standard Practice for Surface Cleaning Concrete for Coating
ASTM E2178  Standard Test Method for Air Permeance of Building Materials

1.2   SUBMITTALS

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

SD-02 Shop Drawings

Fluid-applied membrane air barrier; G

a. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
b. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
c. Include details of interfaces with other materials that form part of air barrier.

SD-03 Product Data
Fluid-applied membrane air barrier; G
Accessory materials; G

Submit material description and physical properties, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity.

SD-06 Test Reports
Fluid-applied membrane air barrier; G
Certify compliance with performance requirements specified herein.

SD-07 Certificates
Fluid-applied membrane air barrier; G
Installer Qualifications; G

1.3 QUALITY ASSURANCE

1.3.1 Installer Qualifications

An entity that employs installers and supervisors who are trained and approved by manufacturer. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

1.4 PREINSTALLATION CONFERENCE

Prior to starting application of barrier membrane system, arrange and attend a preinstallation conference to ensure a clear understanding of drawings and specifications. Give the Contracting Officer 7 days advance written notice of the time and place of meeting. Ensure that the mechanical and electrical subcontractor, flashing and sheetmetal subcontractor, and other trades that may perform other types of work on or over the membrane after installation, attend this conference.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver barrier membrane materials in manufacturer's original, unopened containers, with labels intact and legible. Containers of materials covered by a referenced specification number shall bear the specification number, type, and class of the contents. Deliver materials in sufficient quantity to continue work without interruption. Store and protect materials in accordance with manufacturer's instructions, and use within their indicated shelf life. When hazardous materials are involved, adhere to special precautions of the manufacturer, unless precautions conflict with local, state, and federal regulations. Promptly remove from the site materials or incomplete work adversely affected by exposure to moisture or freezing. Store materials on pallets and cover from top to bottom with canvas tarpaulins.
1.6 ENVIRONMENTAL CONDITIONS

Apply materials when ambient temperature is 40 degrees F or above for a period of 24 hours prior to the application and when there is no ice, frost, surface moisture, or visible dampness on the substrate surface. Apply materials when air temperature is expected to remain above 40 degrees F during the cure period recommended by the manufacturer. Moisture test for substrate is specified under paragraph entitled "Moisture Test." Work may be performed within heated enclosures, provided the surface temperature of the substrate is maintained at a minimum of 40 degrees F for 24 hours prior to the application of the barrier membrane, and remains above that temperature during the cure period recommended by the manufacturer.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.1.1 Air-Barrier Performance

Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.1.2 Air-Barrier Assembly Air Leakage

Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357

2.2 FLUID-APPLIED MEMBRANE AIR BARRIER, VAPOR RETARDING

2.2.1 High-Build, Vapor-Retarding Air Barrier

Modified bituminous membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.

   a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E2178.

   b. Vapor Permeance: Maximum 0.1 perm ASTM E96/E96M Desiccant Method.

   c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.

   d. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested according to ASTM D4541.

2.2.2 Accessory Materials

Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier
manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

PART 3 EXECUTION

3.1 PREPARATION

Coordinate work with that of other trades to ensure that components to be incorporated into the barrier membrane system are available when needed. Inspect and approve surfaces immediately before application of barrier membrane materials. Remove laitance, loose aggregate, sharp projections, grease, oil, dirt, curing compounds, and other contaminants which could adversely affect the complete bonding of the membrane to the concrete or masonry surface.

3.1.1 Flashings

Make penetrations through walls watertight before application of barrier membrane. After flashing is completed, cover elastomeric sheet with fluid-applied barrier membrane during barrier membrane application.

3.1.1.1 Penetrations and Projections

Flash penetrations and projections through structural slab with an elastomeric sheet adhered to the concrete slab and the penetration. Leave elastomeric sheet unadhered for one inch over joint between penetration and concrete slab. Adhere elastomeric sheet a minimum of 4 inches onto horizontal deck.

3.1.1.2 Walls and Vertical Surfaces

Flash wall intersections which are not of monolithic pour or constructed with reinforced concrete joints with an elastomeric sheet adhered to both vertical wall surfaces and concrete slab. Flash intersections which are monolithically poured or constructed with reinforced concrete joints with either an elastomeric sheet or a vertical grade of fluid-applied barrier membrane adhered to vertical wall surfaces. Leave sheet unadhered for a distance of one inch from the corner.

3.1.2 Cracks and Joints

a. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces. Prime substrate and apply a single thickness of preparation coat strip extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of air barrier membrane and embed a joint reinforcing strip in preparation coat.

b. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.
3.1.3 Priming

Prime surfaces to receive fluid-applied barrier membrane membrane. Apply primer as required by membrane manufacturer's printed instructions.

3.2 SPECIAL PRECAUTIONS

Protect barrier membrane materials during transport and application. Do not dilute primers and other materials, unless specifically recommended by materials manufacturer. Keep containers closed except when removing contents. Do not mix remains of unlike materials. Thoroughly remove residual materials before using application equipment for mixing and transporting materials. Do not permit equipment on the project site that has residue of materials used on previous projects. Use cleaners only for cleaning, not for thinning primers or membrane materials.

3.3 APPLICATION

Over primed surfaces, provide a uniform, wet, monolithic coating of fluid-applied membrane, 60 mils thick, plus or minus 5 mils by following manufacturer's printed instructions. Apply material by trowel, squeegee, roller, brush, spray apparatus, or other method recommended by membrane manufacturer. Check wet film thickness as specified in paragraph entitled "Film Thickness" and adjust application rate as necessary to provide a uniform coating of the thickness specified. Where possible, mark off surface to be coated in equal units to facilitate proper coverage. At expansion joints, control joints, prepared cracks, flashing, and terminations, carry membrane over preformed elastomeric sheet in a uniform 60 mil thick, plus or minus 5 mils, wet thickness to provide a monolithic coating. If membrane cures before next application, wipe previously applied membrane with a solvent to remove dirt and dust that could inhibit adhesion of overlapping membrane coat. Use solvent recommended by the membrane manufacturer, as approved.

3.4 FIELD QUALITY CONTROL

3.4.1 Moisture Test

Prior to application of fluid-applied barrier membrane, measure moisture content of substrate with a moisture meter in the presence of the Contracting Officer. An acceptable device is the Delmhorst Moisture Meter, Model BD7/2E/CS, Type 21 E. Similar meters by other manufacturers, which are suitable for the purpose, may be used as approved by the Contracting Officer. Do not begin application until meter reading indicates "dry" range.

3.4.2 Film Thickness

Measure wet film thickness every 100 square feet during application by placing flat metal plates on the substrate or using a mil-thickness gage especially manufactured for the purpose.

3.5 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   REFERENCES

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)


AMERICAN IRON AND STEEL INSTITUTE (AISI)


AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

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

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M (2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


ASTM C 273/C 273M (2007a) Shear Properties of Sandwich Core Materials


ASTM D 2244 (2011) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
1.2 DESCRIPTION OF WALL PANEL SYSTEM

1.2.1 Wall Panel System

Factory color finished, metal wall panel system with concealed fastening attachment. Panel profile shall be as indicated on drawings. Where used as cladding, panels shall be solid and perform as a thermal, vapor, air and moisture barrier.

1.2.2 Performance Requirements for Wall Panel Systems

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

Maximum calculated fiber stress must not exceed the allowable value in the AISI or AA manuals; a one third overstress for wind is allowed. Midspan deflection under maximum design loads is limited to L/180. Drawings show the extent and general assembly details of the metal siding. Provide design for members and connections not shown on the drawings. Siding panels and accessories shall be the products of the same manufacturer.
Provide metal wall panel assemblies complying with the load and stress requirements in accordance with ASTM E 1592. Wind Load force due to wind action governs the design for panels.

Design and fabricate exterior metal wall panels provided to resist wind load criteria indicated on Structural drawings in accordance with ICC IBC and ASCE 7 requirements for Components and Cladding.

1.2.2.1 Air Infiltration; Factory Insulated Wall Panels

Air leakage shall not exceed 0.06 cfm/sf at 6.24 psf when tested according to ASTM E 283.

1.2.2.2 Water Penetration Under Static Pressure; Factory Insulated Wall Panels

No water penetration when tested to 15 psf according to ASTM E 331.

1.2.2.3 Water Penetration Under Dynamic Pressure; Factory Insulated Wall Panels

No evidence of water leakage at a pressure of 15 psf when tested according to AAMA 501.1.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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

Submit Documentation for the following items:

Qualifications of Manufacturer; G
Qualifications of Installation Contractor; G

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Submit Manufacturer's catalog data for the following items:

Wall Panels; G
Factory Color Finish
Accessories
Recycled Content (LEED Credit MR 4); G

Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content included in this Section. Include a statement indicating material
only costs for each product having recycled content. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-04 Samples

Submit as required each of the following samples:

Wall Panels, 12 inches long by actual panel width; G
Fasteners; G
Color chart and chips; G

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

SD-05 Design Data

Performance Verification Validation G

For products and systems indicated to validate compliance with specified wind load performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

SD-06 Test Reports

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

Leakage Tests; G
Coating Tests; G
Chalking Tests; G

SD-07 Certificates

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

Manufacturer's Technical Representative; G
Qualifications of Manufacturer; G
Qualifications of Installation Contractor; G

SD-08 Manufacturer's Instructions

Include detailed application instructions and standard manufacturer drawings altered as required by this Section.

Installation of Wall panels; G

SD-09 Manufacturer's Field Reports

Manufacturer's Field Reports; G

SD-11 Closeout Submittals

All approved LEED Submittals specified under SD-03 Product Data; S
Warranty; G
1.4 QUALITY ASSURANCE

1.4.1 Pre-Installation Conference

Upon notification of submittal receipt and approval by the Contracting Officer; and prior to the commencement of the work, the Contractor must attend a pre-installation conference at the Project site.

1.4.1.1 Installation Drawings

Installation shop drawings for metal panels, flashing, accessories, and anchorage systems must indicate completely dimensioned structural frame and erection layouts, openings in the wall, special framing details, and construction details at corners, building intersections and flashing, location and type of mastic and metal filler strips.

1.4.2 Qualifications of Manufacturer's Technical Representative

The representative must have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and installations in the geographical area where construction will take place.

1.4.3 Qualifications of Manufacturer

Certify that metal panel manufacturer has a minimum of five (5) years experience in manufacturing metal panel system and accessory products.

Manufacturer must also provide engineering services by a qualified registered Professional Engineer, having a minimum of four (4) years experience as an engineer knowledgeable in wind load design analyses, protocols and procedures per ASCE 7.

1.4.4 Qualifications of Installation Contractor

The installation contractor must be approved and certified by the metal panel manufacturer prior to beginning installation.

1.4.5 Manufacturers Maintenance Instructions

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

1.5 DELIVERY, HANDLING, AND STORAGE

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

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

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

1.6 PROJECT CONDITIONS

1.6.1 Field Measurements

Verify locations of wall framing and opening dimensions by field measurements to the greatest extent possible before metal panel fabrication and indicate measurements on Shop Drawings.

1.6.2 Weather Limitations

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

1.7 WARRANTY

1.7.1 Special Warranty

Manufacturer agrees to repair or replace components of metal panel assemblies that fail in materials or workmanship within specified warranty period.

a. Failures include, but are not limited to, the following:

1. Structural failures including rupturing, cracking, or puncturing.

2. Deterioration of metals and other materials beyond normal weathering.

1.7.1.1 Warranty Period

Two years from date of final acceptance of the work.

1.7.2 Special Warranty on Panel Finishes

Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

a. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

1. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

2. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

3. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

1.7.2.1 Finish Warranty Period

10 years from date of final acceptance of the work.
1.8 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT OF PRODUCTS

Provide products with recycled content so post-consumer recycled content plus one-half of pre-consumer recycled content to the greatest extent possible.

2.2 FABRICATION

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

Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weather-tight and minimize noise from movements within panel assembly.

2.2.1 Sheet Metal Accessories

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

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

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

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

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

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

2.3 WALL PANEL MATERIALS

2.3.1 Metallic-Coated Sheet

Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, structural quality. Prepainted by the coil-coating
process to comply with ASTM A 755/A 755M. Nominal thickness shall be minimum 20 gauge for each face sheet and liner sheet.

a. Surface: Smooth, flat finish

b. Individual panels shall be formed without warping, waviness, or ripples that are not part of the panel profile and free of damage to the finish coating system.

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

2.3.2 Foam-Insulation Core Wall Panel System

Factory-formed steel wall panel assembly fabricated from two sheets of metal with modified polyisocyanurate foam insulation core foamed-in-place during fabrication with joints between panels designed to form weather-tight seals. Laminated insulation is not acceptable. Include accessories required for weather-tight installation.

a. Closed-Cell Content: 90 percent when tested according to ASTM D 6226.

b. Density: 2.0 to 2.6 lb/cu. ft. when tested according to ASTM D 1622.

c. Compressive Strength: Minimum 20 psi when tested according to ASTM D 1621.

d. Shear Strength: 26 psi when tested according to ASTM C 273/C 273M.

e. Panel Thickness: 2.5 inches for profiled panels.

f. Profile as indicated on drawings with concealed fasteners. Panels shall have end caps set in routed foam at both ends to complete panel fabrication.

2.3.3 Factory Finish

2-coat Fluoropolymer finish complying with AAMA 621 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to expose metal surfaces to comply with coating and resin manufacturers written instructions.

2.3.3.1 Color

Color as indicated on the drawings. Adjacent panels shall be from same color run for best color match.

2.4 WALL PANEL FASTENERS

2.4.1 General

2.4.1.1 Hidden Fasteners

Provide corrosion resistant fasteners recommended by the manufacturer to meet specified performance requirements.
2.4.1.2 Attachment Clips

Fabricate clips from Series 300 stainless steel. Size, shape, thickness and capacity as required to meet specified performance requirements.

2.5 FIXED LOUVER

See Section 08 91 00 METAL WALL AND DOOR LOUVERS for fixed louver to be installed with specified metal wall panels.

2.6 ACCESSORIES

2.6.1 General

All accessories must be compatible with the metal panels. Sheet metal flashing, trim, metal closure strips, caps and similar metal accessories must not be less than the minimum thickness specified for the metal panels. Exposed metal accessories/finishes to match the panels furnished, except as otherwise indicated. Molded foam rib, ridge and other closure strips must be non-absorbent closed-cell or solid-cell synthetic rubber or pre-molded neoprene to match configuration of the panels.

2.6.2 Metal Closure Strips and Trim

Provide panel manufacturer's standard factory fabricated closure strips and trim to match the specified metal panel.

2.6.3 Joint Sealants

See Section 07 92 00 JOINT SEALANTS.

2.6.4 Stainless Steel Hinges

Provide in accordance with ANSI/BHMA A156.1. Provide hinges that are 4-1/2 by 4-1/2 inch unless otherwise required by metal panel manufacturer. Construct reverse-bevel exterior doors so that pins are non-removable when door is closed. Other anti-friction bearing hinges may be provided in lieu of ball bearing hinges.

2.6.5 Weather-Faced Preformed Foam Gasket

Preformed, precompressed, open-cell polyurethane foam gasket having water-repellent properties manufactured with a weather resistant covering that is factory applied and cured. Foam shall not be impregnated with wax or asphalt compounds. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated.

2.6.5.1 Exposed Face Color

Match adjacent substrates.

2.7 SHEET METAL FLASHING

2.7.1 Fabrication

Where indicated and as required to complete wall panel system, provide Shop fabricated sheet metal flashing to comply with recommendations in
SMACNA 1793 that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.

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

PART 3 EXECUTION

3.1 EXAMINATION

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

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

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

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

3.2 PREPARATION

Clean substrates of substances harmful to insulation, including removing projections capable of interfering with panel attachment. Miscellaneous framing installation, including sub-purlins, girts, angles, furring, and other miscellaneous wall panel support members and anchorage must be according to metal wall panel manufacturer's written instructions.

3.3 WALL PANEL INSTALLATION

Provide metal wall panels as indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement in accordance with panel manufacturer's written installation instructions.

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

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

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

Field cutting metal wall panels by torch is not permitted.
3.3.1 Anchor Clips

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

3.3.2 Metal Protection

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

3.3.3 Joint Sealers

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

3.3.4 Fasteners Installation

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

3.4 SHEET METAL FLASHING INSTALLATION

3.4.1 General Requirements

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

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

3.4.2 Workmanship

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

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793. Provide sheet metal flashing wherever indicated and necessary complete the metal panel system.
3.5 ACCEPTANCE PROVISIONS

3.5.1 Erection Tolerances

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

a. 1/4 inch in 20 feet vertically or horizontally from face plane of framing.

b. 1/2 inch maximum deviation from framing face plane on any building evaluation.

c. 1/8 inch in 5 feet.

3.5.2 Leakage Tests

Finished application of metal panels are to be subject to inspection and test for leakage by request of the Contracting Officer. Conduct inspection and tests at no cost to the Government.

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

3.5.3 Repairs to Finish

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

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

3.6 FIELD QUALITY CONTROL

3.6.1 Construction Monitoring

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

a. Materials comply with the specified requirements.

b. All materials are properly stored, handled and protected from damage. Damaged materials are removed from the site.

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

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

e. Side laps are formed, sealed, fastened or seam locked as required.

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

g. Installer adheres to specified and detailed application parameters.
h. Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.

3.7 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 E136 (2016) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C

1.2   SUBMITTALS

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

SD-02 Shop Drawings

Fiber-cement fabrications; G

Show profiles, thicknesses, finishes, joints, ornamentation, installation tolerances, and anchorage details. Indicate attachment methods, embedded supports, reinforcement, fabrication methods, joint treatments, clearances, and supports. Show connection to suspension system and cutouts for sprinklers, diffusers, grilles, speakers, and lighting fixtures.

SD-03 Product Data

Fiber-cement fabrications; G

SD-04 Samples

Fiber-cement fabrications; G

Samples for verification for each type, color, texture and pattern required.

SD-06 Test Reports

Fiber-cement fabrications; G

Based on evaluation of comprehensive tests performed by a
qualified testing agency for fiber-cement fabrications. Also include ICC-ES research/evaluation reports for each type of fiber-cement fabrication.

SD-07 Certificates
Fiber-cement fabrications
Installer qualifications

SD-10 Operation and Maintenance Data
Fiber-cement fabrications

1.3 QUALITY ASSURANCE

1.3.1 Installer Qualifications

An experienced installer who has completed fiber-cement fabrication installations similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

1.3.2 Fire-Test-Response Characteristics

Provide fiber-cement fabrications with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another independent testing and inspecting agency acceptable to authorities having jurisdiction:

a. Flame Spread: 25 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

Ship and store fiber-cement fabrications in original containers, packaged to keep units dry. Avoid cracking, warping, or staining the units. Comply with manufacturer's written instructions for storage, temperature, and humidity requirements.

1.5 PROJECT CONDITIONS

1.5.1 Field Measurements

Where fiber-cement fabrications are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 COORDINATION

Coordinate layout and installation of fiber-cement fabrications and suspension system components with other construction.

1.7 WARRANTY

1.7.1 Special Warranty

Manufacturer agrees to repair or replace products that fail in materials
or workmanship within specified warranty period. Failures include, but are not limited to, the following:

a. Structural failures including cracking and deforming.
b. Deterioration of materials beyond normal weathering.

1.7.2 Warranty Period

10 years from date of final acceptance of the work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Source Limitations

Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT FABRICATIONS

2.2.1 General

ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136. Configurations for soffit board, fascia board and vertical siding as indicated.

2.2.2 Labeling

Provide fiber-cement fabrications that are tested and labeled according to ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.

2.2.3 Nominal Thickness

As indicated, unless manufacturer's standard for each type of fiber-cement fabrication is more stringent for the specific application.

2.2.4 Panel Texture

Smooth, unless otherwise indicated.

2.2.5 Finish

Manufacturer's standard factory-finish in colors indicated.

2.3 ACCESSORIES

2.3.1 Fasteners

a. For fastening to wood, use corrosion-resistant fasteners of sufficient length to penetrate a minimum of 1 inch into substrate.

b. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.

c. For fastening fiber cement, use stainless-steel fasteners.
2.4 FRAMING SYSTEMS

As indicated for soffit board, fascia board and vertical siding fiber-cement fabrications.

PART 3 EXECUTION

3.1 EXAMINATION

Examine conditions, with Installer present, for compliance with installation tolerances, and other conditions affecting performance of glass reinforced concrete fabrications. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

3.3.1 General

Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply. Do not install damaged components.

3.3.2 Joint Sealants

Install joint sealants as specified in Section 07 92 00 JOINT SEALANTS to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

3.5 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

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

ASTM INTERNATIONAL (ASTM)

ASTM D 41 (2005) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing


ASTM D 6162 (2000a; R 2008) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements


ASTM E 108 (2010a) Fire Tests of Roof Coverings


FM GLOBAL (FM)

FM AS 4470 (1986; R 1992) Class I Roof Covers


INTERNATIONAL CODE COUNCIL (ICC)

1.2 PERFORMANCE REQUIREMENTS

Minimum three-ply SBS modified bitumen roof membrane consisting of modified bitumen base sheet interply sheet and cap sheet. Modified bitumen roof membrane shall be torch applied.

1.2.1 General Performance

General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

1.2.2 Fire Resistance

Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

1.2.3 Material Compatibility

Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

1.2.4 Wind Uplift Resistance

Complete roof covering assembly, including insulation, specified in Section 07 22 00 ROOF AND DECK INSULATION, capable of withstanding specified wind load criteria. Indicated on Structural Drawings in accordance with the ICC IBC and ASCE 7 requirements for Components and Cladding.

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

Roof membrane system; G

Roof plan drawing depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components, as applicable.

SD-03 Product Data

Heat Island Effect for Roofs (LEED Credit SS 7.2); G

Provide product test reports for roofing materials, documentation that roofing materials comply with Solar Reflectance Index (SRI)
requirements. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

Modified Bitumen Sheets; G
Primer; G
Modified Bitumen Roof Cement; G
Pre-Manufactured Accessories; G
Fasteners And Plates; G
Sample Warranty certificate; G

SD-05 Design Data

Performance Requirements Validation; G

For products and systems indicated to validate compliance with specified performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

SD-07 Certificates

Show evidence that products used within this specification are manufactured in the United States.

Qualification of Manufacturer

Certify that the manufacturer of the modified bitumen membrane meets requirements specified under paragraph entitled "Qualification of Manufacturer."

Qualification of Applicator

Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Applicator."

Wind Uplift Resistance classification, as applicable; G
Fire Resistance classification; G

Submit the roof system assembly wind uplift and fire rating classification listings.

SD-08 Manufacturer's Instructions

Modified Bitumen Membrane Application; G
Flashing; G

Base Sheet attachment, including pattern and frequency of mechanical attachments required in field of roof, corners, and perimeters to provide for the specified wind resistance.

Fasteners
Include detailed application instructions and standard manufacturer drawings altered as required by these specifications. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.

SD-11 Closeout Submittals

All approved LEED Submittals specified under SD-03 Product Data; S

WARRANTY

INFORMATION CARD

INSTRUCTIONS TO GOVERNMENT PERSONNEL

Include copies of Material Safety Data Sheets for maintenance/repair materials.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Applicator

Roofing system applicator shall be approved, authorized, or licensed in writing by the modified bitumen sheet roofing system manufacturer and shall have a minimum of 5 years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. The applicator shall supply the names, locations and client contact information of 5 projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years.

1.4.2 Prereroofing Conference

After approval of submittals and before performing roofing and insulation system installation work, hold a prereroofing conference to review the following:

   a. Drawings and specifications and submittals related to the roof work;

   b. Roof system components installation;

   c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representatives to roof manufacturer;

   d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

   e. Quality control plan for the roof system installation;

   f. Safety requirements.
Preroofing conference scheduling shall be coordinated with the Contracting Officer. The conference shall be attended by the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, Fire Marshall, and representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with labels intact and legible. Mark and remove wet or damaged materials from the site. Where materials are covered by a referenced specification, the container shall bear the specification number, type, and class, as applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.5.2 Storage

Protect materials against moisture absorption and contamination or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 50 degrees F for 24 hours immediately before application. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof and yet provide sufficient ventilation to prevent condensation. Do not store more materials on roof than can be installed the same day and remove unused materials at end of each day's work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction. Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the Contracting Officer.

1.5.3 Handling

Prevent damage to edges and ends of roll materials. Damaged materials shall not be installed in the work. Select and operate material handling equipment so as not to damage materials or applied roofing.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not install roofing system when air temperature is below 4 degrees C (40 degrees F), during any form of precipitation, including fog, or when there is ice, frost, moisture, or any other visible dampness on the roof deck. Follow manufacturer's printed instructions for installation during cold weather conditions.

1.7 TORCH SAFETY

Take all precautions necessary to prevent ignition of combustible
materials during torch application of roofing. Flammable liquids shall not be stored on the roof. Provide two fully charged minimum 15 pound CO2 fire extinguishers in separate, easily accessible locations on the roof and within 30 feet of torch work area at all times. Seal off voids or openings in the substrate with non-combustible materials prior to installing torch-applied materials in the area. When working around intakes and openings, temporarily disconnect and block to prevent flame of torch from being drawn into the opening. Provide non-combustible shielding or flame guard protection where gaps or voids occur in the construction in area of torch work.

1.7.1 Fire Watch

Provide a fire watch for a minimum of one hour after completion of all torch work at the end of each work shift. Maintain the fire watch for additional time required to ensure no potential ignition conditions exist. Utilize heat sensing meters to scan for hot spots in the work. Do not leave the rooftop unattended during breaks in work during a work shift. Walk and scan all areas of application checking for hot spots, fumes, or smoldering, especially at wall and curb areas, prior to departure at the end of each work shift. Ensure any and all suspect conditions are eliminated prior to leaving the site each work shift.

1.8 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counterflashing are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. Application of roofing shall immediately follow application of insulation as a continuous operation. Roofing operations shall be coordinated with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.

1.9 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Revision or amendment to standard membrane manufacturer warranty shall be provided as required to comply with the specified requirements.

1.9.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 20-year no dollar limit roof system materials and installation workmanship warranty, to include the roof membrane, flashing, insulation, protection board, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. The warranty shall start at date of final acceptance of the work. The warranty shall state that:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of
defective workmanship shall be the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work shall be the responsibility of the roof membrane manufacturer.

b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others shall not void the warranty.

c. Damage to the roofing system caused by sustained winds up to the design wind speed indicated on Structural drawings is covered by the warranty.

1.9.2 Roofing System Installer Warranty

The roof system installer shall warrant for a period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, protection board, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. The warranty shall start at date of final acceptance of the work. Correction of defective workmanship and replacement of damaged or affected materials shall be the responsibility of the roof system installer. All costs associated with the repair or replacement work shall be the responsibility of the installer.

1.9.3 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period shall be approved, as required, and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.10 CONFORMANCE AND COMPATIBILITY

The entire roofing and flashing system shall be in accordance with specified and indicated requirements, including fire and wind resistance requirements. Work not specifically addressed and any deviation from specified requirements shall be in general accordance with recommendations of the NRCA Roofing and Waterproofing Manual, membrane manufacturer published recommendations and details, and compatible with surrounding components and construction. Any deviation from specified or indicated requirements shall be submitted to the Contracting Officer for approval prior to installation.

1.11 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 HEAT ISLAND EFFECT FOR ROOFS

Provide Solar Reflectance Index (SRI) of not less than 78 for flat or slow slope roofs when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.
2.2 MODIFIED BITUMEN SHEETS AND FIBERGLASS FELT MATERIALS

Furnish a combination of specified materials that comprise the modified bitumen manufacturer's standard system of the number and type of plies specified. Materials provided shall be suitable for the service and climatic conditions of the installation. Modified bitumen sheets shall be watertight and visually free of pinholes, particles of foreign matter, undispersed raw material, factory splices, or other conditions that might affect serviceability. Polymer modifier shall be uniformly dispersed throughout the sheet. Edges of sheet shall be straight and flat.

a. SBS Base Sheet: ASTM D 6162 or ASTM D 6164, Type I, Grade S, minimum 80 mils thick.

b. SBS Interply Sheet: ASTM D 6162 or ASTM D 6164, Type I, Grade S, minimum 80 mils thick.

c. SBS Cap Sheet: ASTM D 6163, Type I, Grade S, minimum 120 mil thick with highly reflective reinforcing film or ASTM D 6163, Type I, Grade G, nominal 140 mil thickness. Solar Reflectance Index specified. Cap membrane shall be manufactured with fire retardant agents for UL and ASTM E 108 Class A Ratings.

2.3 FLASHING MEMBRANE

Membrane manufacturer's standard, minimum two-ply modified bitumen membrane flashing system compatible with the roof membrane specified and as recommended in membrane manufacturer's published literature. Flashing membranes shall meet or exceed the properties of the material standards specified for the modified bitumen base, interply and cap sheet, except that flashing membrane thickness shall be as recommended by the membrane manufacturer.

2.4 PRIMER

ASTM D 41, or other primer compatible with the application and as approved in writing by the modified bitumen membrane manufacturer.

2.5 MODIFIED BITUMEN ROOF CEMENT

ASTM D 4586, Type II for vertical surfaces, Type I for horizontal surfaces, compatible with the modified bitumen roof membrane and as recommended by the modified bitumen membrane manufacturer.

2.6 CANT STRIPS

Section 07 22 00 ROOF AND DECK INSULATION.

2.7 FASTENERS AND PLATES

Coated, corrosion-resistant fasteners as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM AS 4470 and FM P7825c for Class I roof deck construction and the wind uplift resistance specified. For fastening of membrane or felts to wood materials, provide fasteners driven through 1 inch diameter metal discs, or one piece composite fasteners with heads not less than 1 inch in diameter or 1 inch square with rounded or 45 degree tapered corners.
2.7.1 Masonry or Concrete Walls and Vertical Surfaces

Hardened steel nails or screws with flat heads, diamond shaped points, and mechanically deformed shanks not less than 1 inch long for securing felts, modified bitumen sheets, metal items, and accessories to masonry or concrete walls and vertical surfaces. Use power-driven fasteners only when approved in writing by the Contracting Officer.

2.7.2 Metal Plates

Flat corrosion-resistant round stress plates as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM AS 4470; not less than (2 inches) in diameter. Discs shall be formed to prevent dishing or cupping.

2.8 PRE-MANUFACTURED ACCESSORIES

Pre-manufactured accessories shall be manufacturer's standard for intended purpose, comply with applicable specification section, compatible with the membrane roof system and approved for use by the modified bitumen membrane manufacturer.

2.8.1 Pre-fabricated Roof Curbs

See Section 07 72 00.00 50 ROOF ACCESSORIES.

2.9 WALKPADS

Roof walkpads shall be polyester reinforced, granule-surfaced modified bitumen membrane material, minimum 3/16 inch thick, compatible with the modified bitumen sheet roofing and as recommended by the modified bitumen sheet roofing manufacturer. Panels shall not exceed 4 feet in length. Other walkpad materials require approval of the Contracting Officer prior to installation.

2.10 ROOF INSULATION BELOW MODIFIED BITUMEN MEMBRANE SYSTEM

Insulation shall be compatible with the roof membrane, approved by the membrane manufacturer and as specified in Section 07 22 00 ROOF AND DECK INSULATION.

PART 3 EXECUTION

3.1 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

a. Drains, curbs, cants, expansion joints, perimeter walls, roof penetrating components, and equipment supports are in place.

b. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation. Joints in the substrate are sealed to prevent dripping of bitumen into building or down exterior walls.

c. The plane of the substrate does not vary more than 1/4 inch within an area 10 by 10 feet when checked with a 10 foot straight edge placed anywhere on the substrate.
d. Substrate is sloped as indicated to provide positive drainage.

e. Walls and vertical surfaces are constructed to receive counterflashing, and will permit mechanical fastening of the base flashing materials.

f. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inches above finished roofing surface.

g. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is 45 degrees and the height of the vertical leg is not less than 3-1/2 inches.

h. Insulation and protection boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 1/4 inch in width. Insulation is being roofed over on the same day the insulation is installed.

3.2 PREPARATION

3.2.1 Protection of Property

3.2.1.1 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoists prior to starting the work. Lap protective coverings not less than six inches, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for the duration of the roofing work.

3.2.2 Equipment

3.2.2.1 Mechanical Application Devices

Mount mechanical application devices on pneumatic-tired wheels. Use devices designed and maintained to operate without damaging the insulation, roofing membrane, or structural components.

3.2.2.2 Open Flame Application Equipment

Torches and other open flame equipment shall be specifically designated for use in application of modified bitumen materials and approved by the modified bitumen sheet manufacturer. Open flame equipment shall not be ignited (burning) when left unattended. Provide and maintain a fire extinguisher adjacent to open flame equipment on the roof. Specific requirements for fire watches and burn permits exist. These requirements will be reviewed at the preroofing conference.

3.2.2.3 Electric-Heated Equipment

Provide adequate electrical service as required by manufacturer of electrical equipment to ensure against damage to equipment and property and to ensure proper application of roofing materials.
3.2.3 Priming of Surfaces

Prime all surfaces to be in contact with adhered membrane materials. Apply primer at the rate of 0.75 gallon per 100 sq. ft. or as recommended by modified bitumen sheet manufacturer's printed instructions to promote adhesion of membrane materials. Allow primer to dry prior to application of membrane materials to primed surface. Avoid flammable primer material conditions in torch applied membrane applications.

3.2.3.1 Priming of Concrete and Masonry Surfaces

After surface dryness requirements have been met, coat concrete and masonry surfaces which are to receive membrane materials uniformly with primer.

3.2.3.2 Priming of Metal Surfaces

Prime flanges of metal components to be embedded into the roof system prior to setting in bituminous materials or stripping into roofing system.

3.2.4 Membrane Preparation

Unroll modified bitumen membrane materials and allow to relax a minimum of 30 minutes prior to installation. In cold weather, adhere to membrane manufacturer's additional recommendations for pre-installation membrane handling and preparation. Inspect for damage, pinholes, particles of foreign matter, undispersed raw material, factory splices, or other conditions that might affect serviceability. Edges of seams shall be straight and flat so that they may be seamed to one another without forming fish mouths or wrinkles. Discard damaged or defective materials.

3.2.5 Substrate Preparation

Apply membrane to clean, dry surfaces only. Membrane shall not be applied to surfaces that have been wet by rain or frozen precipitation within the previous 12 hours. Provide cleaning and artificial drying with heated blowers or torches as necessary to ensure clean, dry surface prior to membrane application.

3.3 APPLICATION

Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer. Keep roofing materials dry before and during application. Complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperatures for asphalt. Provide temporary roofing and flashing as specified herein prior to application of permanent roofing system.

3.3.1 Phased Membrane Construction

Phased application of membrane plies is prohibited unless otherwise approved by the Contracting Officer and supported by the membrane manufacturer's written application instructions. Any delay in cap sheet installation shall result in thorough cleaning of the applied membrane material surface and drying immediately prior to cap sheet installation. Priming of the applied membrane surface may be required at the discretion of the Contracting Officer prior to cap sheet installation.
3.3.2 Temporary Roofing and Flashing

Provide watertight temporary roofing and flashing where considerable work by other trades, such as installing antennas, pipes, is to be performed on the roof or where construction scheduling or weather conditions require protection of the building's interior before permanent roofing system can be installed. Do not install temporary roofing over permanently installed insulation. Provide rigid pads for traffic over temporary roofing.

3.3.2.1 Removal

Completely remove temporary roofing and flashing before continuing with application of the permanent roofing system.

3.3.3 Application Method

3.3.3.1 Torch Applied Modified Bitumen Membrane

Ensure substrate membrane surfaces are warmed either naturally or by torch during the installation. Apply heat evenly to underside of roll membrane being installed and exposed side lap area of previously installed sheet. Provide for slight, uniform flow of bitumen in front of roll and full width of roll as the material is being rolled or set into place. Apply uniform positive pressure to ensure membrane is fully adhered and all laps are sealed. Roll all lap areas with a weighted roller immediately after forming lap. Provide for visual bleed out of compound in lap areas. Avoid overheating the membrane or burning through to membrane reinforcement. Inspect and ensure all lap areas are fully sealed.

3.3.4 Modified Bitumen Base Sheet

On nailable substrates, mechanically fasten base sheet in conformance with specified wind resistance requirements and membrane manufacturer's printed instructions, and to include increased fastening frequency in corner and perimeter areas. Drive fasteners flush with no dishing or cupping of fastener plate. Where applicable, base sheet may be mechanically fastened in conjunction with insulation to the substrate, in accordance with membrane manufacturers printed instructions. Apply sheets in a continuous operation. Apply sheets with side laps at a minimum of 2 inches unless greater side lap is recommended by the manufacturer's standard written application instructions. Provide end laps of not less than 6 inches and staggered a minimum of 36 inches. Apply sheets at right angles to the roof slope so that the direction of water flow is over and not against the laps so that plies of sheets extend from eave line on one side of the barrel-type roof and 18 inches over the center line of the crown of the roof. Apply sheets on the other side in the same manner, resulting in twice the normal amount of roofing sheets and asphalt at the crown. Extend base sheets approximately 2 inches above the top of cant strips at vertical surfaces and to the top of cant strips elsewhere. Trim base sheet to a neat fit around vent pipes, roof drains, and other projections through the roof. Application shall be free of ridges, wrinkles, and buckles.

3.3.5 Modified Bitumen Membrane Application

Ensure proper sheet alignment prior to installation. Apply membrane layers perpendicular to slope of roof in shingle fashion to shed water, including application on areas of tapered insulation that change slope direction. Bucking or backwater laps are prohibited. Fully adhere
membrane sheets to underlying substrate materials. Provide minimum 3 inch side laps and minimum 6 inch end laps and as otherwise required by membrane manufacturer. Stagger end laps minimum 36 inches. Offset side laps between membrane layers a minimum of 12 inches. Offset end laps between membrane layers a minimum of 36 inches. All membrane layers shall be installed the same workday, unless supported otherwise by roof membrane manufacturer application instructions and approved by the Contracting Officer. Provide tight smooth laminations of each membrane layer without wrinkles, ridges, buckles, kinks, fishmouths, or voids. Ensure full membrane adhesion and full lap seals. Rework to seal any open laps prior to application of subsequent membrane layers. The completed membrane application shall be free of surface abrasions, air pockets, blisters, ridges, wrinkles, buckles, kinks, fishmouths, voids, or open seams.

3.3.5.1 Cap Sheet Installation

Underlying applied membrane shall be inspected and repaired free of damage, holes, puncture, gouges, abrasions, and any other defects, and free of moisture, loose materials, debris, sediments, dust, and any other conditions required by the membrane manufacturer prior to cap sheet installation. Do not apply cap sheet if rain or frozen precipitation has occurred within the previous 24 hours. Align cap membrane and apply by the specified method with the proper side and end lap widths. Cut at a 45 degree angle across selvage edge of cap membrane to be overlapped in end lap areas prior to applying overlapping cap membrane. Minimize traffic on newly installed cap sheet membrane.

3.3.6 Membrane Flashing

Apply two-ply modified bitumen strip flashing and sheet flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Apply membrane flashing in accordance with the roof membrane manufacturers printed instructions and as specified. Cut at a 45 degree angle across terminating end lap area of cap membrane prior to applying adjacent overlapping cap membrane. Press flashing into place to ensure full adhesion and avoid bridging. Ensure full lap seal in all lap areas. Mechanically fasten top edge of modified bituminous base flashing 6 inches on center through minimum 1 inch diameter tin caps with fasteners of sufficient length to embed minimum one inch into attachment substrate. Apply matching granules in any areas of asphalt bleed out while the asphalt is still hot. Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components. Metal flashing are specified under Section 07 60 00 FLASHING AND SHEET METAL.

3.3.6.1 Membrane Strip Flashing

Set primed flanges of metal flashings in full bed of modified bituminous cement material and securely fasten through to attachment substrate. Strip-in with membrane flashing so that strip extends not less than 4 inches beyond outer edge of flange. Where multiple membrane stripping plies are installed, extend each additional stripping ply minimum 4 inches beyond edge of previous ply.

3.3.6.2 Pre-fabricated Curbs

Prefabricated curbs shall be securely anchored to nailer or other base
substrate and flashed with modified bitumen membrane. See Section 07 72 00.00 50 ROOF ACCESSORIES for roof curbs.

3.3.6.3  Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories are set on the membrane, adhere walkpad material to bottom of accessories prior to setting on roofing membrane. Specific method of installing set-on accessories must permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.3.6.4  Lightning Protection

Lightning protection system components shall be flashed or attached to the roof membrane in a manner acceptable to the roof membrane manufacturer.

3.3.7  Roof Walkpads

Install walkpads at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the modified bitumen sheet roofing manufacturer's printed instructions. Provide minimum (6 inch) separation between adjacent walkpads to accommodate drainage.

3.3.8  Correction of Deficiencies

Where any form of deficiency is found, additional measures shall be taken as deemed necessary by the Contracting Officer to determine the extent of the deficiency and corrective actions shall be as directed by the Contracting Officer.

3.3.9  Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.4  PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied modified bitumen roofing system from water intrusion.

3.4.1  Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of modified bitumen roofing system in an effective manner. Seal off flutes in metal decking along the cutoff edge. Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

3.4.2  Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashings can be applied. Remove temporary flashing before applying permanent flashing.
3.4.3 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.5 FIELD QUALITY CONTROL

Perform field tests in the presence of the Contracting Officer. Notify the Contracting Officer one day before performing tests.

3.5.1 Construction Monitoring

During progress of the roof work, Contractor shall make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

- Materials comply with the specified requirements.
  - a. Materials are not installed in adverse weather conditions.
    - All materials are properly stored, handled and protected from moisture or other damages.
  - b. Equipment is in working order. Metering devices are accurate.
  - c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.
    - Nailers and blocking are provided where and as needed.
    - Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.
    - The proper number, type, and spacing of fasteners are installed.
    - Membrane heating or adhesive application is provided uniformly and as necessary to ensure full adhesion of roll materials.
    - The proper number and types of plies are installed, with the specified overlaps.
    - Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.
    - Lap areas of all plies are full sealed.
    - Membrane is fully adhered without ridges, wrinkles, kinks, fishmouths, or other voids or delaminations.
    - Installer adheres to specified and detailed application parameters.
    - Associated flashings and sheet metal are installed in a timely manner in accord with the specified requirements.
    - Temporary protection measures are in place at the end of each work
shift.

3.5.1.1 Manufacturer's Inspection

Manufacturer's technical representative shall visit the site a minimum of once per week during the installation for purposes of reviewing materials installation practices and adequacy of work in place. After each inspection, a report, signed by the manufacturer's technical representative shall be submitted to the Contracting Officer within 3 working days. The report shall note overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.5.2 Samples of Roofing

If directed by the Contracting Officer, take 4-inch by 40-inch cut samples across width of modified bitumen sheets as directed by the manufacturer's technical representative. Cut samples will be examined by the Contracting Officer and the manufacturer's technical representative for specified number of plies, proper lap width, complete lap seal, full uniform adhesive compound application and adhesion, full bond between plies, harmful foreign materials, presence of moisture, and wet insulation. Where cuts are not retained by the Contracting Officer or disposed, set cut strip back in cut area in bed of modified bitumen cement. Repair area of cut with new minimum two-ply modified bitumen membrane patch in accordance with the roofing system manufacturer's written instructions.

3.6 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the modified bitumen membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

3.7 INFORMATION CARD

For each roof, furnish a typewritten information card for facility Records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Card shall be 8 1/2 by 11 inches minimum. Information card shall identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

3.8 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)


ASTM INTERNATIONAL (ASTM)


ASTM A 653/A 653M (2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


ASTM D 2244 (2011) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates


ASTM D 41 (2005) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing


INTERNATIONAL CODE COUNCIL (ICC)

1.2   General Requirements

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations.

1.2.1   Performance Requirements

Design and fabricate all exterior sheet metal flashing and trim provided to resist wind uplift resistance based on the design wind load criteria indicated on the Structural drawings, in accordance with the ICC IBC and ASCE 7 requirements for Components and Cladding.

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

Gutters; G
Downspouts; G
Flashing for roof drains; G
Counterflashing; G
Flashing at roof penetrations; G
Scuppers; G
Conductor heads; G
Parapet coping system; G
Reglet system; G
Roof expansion joint; G
Roof edging system; G

Indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

SD-03 Product Data
Parapet coping system; G
Reglet system; G,
Roof expansion joint; G
Roof edging system; G
Recycled Content (LEED Credit MR 4); G

Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content included in this Section. Include a statement indicating material only costs for each product having recycled content. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-05 Design Data
Performance Requirements Validation; G

For products and systems indicated to validate compliance with specified wind load performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

SD-11 Closeout
All approved LEED Submittals specified under SD-03 Product Data; S

1.4 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

1.5 SPECIAL FINISH WARRANTY

Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1.5.1 Exposed Panel Finish

Deterioration includes, but is not limited to, the following:
a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

1.5.2 Finish Warranty Period

10 years from date of final acceptance of the Work.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT OF PRODUCTS

Provide products with post-consumer recycled content plus one-half of pre-consumer recycled content to the greatest extent possible.

2.2 MATERIALS

2.2.1 Lead Sheet

Minimum weight 4 pounds per square foot.

2.2.2 Steel Sheet, Zinc-Coated (Galvanized)

ASTM A 653/A 653M.

2.2.3 Stainless Steel

ASTM A 167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.2.4 Aluminum Alloy Sheet and Plate

ASTM B 209, form alloy and temper appropriate for use and as specified herein.

2.2.5 Solder

ASTM B 32, 95-5 tin-antimony.

2.2.6 Bituminous Plastic Cement

ASTM D 4586, Type I.

2.2.7 Building Paper

ASTM D 226 Type I.
2.2.8 Asphalt Primer

ASTM D 41.

2.2.9 Fasteners

Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

2.2.10 Through-Wall Flashing

Through-wall flashing for masonry is specified in Section 04 20 00 UNIT MASONRY.

2.3 ALUMINUM FINISHES

2.3.1 2-Coat Fluoropolymer

AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2.3.2 Color

Color as indicated on drawings.

2.4 MANUFACTURED METAL FLASHING SYSTEMS

2.4.1 Parapet Coping System

2.4.1.1 Coping

Metal coping system with galvanized steel anchor cleats and gutter support chairs for capping parapet wall. The system shall be watertight, maintenance free, and not require exposed fasteners or sealant. Joints shall be butt type with concealed splice plates. Coping system shall be sized for maximum 1/4 inch clearance on each side of each parapet wall condition.

2.4.1.2 Performance Characteristics

a. Coping sections shall expand and contract freely while mechanically locked in place on anchor cleats.

b. Coping sections shall lock to anchor cleats by mechanical pressure from support chairs.

c. All coping cover joints shall be underlaid with gutter/support chairs capable of draining water.

2.4.1.3 Exposed Surfaces

Exposed surfaces shall be minimum 0.050 inch aluminum in 10-foot lengths. Width as indicated and as required. Coping vertical face and back leg shall be standard 4 inches nominal.
2.4.1.4 Internal Splice Plates

Shall be concealed with matching finish to maintain outside face continuity.

2.4.1.5 Coping Cleat

Shall be minimum 20 gauge galvanized steel anchor cleat and as required to meet performance requirements. Adhesive bonded or mechanically fastened as required per manufacturer's written instructions.

2.4.1.6 Fasteners

Shall be corrosion resistant screw type with a minimum pull-out resistance of 240 pounds as supplied by the manufacturer per substrate application. No exposed fasteners shall be permitted. Fasteners shall be electrolytically compatible.

2.4.1.7 Accessories

Provide corners, end caps, pier caps, gutter/support chairs, etc., fabricated by the coping manufacturer as required for a complete assembly.

2.4.2 Reglet System

2.4.2.1 Reglets

Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.

2.4.2.2 Material

Material shall be aluminum, minimum 0.024 inch thick; counterflashing shall be aluminum, minimum 0.032 inch thick.

2.4.2.3 Reglet Types

Provide reglet types per the following as indicated and as required:

a. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

b. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.

c. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.

d. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
2.4.2.4 Accessories

Provide accessories as indicated and as required for a complete assembly including the following:

a. Flexible-Flashig Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing.

b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

2.4.2.5 Fasteners

Fasteners shall be manufacturer's standard corrosion resistant screw type.

2.4.3 Roof Expansion Joint

2.4.3.1 System

Multi-part assembly designed to facilitate the horizontal and lateral movement of the roof sections. The system shall consist of a membrane condensate and air seal with insulation continuous galvanized rails and anchor cleat, fasteners and a formed metal cover. The system shall be watertight, maintenance free, and not require exposed fasteners. Joints shall be butt type with concealed splice plates.

2.4.3.2 Performance Characteristics

Expansion joint sections shall expand and contract freely while mechanically locked in place on anchor cleats. Provide additional components as required to meet specified seismic criteria.

2.4.3.3 Exposed Surfaces

Exposed surfaces shall be minimum 0.050 inch aluminum in 10-foot lengths. Width as indicated and as required.

2.4.3.4 Internal Splice Plates

Shall be concealed with matching finish to maintain outside face continuity.

2.4.3.5 Cleat and Rails

Cleat shall be minimum 20 gauge galvanized steel continuous anchor cleat and as required to meet performance requirements. Rails shall be minimum 24 gauge galvanized steel continuous rails and as required to meet performance requirements; rails permit unrestricted movement between cleat and rails. Mechanically fastened as required per manufacturer's written instructions.

2.4.3.6 Fasteners

Shall be corrosion resistant screw type with a minimum pull-out resistance of 240 pounds as supplied by the manufacturer per substrate application. No exposed fasteners shall be permitted. Fasteners shall be electrolytically compatible.
2.4.3.7 Accessories

Provide corners, end caps, pier caps, condensate and air seal, etc., fabricated by the roof expansion joint manufacturer as required for a complete assembly.

2.4.4 Roof Edging System (Also referenced as "Gravel Stop System" on Drawings)

2.4.4.1 Roof Edging

Provide assembly with a continuous anchor cleat and a snap-on aluminum fascia cover for modified bitumen roofs. The system shall have all concealed fasteners with no penetration on horizontal roof surface. Size and configuration as indicated.

2.4.4.2 Continuous Anchor Cleat

Shall be manufacturer's standard aluminum or galvanized metal with slotted holes for fasteners in 10-foot standard lengths.

2.4.4.3 Exterior Fascia Covers

Shall be 0.050 inch aluminum in 10-foot lengths with concealed, matching joint splice plates.

2.4.4.4 Fasteners

Fasteners shall be manufacturer's standard corrosion resistant screw type.

2.4.4.5 Accessories

Provide corners, end caps, facia sumps, or spillouts, etc., fabricated by the roof edging manufacturer as required for a complete assembly. Factory fabricated mitered corners shall have 12 inch nominal leg lengths.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Workmanship

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

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

3.1.2 Manufactured Metal Flashing Systems

Installation per respective manufacturer's written instructions.
3.1.3 Protection from Contact with Dissimilar Materials

3.1.3.1 Aluminum

Aluminum surfaces shall not directly contact other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

3.1.3.2 Metal Surfaces

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

3.1.3.3 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.4 Counterflashing

Except where indicated or specified otherwise, provide minimum 0.032 inch aluminum counterflashing at locations indicated or required. Fold the exposed edges of counterflashings 1/2 inch. Provide end laps in counterflashings not less than 3 inches and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 10 feet. Form the flashings to the required shapes before installation. Factory-form the corners not less than 12 inches from the angle. Install counterflashing to provide a spring action against base flashing. Where bituminous base flashings are provided, the counter flashing shall extend down as close as practicable to the top of the cant strip. Counter flashing shall be factory formed to provide spring action against the base flashing.

3.1.5 Gutters

The hung type of sizes and shapes indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide minimum of 0.050 inch aluminum gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 3/4 by 3/16 inch of material compatible with gutter. Fabricate gutters in sections not less than 8 feet. Lap the sections a minimum of one inch in the direction of flow or provide with concealed splice plate 6 inches minimum. Join the gutters, other than aluminum, by riveted and soldered joints. Aluminum gutters shall be joined with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Install gutters below slope line of the roof so that snow and ice can slide clear. Support gutters on adjustable hangers spaced not more than 30 inches on center, unless otherwise indicated. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from metals compatible with the gutters.
3.1.5.1 Gutter Accessories

Provide stainless steel wire ball strainer at each downspout outlet location. Provide strainers to fit tightly into outlets.

3.1.6 Flashing for Roof Drains

Roof drains are specified in Section 22 00 70 PLUMBING, HEALTHCARE FACILITIES. Provide a 30 inch square sheet indicated. Taper insulation to drain from 24 inches out. Set flashing on finished felts in a full bed of asphalt roof cement, ASTM D 4586. Apply strip flashing to the drain flashing. Heavily coat the drain flashing ring with asphalt roof cement. Clamp the roof membrane, flashing sheet, and stripping felt in the drain clamping ring. Secure clamps so that felts and drain flashing are free of wrinkles and folds.

3.1.7 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck as indicated.

3.1.8 Single Pipe Vents

As indicated. Set flange of sleeve in bituminous plastic cement and nail 3 inches on centers. Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inches. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 4 inch roof flange in bituminous plastic cement and nailed 3 inches on centers. Extend sleeve a minimum of 8 inches above the roof deck and lapped a minimum of 3 inches by metal hood (counterflashing umbrella with close-fitting collar with top edge flared for sealant) secured to the vent pipe by stainless steel draw band. Seal the area of hood in contact with vent pipe with sealant specified in Section 07 92 00 JOINT SEALANTS.

3.1.9 Downspouts

Provide minimum 0.050 inch aluminum downspouts and supports of sizes and shapes indicated. Supports for downspouts shall be spaced according to the manufacturer's recommendation for the substrate. Types, shapes and sizes as indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 10 foot lengths. Provide end joints to telescope not less than 1/2 inch and lock longitudinal joints. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on centers with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

3.1.10 Scuppers

Line interior of scupper openings with minimum of 0.050 inch aluminum. Extend the lining through and project outside of the wall to form a drip on the bottom edge and form to return not less than one inch against the face of the outside wall at the top and sides. Fold outside edges under 1/2 inch on all sides. Provide the perimeter of the lining approximately 1/2 inch less than the perimeter of the scupper. Join the top and sides of the lining on the roof deck side to a closure flange by a locked and soldered joint. Join the bottom edge by a locked and soldered joint to
the closure flange, where required, form with a ridge to act as a gravel stop around the scupper inlet. Provide surfaces to receive the scupper lining and coat with bituminous plastic cement. Mechanically fasten joints in aluminum and seal.

3.1.11 Conductor Heads

Type indicated and fabricated of the same material as the downspouts. Set the depth of top opening equal to two-thirds of the width. Provide outlet tubes not less than 4 inches long. Flat-lock solder the seams except the mechanically fastened aluminum joints filled with sealant, see Section 07 92 00 Joint Sealants. Where conductor heads are used in conjunction with scuppers, set the conductor a minimum of 2 inches wider than the scupper. Attach conductor heads to the wall with appropriate corrosion-resistant fasteners for the substrate indicated. Loose-lock to provide conductor heads with stainless steel screens. Securely fasten screens to the heads.

3.2 PAINTING

Field-paint sheet metal for separation of dissimilar materials. Finish painting is specified in Section 09 90 00 PAINTS AND COATINGS.

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Work not in compliance with the contract shall be promptly removed and replaced or corrected. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification that specified material is provided and installed.

c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

3.6 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   REFERENCES

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)


AAMA 621 (2002) Voluntary Specifications For High Performance Organic Coatings On Coil Coated Architectural Hot Dipped Galvanized (hdg) And Zinc-aluminium Coated Steel Substrates

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)


ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M (2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


ASTM D 2244 (2009b) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

Exterior Paint Films


INTERNATIONAL CODE COUNCIL (ICC)


U.S. GREEN BUILDING COUNCIL (USGBC)


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


1.2  DEFINITIONS

1.2.1  Field-Formed Seam

Seams of panels so configured that when adjacent sheets are installed the seam is sealed utilizing mechanical seammers. Crimped (45 degree bend), roll formed (180 degree bend), double roll formed (2 - 180 degree bend), and roll and lock systems are types of field-formed seam systems.

1.2.2  Roofing System

The roofing system is defined as the assembly of roofing components, including roofing panels, soffit panels, fascia, flashing, expansion joints, fasteners, gutters, downspouts, snow guards system, fall protection system and accessories as indicated and as required for a watertight installation. Complete roof covering assembly shall include roof insulation specified in Section 07 22 00 ROOF AND DECK INSULATION.

1.3  SYSTEM DESCRIPTION

1.3.1  Design Requirements

a. Provide continuous length panels with no joints or seams, except where recommended by the manufacturer. Individual panels shall be removable for replacement of damaged material.

b. There shall be no exposed or penetrating fasteners except where shown on the approved erection drawings. Fasteners into wood shall be stainless steel sheet metal screws with full length threads. Fasteners into steel shall be stainless steel screws inserted into predrilled holes. Length and diameter of screws shall be sufficient to meet the design loads with a suitable
factor of safety for the material to which the roofing components are attached.

c. Roof panel standing seam shall include a capillary break and be mechanically locked closed by the manufacturer's locking tool. The seam shall include a continuous sealant when required by the manufacturer.

d. Roof panel anchor clips shall be concealed and designed to allow for thermal movement of the panels, except where specific fixed points are recommended by the manufacturer.

1.3.2 Performance Requirements

1.3.2.1 Wind Loads

The system shall be designed to resist wind uplift based on the design wind load criteria indicated on the Structural drawings in accordance with the ICC IBC and ASCE 7 for Components and Cladding.

1.3.2.2 Roof Live Loads

Loads shall be applied on the horizontal projection of the roof structure. The minimum roof design live load shall be as indicated on Structural drawings.

1.3.2.3 Air Infiltration

Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 at the test-pressure difference of 6.24 lbf/sq. ft.

1.3.2.4 Water Penetration Under Static Pressure

No water penetration when tested according to ASTM E1646 at the test-pressure difference of 6.24 lbf/sq. ft.

1.3.2.5 Resistance to Water Infiltration

No water penetration when tested according to ASTM E1646 criteria.

1.3.2.6 Thermal Movement

Allow for thermal movements resulting from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

   a. Temperature Change (Range): 120 deg F., ambient; 180 deg F material surfaces.

1.3.2.7 Deflection

Panels shall be capable of supporting design loads between unsupported spans with deflection of not greater than L/180 of the span.

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
SD-02 Shop Drawings

Erection Drawings; G

Submit erection drawings to supplement the instructions and diagrams. Drawings shall include an isometric view of the roof showing the design uplift pressures and dimensions of edge, ridge and corner zones. Show typical and special conditions including flashings, locations of snow guards, accessories installation, materials and thicknesses, all dimensions, panel attachment clip layouts, sealant locations, sealant tape locations, fastener layout, sizes, spacing, provisions for thermal and building movement, terminations, edge conditions such as fascia or rakes, penetrations, and attachments. Fabrication and installation details of gutters and downspouts. Details of installation shall be in accordance with the manufacturer's Standard Instructions and details or the SMACNA Arch. Manual. The manufacturer's technical engineering department shall approve the drawings before they are submitted.

SD-03 Product Data

Recycled Content (LEED Credit MR 4); G

Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content included in this Section. Include a statement indicating material only costs for each product having recycled content. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

Heat Island Effect for Roofs (LEED Credit SS 7.2); G

Provide product test reports for roofing materials, documentation that roofing materials comply with Solar Reflectance Index (SRI) requirements. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

Roofing panels; G
Soffit and fascia panels; G
Gutters and downspouts; G
Attachment clips; G
Closures
Accessories; G
Underlayment; G
Fall protection system; G

Submit for all materials to be provided. Submit data sufficient to indicate conformance to specified requirements.
SD-04 Samples

Roofing panels; G
Soffit and fascia panels; G
Gutters and downspouts; G

When colors are not indicated, submit samples of not less than six different manufacturer's standard colors for selection.

Accessories G

Submit each type of accessory item used in the project including, but not limited to: each type of anchor clip, closures, fasteners and leg clamps.

SD-05 Design Data

Performance Requirements Validation; G

For products and systems indicated to comply with specified standing seam roofing system performance requirements and design criteria, including analysis data signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

Fall protection systems; G

SD-06 Test Reports

Structural performance; G
Panel finish; G

Submit reports of the tests required by this Section.

Manufacturer's field inspection; G

Submit manufacturer's technical representative's inspection reports as required in paragraph entitled "Manufacturer's Field Inspection."

SD-07 Certificates

Manufacturer; G
Technical representative; G
Qualification of Installer; G

Submit documentation proving the installer is factory-trained, has the specified experience and is authorized by the manufacturer to install the products specified.

Coil stock compatibility

Provide certification of coil compatibility with roll forming
machinery to be used for forming panels without warping, waviness, and rippling not part of panel profile; to be done without damage, abrasion or marking of finish coating.

Roofing system manufacturer's approval of PV panel attachment

SD-08 Manufacturer's Instructions

Sealant

Installation manual

Submit manufacturer's printed installation manual/instructions and standard details.

SD-11 Closeout Submittals

Information card

All approved LEED Submittals specified under SD-03 Product Data; S

1.5 QUALITY ASSURANCE

1.5.1 Preroofing Conference

After submittals are received and approved but before roofing work, including associated work, is performed, the Contractor shall hold a preroofing conference to review the following:

a. The drawings and specifications.

b. Procedure for on site inspection and acceptance of the roofing substrate and pertinent structural details relating to the roofing system.

c. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing.

d. Safety requirements.

The preroofing conference shall be attended by the Contractor and personnel directly responsible for the roofing installation, and the roofing manufacturer's technical representative. Conflicts among those attending the preroofing conference shall be resolved and confirmed in writing before roofing work, including associated work, is begun. Prepare written minutes of the preroofing conference and submit to the Contracting Officer.

1.5.2 Manufacturer's Technical Representative

The representative shall have authorization from manufacturer to approve field changes and be thoroughly familiar with the products and with installations in the geographical area where construction will take place. The manufacturer's representative shall be an employee of the manufacturer with at least 5 years experience in installing the roof system. The representative shall be available to perform field
inspections and attend meetings as required herein, and as requested by the Contracting Officer.

1.5.3 Qualification of Installer

The roofing system installer shall be factory-trained, approved by the metal roofing system manufacturer to install the system, and shall have a minimum of three years experience as an approved applicator with that manufacturer. The applicator shall have applied five installations of similar size and scope to this project within the previous 3 years.

1.5.4 Single Source

Provide roofing panels, clips, closures and other accessories from a single manufacturer.

1.5.5 Manufacturer

The standing seam roofing system shall be the product of a metal roofing industry recognized manufacturer who has been in the practice of manufacturing aluminum standing seam roofing systems for a period of not less than 5 years and who has been involved in at least 5 projects similar in size and complexity to this project.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle preformed panels, bulk roofing products and other manufactured items in a manner to prevent damage or deformation.

1.6.1 Delivery

Provide adequate packaging to protect materials during shipment. Do not uncrate materials until ready for use except for inspection. Immediately upon arrival of materials at jobsite, inspect materials for damage, dampness, and staining. Replace damaged or permanently stained materials that cannot be restored to like-new condition with new material. If materials are wet, remove moisture, restack and protect panels until used.

1.6.2 Handling

Handle material carefully to avoid damage to surfaces, edges and ends.

1.6.3 Storage

Stack materials stored on the site on platforms or pallets and cover with tarpaulins or other suitable weathertight coverings which prevent water trapping or condensation. Store panels so that water which might have accumulated during transit or storage will drain off. Do not store the panels in contact with materials that might cause staining, such as mud, lime, cement, fresh concrete or chemicals. Protect stored panels from wind damage.

1.7 WARRANTY

1.7.1 Special Warranty

Installer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
1.7.1.1 Failures

Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

1.7.1.2 Warranty Period

Two years from date of final acceptance of the work.

1.7.2 Special Warranty on Panel Finishes

Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1.7.2.1 Exposed Panel Finish

Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling or failure of paint to adhere to bare metal.

1.7.2.2 Finish Warranty Period

10 years from date of final acceptance of the work.

1.7.3 Special Weathertightness Warranty

Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period; no dollar limit.

1.7.3.1 Warranty Period

20 years from date of final acceptance of the work.

1.8 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT OF PRODUCTS

Provide products with post-consumer recycled content plus one-half of pre-consumer recycled content is the greatest extent possible.
2.2 HEAT ISLAND EFFECT FOR ROOFS

Provide Solar Reflectance Index (SRI) of not less than 29 for steep slope roofs when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

2.3 ROOFING PANELS

2.3.1 Metallic-Coated Steel Sheet

Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

2.3.1.1 Thickness

0.040 inch minimum.

2.3.1.2 Two-Coat Fluoropolymer Finish

AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2.3.1.3 Texture

Smooth.

2.3.1.4 Color

As indicated on the drawings.

2.3.1.5 Configuration

Provide panels of continuous lengths from ridge to eaves or from top to eaves on shed roof designs. Panels shall be nominal 12 inches wide with a minimum 2-1/2 inch high vertical legs; each panel shall have two stiffening, or pencil ribs. Leading vertical leg shall have a continuous groove in the rib top for anti-siphon protection when hook-rib top of next panel is locked over leading vertical leg to form the standing seam. Panels from coil stock shall be formed without warping, waviness or ripples not a part of the panel profile, and shall be free of damage to the finish coating system.

2.3.1.6 Radius Edge Metal

Edges such as rake trim or similar components that will be arched/radiused in elevation view, shall be factory fabricated and continuously welded.

2.3.2 Attachment Clips

Manufacturer's standard corrosion-resistant metal clips.

2.4 SOFFIT PANELS

2.4.1 General

Provide metal soffit panels designed to be installed by lapping and
interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

2.4.2 Reveal-Joint-Profile Metal Soffit Panels

Solid panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with recessed reveal joint between panels.

2.4.2.1 Aluminum Sheet

Coil-coated aluminum sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.040 inch.
b. Surface: Smooth, flat finish.
d. Color: As indicated.

2.4.2.2 Panel Coverage

12 inches, unless otherwise indicated or required.

2.4.2.3 Panel Height

0.75 inch.

2.4.3 Two-Coat Fluoropolymer Finish

AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2.4.3.1 Color

As indicated on drawings.

2.5 GUTTERS AND DOWNSPOUTS

2.5.1 Gutters

Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch long sections. Furnish flat-stock gutter brackets and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

2.5.1.1 Gutter Accessories

Provide stainless steel wire-ball strainer at each downspout outlet location. Provide strainers to fit tightly into outlets.
2.5.2 Downspouts

Fabricate to dimensions indicated, complete with mitered elbows. Fabricate in minimum 10 foot long sections. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

2.5.3 Material and Thickness

Aluminum sheet same as soffit panels, not less than 0.040 inch thick.

2.5.4 Two-Coat Fluoropolymer Finish

AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2.5.4.1 Color

As indicated on drawings.

2.6 ACCESSORIES

Sheet metal flashings, trim, moldings, closure strips, caps, preformed crickets, gutters, downspouts, and other similar sheet metal accessories provided in conjunction with preformed metal panels shall be of the same material and finish as panels, except that such items which will be concealed after installation may be provided without the finish if they are aluminum or stainless steel. Metal shall be of thickness not less than that of panels. Molded closure strips shall be closed-cell synthetic rubber, neoprene, or polyvinyl chloride premolded to match configurations of preformed metal panels. Provide metal roofing manufacturer's standard roof penetration boot suitable for each condition. Thermal spacer blocks and other thermal barriers at concealed fasteners shall be as recommended by the roofing panel manufacturer.

2.6.1 Fasteners

Series 300 stainless steel with composite metal and neoprene composition washers. Fasteners for attachment to structural supports and fasteners for attachment of panels shall be as approved and in accordance with manufacturer's recommendation. Unless specified otherwise herein, fasteners shall be either self-tapping screws, bolts and nuts, or self-locking bolts. Design fastening system to withstand design loads indicated. Fasteners shall not be over-torqued and shall develop full capacity of attachment clips.

2.6.1.1 Screws

Provide not less than No. 14 diameter for self-tapping type and not less than No. 12 diameter for self-drilling and self-tapping. Length shall be sufficient to penetrate insulation and secure to the structural deck.

2.6.1.2 Bolts

Provide not less than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.
2.6.1.3 Rivets

Blind rivets shall be stainless steel with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than fastening trim. Rivets with hollow stems shall have closed ends.

2.6.2 Sealant

See Section 07 92 00 JOINT SEALANTS.

2.6.3 Snow Guards; Seam-Mounted, Bar-Type

Prefabricated units designed to be installed without penetrating metal roof panels, and complete with predrilled holes and clamps for anchoring. Aluminum rods or bars held in place by stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels.

2.6.4 Fall Protection System

Prefabricated units designed to be installed without penetrating metal roof panels, complete predrilled holes and clamps for anchoring. Provide safety cable and line attachment clip to meet OSHA regulations.

2.7 UNDERLAYMENT MATERIALS

Self-adhering, high-temperature sheet, 30 to 40 mils thick minimum, consisting of slip-resisting, polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

2.7.1 Properties


b. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.

PART 3 EXECUTION

3.1 EXAMINATION

Examine surfaces to receive standing seam metal roofing and flashing. Provide plumb and true surfaces, clean, even, smooth and as dry as possible. Ensure that surfaces are free from defects and projections which might affect the installation. Report unsuitable conditions to Contracting Officer.

3.2 PROTECTION OF DISSIMILAR METALS

Where an aluminum or steel component is in contact with, fastened to, or contacted by drainage from dissimilar metals other than stainless steel, give such dissimilar metals one of the following treatments:

a. A heavy coat of alkali-resistant bituminous paint.

b. Separate contact surfaces with non-absorptive tape or gasket.
3.2.1 Contact with Masonry

Where aluminum or steel is in contact with masonry, concrete, or plaster, apply a heavy coat of alkali-resistant bituminous paint.

3.2.2 Contact with Wood

Where aluminum or steel is in contact with wood or other absorptive material subject to wetting, or with wood treated with a preservative not compatible with aluminum, seal joints with sealing compound and apply one heavy brushcoat of bituminous paint.

3.3 INSTALLATION

Install in accordance with roofing panel manufacturer's written instructions and approved erection drawings. Provide panels in full and firm contact with clips. Obtain approval prior to installation on prefinished panels cut in the field, and factory applied coverings or coatings that were repaired after being abraded or damaged during handling or installation. Make repairs with material of same color as weather coating. Completely seal openings through panels. Correct defects or errors in materials in an approved manner. Replace materials which cannot be corrected in an approved manner with new materials. Provide molded closure strips where necessary for weathertight construction. Use compatible metal shims as required to ensure clip line is true. Use a spacing gage at each row of panels to ensure that panel width is not stretched or shortened.

3.3.1 Self-Adhering Sheet Underlayment Installation

Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply over the entire area, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.3.2 Roof Panels

Apply roofing panels with standing seams parallel to slope of roof as indicated. Provide roofing panels in full lengths from ridge to eaves (top to eaves on shed roofs), with no transverse joints. Form interlocking rib type panel seams in the field with an automatic mechanical seamer approved by the manufacturer. Attach panels to structure with concealed clips which are incorporated into the panel seams. Clip attachment shall allow roof to move freely and independently of the structure, except at fixed points as recommended by the manufacturer and indicated on shop drawings.

3.3.2.1 Clip Fastening

Clip spacing shall be as required to resist specified wind loads and be secured to structural deck.

3.3.3 Metal Soffit Panels

Install as indicated in accordance with manufacturer's written instructions.
3.3.4 Flashings

Provide flashing and related closures and accessories in connection with preformed metal panels as indicated and as necessary to provide a weathertight installation. Install flashing to ensure positive water drainage away from roof penetrations. Flash and seal roof at ridge, eaves and rakes, at projections through roof, and elsewhere as necessary. Accomplish placement of closure strips, flashing, and sealing material in an approved manner that will ensure complete weathertightness. Details of installation which are not indicated shall be in accordance with the panel manufacturer's printed instructions and details of the approved shop drawings. Installation shall allow for expansion and contraction of flashing.

3.3.5 Flashing Fasteners

Fastener spacings shall be in accordance with the panel manufacturer's recommendations and as necessary to withstand the indicated design loads.

3.3.6 Closure/Closure Strips

Set closure/closure strips in joint sealant material.

3.3.7 Fall Protection Systems

Attach bar supports to vertical ribs of standing-seam metal roof panels with clamps or set screws. Do not use fasteners that will penetrate metal roof panels. Provide number rows at the locations with spacing as indicated on the erection drawings.

3.3.8 Gutters

Lap the sections a minimum of one inch in the direction of flow or provide with concealed splice plate 6 inch minimum. Join aluminum gutters with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Install gutters below slope line of the roof so that snow and ice can slide clear. Support gutters on adjustable hangers spaced not more than 30 inch on center. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from metals.

3.3.8.1 Gutter Accessories

Provide stainless steel wire ball strainer at each downspout outlet location. Provide strainers to fit tightly into outlets.

3.3.9 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the substrate. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on center with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

3.4 CLEANING

Clean exposed sheet metal work at completion of installation. Remove metal shavings, filings, nails, bolts, and wires from roofs on completion.
to prevent discoloration and harm to the panels and flashing. Remove grease and oil films, excess sealants handling marks, contamination from steel wool, fittings and drilling debris and scrub the work clean. Exposed metal surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks.

3.5 MANUFACTURER'S FIELD INSPECTION

Manufacturer's technical representative shall visit the site as necessary during the installation process to assure panels, flashings, and other components are being installed in a satisfactory manner. Manufacturer's technical representative shall perform a field inspection during the first 20 squares of roof panel installation and at substantial completion prior to issuance of warranty, as a minimum, and as otherwise requested by the Contracting Officer. Follow-up inspections of previously noted deficiencies or application errors shall be performed as requested by the Contracting Officer. Each inspection visit shall include a review of the entire installation to date. After each inspection, a report, signed by the manufacturer's technical representative, shall be submitted to the Contracting Officer noting the overall quality of work, deficiencies and any other concerns, and recommended corrective actions in detail. Notify Contracting Officer a minimum of 2 working days prior to site visit by manufacturer's technical representative.

3.6 COMPLETED WORK

Completed work shall be plumb and true to configuration indicated without oil canning, dents, ripples, abrasion, rust, staining, or other damage detrimental to the performance or aesthetics of the completed roof assembly.

3.7 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the panel manufacturer and include a minimum of 2 hours on maintenance and emergency repair of the roofing system. Furnish information on safety requirements during maintenance and emergency repair operations.

3.8 INFORMATION CARD

For each roof, provide a typewritten information card for facility Records and laminated in plastic and framed for interior display or a photoengraved 0.032 inch thick aluminum card for exterior display. Card to be 8 1/2 by 11 inches minimum. Information card shall identify facility name and number; location; contract number; approximate roof area; detailed roof system description; date of completion; installing contractor identification and contact information; panel manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

3.9 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 07 72 00.00 50
ROOF ACCESSORIES
01/16

PART 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 A 182 (1996) Forged or Rolled Alloy - Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service

ASTM A 36 (1992) Structural Steel


ASTM A 500 (2003a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 792 (2002) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

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

INTERNATIONAL CODE COUNCIL (ICC)


1.2   QUALITY ASSURANCE

1.2   Performance Requirements

Design and fabricate roof accessory items provided to resist wind uplift requirements based on the design wind, load criteria indicated on the Structural drawings in accordance with the ICC and ASCE 7 for Components and Cladding.

1.3   SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:
SD-02 Shop Drawings
   Roof hatch; G
   Roof curb; G
   Roof anchorage device; G

SD-03 Product Data
   Roof hatch; G
   Roof curb; G
   Roof anchorage device; G

SD-05 Design Data
   Performance Requirements Validation; G
   For products and systems indicated to validate compliance with specified roof accessories performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

SD-07 Certificates
   Roof hatch
   Roof curb
   Roof anchorage device
   Submit written certificate, signed and sealed by a professional engineer, certifying that roof accessory items provided comply with the specified performance requirements.

PART 2   PRODUCTS

2.1   METAL MATERIALS

2.1.1   Aluminum Sheet
   ASTM B 209, alloy and temper recommended by manufacturer for type of use and mill finish.

2.1.2   Wire Rope and Fittings
   a. Stainless Steel Wire Rope: Wire rope made from wire complying with ASTM A 492, Type 316. Size and configurations as required to suit conditioners.
   b. Wire-Rope Fittings: Connectors of types indicated, and as required to suit conditions, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
2.2   ROOF HATCH

2.2.1   Roof Hatches

Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

2.2.2   Type and Size

Single-leaf lid, 30 by 36 inches, unless otherwise indicated.

2.2.3   Load Requirements

See paragraph entitled "Performance Requirements."

2.2.4   Hatch Material

Aluminum sheet.

a.   Thickness: Manufacturer's standard thickness for hatch size(s) indicated and as required to suit conditions.
b.   Finish: Clear anodic.

2.2.5   Construction

a.   Insulation: Polyisocyanurate board.
c.   Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
d.   Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
e.   Roof hatches shall be supported by roof structure as indicated with a minimum clear height of 12 inches above finish roof membrane, unless otherwise indicated or required.

2.2.6   Hardware

Spring operators, hold-open arm, stainless-steel spring latch with turn handles, stainless-steel butt- or pintle-type hinge system, and padlock hasps inside and outside.

2.2.7   Safety Railing System

Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

a.   Height: 42 inches above finish roof membrane.
b.   Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches in diameter.
c.   Flat Bar: Galvanized steel, 2 inches high by 3/8 inch thick.
d.   Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
e.   Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and
self-latching mechanism.

f. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.

g. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.

h. Fabricate joints exposed to weather to be watertight.

i. Fasteners: Manufacturer's standard, finished to match railing system.

j. Finish: Manufacturer's standard.

k. Color: OSHA Yellow, unless otherwise indicated.

2.2.8 Ladder-Assist Post

Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

a. Operation: Post locks in place on full extension; release mechanism returns post to closed position.

b. Height: 42 inches above finished roof deck.

c. Material: Aluminum.


e. Finish: Manufacturer's standard.

f. Color: OSHA Yellow, unless otherwise indicated.

2.3 ROOF CURB

Prefabricated roof curb capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated to be supported on roof curb. Coordinate dimensions with rough-in information on shop drawings of equipment to be supported.

2.3.1 Fabrication

Unless otherwise indicated or required for strength, fabricate units from minimum 0.06 inch thick, structural quality, hot-dip galvanized or aluminum-zinc alloy coated steel sheet conforming to ASTM A 792; factory primed and prepared for painting with welded or sealed mechanical corner joints.

a. Provide preservative treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.

b. Fill curb interior with manufacturer's standard rigid or semi-rigid insulation.

c. Provide base profile coordinated with roof insulation thickness.

d. Fabricate units to minimum clear height of 12 inches above finish roof membrane, unless otherwise indicated or required.

e. Unless otherwise indicated or specified as part of equipment, provide elastomeric material setting pads with a Shore, Type A durometer hardness of 85 plus or minus 5.

2.3.2 Finish

Manufacturers standard prime paint.
2.4 ROOF ANCHORAGE DEVICE

Upright hollow structural section having lanyard loop welded to the top and base plate welded to the bottom. All metal shall be hot-dip galvanized after fabrication. Hollow structural section may be filled with polyurethane foam. Completed unit shall comply with requirements for "fall arrest safety anchors" as defined in OSHA regulations, Appendix C to 1910 Subpart F.

2.4.1 Major components composition and materials


c. Upright Hollow Structural Section: Carbon steel conforming to ASTM A 500, Grade B. Outside diameter, wall thickness, and length shall be appropriate to suit design. Galvanize after fabrication.


2.4.2 Attachment to Building Structure

By one of the following methods as appropriate to conditions and recommended by the tieback anchor manufacturer.

a. Beam Wrap Method: Four threaded steel bolts passing through the base plate, deck and extending to bottom of structural member to a bottom plate; secured by steel hex nuts with flat and lock washers. Bolts, washers and nuts shall be hot dip galvanized.

b. Epoxy Adhesive Method: Four stainless threaded rods adhere to concrete by epoxy capsules; secured by stainless steel hex nuts with stainless steel flat and lock washers.

PART 3 EXECUTION

3.1 INSTALLATION

Comply with manufacturer's instructions and recommendations. Coordinate with installation of roof deck, and other substrates to receive roof accessories, roof insulation, roofing and flashing, as required, to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses, as well as inward and outward loading pressures.

3.1.1 General Installation Requirements

3.1.1.1 Isolation

Where metal surfaces of units are to be installed in contact with incompatible metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation or setting pads where indicated or required.
3.1.1.2 Flange Seals

Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.

3.1.1.3 Operation of Units

Test operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.1.2 Roof Anchorage Device

Install at locations indicated or directed. Attach to building structure as appropriate with manufacturer installation instructions.

3.1.3 Roof-Hatch Installation

a. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
b. Attach safety railing system to roof-hatch curb.
c. Attach ladder-assist post according to manufacturer's written instructions.

3.2 CLEANING AND PROTECTION

Clean exposed metal and plastic surfaces according to manufacturer's instructions. Touch up damaged metal coatings.

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 E 605   (1993; R 2006) Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members


ASTM E136    (2016) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Protect all structural steel, undersides of steel floors (if required) and steel roof decks (if required) with spray-applied fireproofing, and board fireproofing system as indicated, to a fire resistance hour-rating as indicated below, unless otherwise indicated.

1.2.2 Fire Resistance Rating

Fire resistance ratings shall be in accordance with the fire rated assemblies listed in UL Fire Resistance for the ratings indicated on the Life Safety Drawings. Proposed materials not listed in UL Fire Resistance shall have fire resistance ratings at least equal to the UL Fire Resistance ratings as determined by an approved independent testing laboratory, based on tests specified in UL 263 or ASTM E 119. Apply fireproofing to structural steel members, with the hourly fire resistance rating indicated and in accordance with the indicated UL design or approved equivalent. Use unrestrained fire resistance ratings. Performance tests shall be in accordance with ASTM E 119.

1.2.3 Evaluation Reports - ICC-ES Reports

Spray-applied fireproofing materials shall be evaluated in accordance with ICC-ES AC23. ICC-ES Reports shall be included as part of the Submittals below. The reports will identify the product as code compliant and having met the physical performance requirements outlined in paragraphs "Dry Density and Bond Strength" through "Air Erosion".

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. For this specification, NVPAC signifies the office that will review the submittal for the Government to be Naval Facilities Engineering Command Fire Protection Engineer. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fireproofing Material; G, NVPAC

Data identifying performance characteristics of fireproofing material. Data shall include recommended application requirements and indicate thickness of fireproofing that should be applied to achieve each required fire rating.
Board Fireproofing System; G, NVFAC

SD-04 Samples

Spray-Applied Fireproofing; G, NVFAC

One sample panel, 18 inches square, for each specified type of fireproofing. Also, a designated sample area of not less than 100 square feet shall be prepared. Sample area shall be representative of typical installation of fireproofing including metal decks, beams, columns and attachments. Equipment, materials and procedures used in the sample area shall be the same as, or representative of, that to be used in the work. The sample area shall be approved prior to proceeding with fireproofing work in any other area. The approved sample area shall be used as a reference standard for applied fireproofing material. Sample area shall remain in place and open to observation until all spray-applied fireproofing is completed and accepted, at which time it may become part of the work.

Board Fireproofing System; G, NVFAC

SD-06 Test Reports

Fire Resistance Rating; G, NVFAC

Reports and test records, attesting that the fireproofing material conforms to the specified requirements. Each test report shall conform to the report requirements specified by the test method.

Field Tests; G

Test reports documenting results of tests on the applied material in the project. Report shall include defects identified, repair procedures, and results of the retests when required.

SD-07 Certificates

Installer Qualifications; G

Manufacturer's certification that each listed installer is qualified and trained to install the specified fireproofing. Evidence that each fireproofing installer has had a minimum of 3 years experience in installing the specified type of fireproofing.

Surface Preparation Report; G, NVFAC

Manufacturer's certification that surfaces to be protected have been inspected and are acceptable to receive spray-applied fireproofing. The statement shall list the structural members and the areas that have been inspected and certified.

Manufacturer's Inspection Report; G, NVFAC

Manufacturer's certification that the spray-applied fireproofing in the entire project complies with the manufacturer's criteria and recommendations.
1.4 QUALITY ASSURANCE

1.4.1 Installer Qualifications

Engage experienced installer(s) that is (are) certified, licensed, or otherwise qualified by the spray-on fireproofing manufacturer, and the board fireproofing manufacturer, as having the necessary experience, staff, and training to install the manufacturer's products in accordance with specified requirements. Each installer of fireproofing material shall be trained, have a minimum of 3 years experience and a minimum of three installations using fireproofing of the type specified. A manufacturer's willingness to sell its products to the Contractor or installer does not infer qualification of the buyer.

1.4.2 Pre-Installation Meeting

Hold a meeting with the installer, field testing agency, the manufacturer, subcontractors (whose employees come into contact with the fireproofing), and the Contracting Officer prior to the installation of any fireproofing material to review the substrates for acceptability, method of application, applied thickness, patching, repair, inspection and testing procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

Packaged material shall be delivered in the original unopened containers, marked to show the brand name, the manufacturer, and the UL markings. Fireproofing material shall be kept dry until ready to be used, and shall be stored off the ground, under cover and away from damp surfaces. Damaged or opened containers will be rejected. Material with shelf-life shall be applied prior to expiration of the shelf-life.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Temperature

Maintain substrate and ambient air temperatures above 40 degrees F during application and for 24 hours before and after application. Relative humidity shall be maintained within the limits recommended by the fireproofing manufacturer.

1.6.2 Ventilation

Provide adequate ventilation to properly dry the fireproofing after application. In enclosed areas, provide a minimum of 4 air exchanges per hour by forced air circulation.

PART 2 PRODUCTS

2.1 SPRAY-APPLIED FIREPROOFING

Provide spray-applied fireproofing material, factory-mixed, lightweight, dry formulation having a Portland cement binder, mixed with water at Project site to form a slurry or mortar before conveyance and application to produce the indicated fire-resistance design. Material shall be asbestos free, and shall resist fungus for a period of 28 days when tested in accordance with ASTM G 21. Material shall have a flame spread of 10 or less and a smoke developed rating of 10 or less when tested in accordance
with ASTM E 84.

2.1.1   Dry Density and Bond Strength

Fireproofing shall have a minimum ASTM E 605 dry density and ASTM E 736 bond strength properties as follows:

2.1.1.1   Concealed Structural Components

Fireproofing for structural components concealed above the ceiling, or within a wall, chase, or furred space, shall have a minimum applied dry density of 15 pounds per cubic foot and a bond strength of 200 psf.

2.1.1.2   Exposed Structural Components

Fireproofing for exposed structural components, shall have a minimum applied dry density of 40 pounds per cubic foot and a bond strength of 1000 psf.

2.1.2   Deflection

Spray-applied fireproofing shall not crack, spall, or delaminate when backing to which it is applied is subject to downward deflection 1/120 of 10 foot clear span, when tested in accordance with ASTM E 759.

2.1.3   Bond-Impact

Spray-applied fireproofing material shall not crack, spall or delaminate when tested in accordance with ASTM E 760.

2.1.4   Compressive Strength

The minimum compressive strength shall be 300 psi when tested in accordance with ASTM E 761.

2.1.5   Corrosion

Spray-applied fireproofing material shall not contribute to corrosion of test panels when tested as specified in ASTM E 937.

2.1.6   Air Erosion

Dust removal shall not exceed 0.025 gram per square foot when tested in accordance with ASTM E 859.

2.1.7   Water

Water used for material mixing and surface preparation shall be potable.

2.2   BOARD FIREPROOFING SYSTEM

2.2.1   Mineral-Fiber Board

Unfaced rigid board produced by combining slag-wool-/rock-wool fibers with thermosetting resin binders passing ASTM E136 for combustion characteristics; of thickness required to produce fire-resistance rating indicated.
2.2.1.1 Nominal Density

9 lb/cu. ft.

2.2.1.2 Surface-Burning Characteristics

Flame-spread and smoke-developed indexes of zero and 15, respectively, according to ASTM E84.

2.2.2 Anchorage Accessories

Provide manufacturer's standard board-anchorage components complying with related design of UL or of another testing and inspecting agency acceptable to authorities having jurisdiction.

PART 3 EXECUTION

3.1 SURFACE PREPARATION FOR SPRAY-APPLIED FIREPROOFING SYSTEM

Thoroughly clean surfaces to be fireproofed of dirt, grease, oil, paint, primers, loose rust, rolling lubricant, mill scale or other contaminants that will interfere with the proper bonding of the sprayed fireproofing to the substrate. Test painted/primed steel substrates in accordance with ASTM E 736, with specified sprayed fireproofing material, to provide the required fire-resistance rating; painted or primed steel surfaces may require a fireproofing bond test to determine if the paint formulation will impair proper adhesion. Certify the acceptability of surfaces to receive sprayed-applied fireproofing by inspection and submit a Surface Preparation Report accordingly. Overhead areas to be fireproofed shall be cleared of all obstructions interfering with the uniform application of the spray-applied fireproofing. Hardware such as support sleeves, inserts, clips, hanger attachment devices and the like shall be installed prior to the application of the fireproofing. Condition of the surfaces shall be acceptable to the manufacturer prior to application of spray-applied fireproofing. Applications listed for use on primed surfaces shall be in accordance with the manufacturer's recommendations and standards, and detailed in submittal item SD-03 Product Data.

3.2 PREPARATION FOR BOARD FIREPROOFING SYSTEM

Install board fire protection on structural members after piping and other construction behind fire-resistive materials have been completed.

3.3 PROTECTION FOR SPRAY-APPLIED FIREPROOFING SYSTEM

Surfaces not to receive spray-applied fireproofing shall be covered to prevent contamination by splatter, rebound and overspray. Exterior openings in areas to receive spray-applied fireproofing shall be covered prior to and during application of fireproofing with tarpaulins or other approved material. Surfaces not to receive fireproofing shall be cleaned of fireproofing.

3.4 PROTECTION FOR BOARD FIREPROOFING SYSTEM

Replace or repair board fire protection that has been cut away to facilitate other construction. Maintain complete coverage of full thickness on members and substrates protected by board fire protection. Provide final protection and maintain conditions in a manner acceptable to Installer, manufacturer, and authorities having jurisdiction to ensure
that board fire protection is without damage or deterioration at time final acceptance of the work.

3.5 APPLICATION OF SPRAY-APPLIED FIREPROOFING SYSTEM

3.5.1 Mixing

Mix fireproofing material in accordance with the manufacturer's recommendations.

3.5.2 Sequence

Prior to application of fireproofing on each floor, the manufacturer shall inspect and approve application equipment, water supply and pressure, and the application procedures. If fireproofing is required to be applied to underside of steel roof deck and steel floor assemblies, it shall be done only after respective roof or floor construction is complete. No roof or floor traffic shall be allowed during application. Fireproofing material shall be applied prior to the installation of ductwork, piping and conduits which would interfere with uniform application of the fireproofing.

3.5.3 Application Technique

Water pressure and volume shall be maintained to manufacturer's recommendations throughout the fireproofing application. Fireproofing material shall be applied to the thickness and density established for the specified fire resistance rating, in accordance with the procedure recommended by the manufacturer, and to a uniform density and texture. Fireproofing material shall not be tamped to achieve the desired density.

3.5.4 Applied Thickness

The minimum average thickness shall be no less than 0.375 inches. Thicknesses shall not be less than required to achieve designated fire resistance ratings. If the specified thickness is greater than or equal to 1 inch, any individual measurement shall not be less than the specified thickness minus 0.25 inches. If the specified thickness is less than 1 inch, any individual measurement shall not be less than the specified thickness minus 25 percent.

3.5.5 INSTALLATION OF BOARD FIREPROOFING SYSTEM

Install board fire protection according to manufacturer's written instructions.

Install board fire protection to comply with requirements for layer thicknesses and number, construction of joints and corners, and anchorage methods applicable to fire-resistance-rated assemblies indicated.

Install enclosing or concealing construction only after board fire protection has been applied and inspected by authorities having jurisdiction.

3.6 MANUFACTURER'S SERVICES

3.6.1 General

The spray-applied and board fire proofing system manufacturer(s), or its
(their) representative, shall be onsite prior to, periodically during, and at completion of the application, to provide the specified inspections and certifications; and to ensure that preparations are adequate and that the material is applied according to manufacturer's written instructions and the contract requirements.

3.6.2 Manufacturer's Inspection

The spray-applied and board fireproofing manufacturer(s) shall inspect the fireproofing work after the work is completed on each floor or area, including testing, repair and clean-up, and shall certify that the work complies with the respective manufacturer's criteria and recommendations. Before the fireproofing material is covered, and after all of the fireproofing work is completed, including repair, testing, and clean-up; and after mechanical, electrical and other work in contact with fireproofing material has been completed, the spray-applied and board fireproofing manufacturer(s) shall re-inspect the work and certify that the entire project complies with the respective manufacturer's criteria and recommendations. Obtain and submit the respective Manufacturer's Inspection Report and certifications of approval.

3.7 FIELD TESTS FOR SPRAY-APPLIED FIREPROOFING SYSTEM

The spray-applied fireproofing shall be tested by an approved independent testing laboratory to be selected by the Contracting Officer and paid for by the Contractor. Perform the tests in approved locations: for density in accordance with ASTM E 736, bond in accordance with ASTM E 736, and for thickness in accordance with ASTM E 605. Determine densities in accordance with ASTM E 605. Take density determinations at the flat portion of deck, beam bottom flange, beam web, column, and an equivalent area from the top of the lower beam flange. Areas showing a density less than specified will be rejected. A test sample shall be located every 10,000 square feet of floor area or two for each floor, whichever produces the greatest number of test areas. Any area showing less than minimum requirements shall be corrected. Proposed corrective measures, in writing, shall be approved before starting the corrective action. Corrected work shall be retested.

3.7.1 Structural Components

Each structural component type shall be tested at floor and roof decks, beams, columns, joists, and trusses. Minimum average thickness shall be as required by UL Fire Resistance. Density and bond shall be as specified.

3.7.2 Repair

Additional fireproofing material may be added to provide proper thickness. Rejected areas of fireproofing shall be corrected to meet specified requirements by adding fireproofing material to provide the proper thickness, or by removing defects and respraying with new fireproofing material. Repairs shall use same type of fireproofing material as originally applied or patching materials recommended by the manufacturer. Repaired areas shall be retested and reinspected. Fireproofing material shall be applied to voids or damaged areas by hand-trowel, or by respraying.

3.7.3 Visual Inspections

Inspections shall be made by the certified independent laboratory prior to
closure of concealed areas. These inspections may be phased, but shall not occur less than 5 working days prior to the enclosure of the fireproofing. Sprayed areas shall receive a final inspection. Fireproofed surfaces shall be inspected after mechanical, electrical, and other work in contact with fireproofing material has been completed and before sprayed material is covered. Any locations missing fireproofing shall be patched in accordance with the manufacturer's requirements.

3.7.4 Patching

Patch and repair damaged fireproofing. The patching material shall be the same as that specified for that area.

3.7.5 Cleanup

Surfaces not indicated to receive fireproofing shall be thoroughly cleaned of sprayed material within a 24 hour period after application.

3.8 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 E 136  (2011) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C


FM GLOBAL (FM)

FM APP GUIDE  (updated on-line) Approval Guide
http://www.approvalguide.com/CC_host/pages/public/cust
1.2 SYSTEM DESCRIPTION

1.2.1 General

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, according to requirements indicated, resist passage of 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.

d. Fire-resistance-rated walls include smoke barrier walls.

1.2.2 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.

1.2.3 Submittals Requirements

a. 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 shall indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application.

b. Submit certificates attesting that firestopping material complies with the specified requirements. In lieu of certificates, drawings showing UL classified materials as part of a tested assembly may be provided. Drawings showing evidence of testing by an alternate nationally recognized independent laboratory may be substituted. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification from UL of passing the "Aging and Environmental Exposure Testing " portion of UL 1479.

c. Submit documentation of training and experience for Installer.

d. Submit manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.3 SUBMITTALS

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

SD-02 Shop Drawings
Firestopping Materials

SD-07 Certificates
Firestopping Materials; G
Installer Qualifications; G
Inspection

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualifications

A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.5 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. Remove damaged or
deteriorated materials from the site.

PART 2   PRODUCTS

2.1   FIRESTOPPING MATERIALS

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

2.1.1   Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed
rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723.
Material shall be an approved firestopping material as listed in
UL Fire Resistance or by a nationally recognized testing laboratory.

2.1.2   Toxicity

Material shall be nontoxic 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.
Firestop material must be free from Ethylene Glycol, PCB, MEK, or other
types of hazardous chemicals.

2.1.3   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.

2.1.3.1   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 E 814 or UL 1479. Fire resistance ratings shall
be as follows:

a. Penetrations of Fire Resistance Rated Walls and Partitions:  F
   Rating = Rating of wall or partition being penetrated.

b. Penetrations of Fire Resistance Rated Floors, Floor-Ceiling
   Assemblies and the ceiling of Roof-Ceiling Assemblies:  F Rating =
   Rating of floor and ceiling being penetrated. Where the
   penetrating item is outside of a wall cavity the F rating and T
   rating must be equal to the fire resistance rating of the floor
   penetrated.

c. Penetrations of Fire and Smoke Resistance Rated Walls, Floors,
   Floor-Ceiling Assemblies, and the ceiling membrane of Roof-Ceiling
   Assemblies:  F Rating = as indicated on Life Safety Drawings, T
   Rating = as indicated on Life Safety Drawings and L Rating = <5
   cfm/sf Where L rating is required.
2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph SYSTEM DESCRIPTION, and gaps such as those between floor slabs or roof decks and curtain walls shall be as follows: construction joints in walls, as indicated on Life Safety Drawings and on the Penetration Schedule Sheet; construction joints in floors, as indicated on Life Safety Drawings and on the Penetration Schedule Sheet; gaps between floor slabs and curtain walls, as indicated on Life Safety Drawings and on the Penetration Schedule Sheet; gaps between top of the walls and the bottom of roof and floor decks, as indicated on Life Safety Drawings and on the Penetration Schedule Sheet, and provide L rating of &lt;5 cfm/lf where required. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E 119, ASTM E 1966 or UL 2079 to meet the required fire resistance rating. Curtain wall joints shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E 2307 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079. All joints at the intersection of the top of a fire resistance rated wall and the underside of a fire-rated floor, floor ceiling, or roof ceiling assembly shall provide a minimum class II movement capability.

2.1.4 Fire Containment Insulation

ASTM C 665, Type I (without membrane facing); consisting of rock- or slag-wool-fibers; with maximum flame-spread and smoke-developed indexes of 0 and 0, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.1.5 Material Performance

All firestop materials are subject to these minimum standards of performance.

a. Firestop material shall be capable of installation at temperatures of 35 to 120 degrees F.

b. Material must be able to be frozen, thawed and still maintain manufacturer approval for installation.

c. Firestop material must convey a manufacturer's written warranty guaranteeing the performance of the material for the sustainable lifetime of the structure.

d. Material must maintain a shelf life of no less than 2 years form date of manufacturing.

e. Acceptable firestop cast-in-place devices are factory assembled intumescent lined round or oval plastic cylinders capable of protecting plastic, metallic, cable, and blank openings through the cast-in-place device equal to the fire-resistance rating of the floor.
3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound and capable of supporting device. 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. Firestopping systems for filling floor voids 4 inches or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. 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 floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating or smoke barrier 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.

3.2.3 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with
re-enterable firestopping products. Firestopping devices shall be pre-manufactured modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, additions or changes without the need to remove or replace any firestop materials. Devices must be capable of maintaining the fire resistance rating of the penetrated membrane at 0% to 100% visual fill of penetrants; while maintaining "L" rating of <5 cfm/sf measured at ambient temperature and 400°F at 0% to 100% visual fill. Each device must be capable of retrofit applications and be available in square and round configurations, with single, double, triple and six-plex bracket systems provided. Firestop devices must also allow for plastic pipe, metallic pipe, and mixed multiple penetrations plastic, metallic, insulated metallic, and cable through a single device.

3.3 INSPECTION

3.3.1 General Requirements

For Navy projects, install one of each type of penetration and have it inspected and accepted by the Midlant Division, Naval Facilities Engineering Command, Fire Protection Engineer prior to the installation of the remainder of the penetrations. At this inspection, the manufacturer's technical representative of the firestopping material shall be present. For all projects, the remainder of the firestopped areas shall not be covered or enclosed until inspection is complete and approved by the manufacturer's technical representative. The manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

3.3.2 Inspection Standards

Inspect all firestopping in accordance to ASTM standards for firestop inspection, and document inspection results to be submitted to GC, Architect and Owner.

   a. ASTM E 2393.

   b. ASTM E 2174.

3.4 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

   -- End of Section --
PART 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 734 (2006) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering

ASTM C 834 (2010) Latex Sealants

ASTM C 919 (2008) Use of Sealants in Acoustical Applications


ASTM D 217 (2002; R 2007) Cone Penetration of Lubricating Grease


U.S. GREEN BUILDING COUNCIL (USGBC)


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 Sectio 01 33 29 SUSTAINABILITY REPORTING.
Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants
Primers
Bond breakers
Backstops

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). Provide a copy of the Material Safety Data Sheet for each solvent, primer or sealant material.

Low-VOC Sealants and Adhesives (LEED Credit IEQ 4); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter less water and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-07 Certificates

Sealant

Certificates of compliance stating that the materials conform to the specified requirements.

SD-11 Closeout

All approved LEED Submittals specified under SD-03 Product Data; S

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.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 LOW-VOC SEALANTS AND ADHESIVES

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

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 silicone ASTM C 920, Type S or M, Grade NS, Class 12.5, Use NT. Provide mildew-resistant silicone ASTM C920, Type S, Grade NS, Class 25, Use in wet areas. Colors to match adjacent surfaces; provide custom colors as required to suit conditions at no additional cost to the Government. Location(s) of sealant for the following:

LOCATION

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.

b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.

c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.

d. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.

e. Joints between plumbing fixtures and ceramic tile; joints formed where nonplaner tile surfaces meet.
LOCATION

f. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.

g. Behind escutcheon plates at valve pipe penetrations.

2.2.2 Exterior Sealant

For joints in vertical surfaces, provide silicone ASTM C 920, Type S, Grade NS, Class 100/50, Use NT. Colors shall match adjacent surfaces unless otherwise indicated or specified; provide custom colors as required to suit conditions at no additional cost to the Government. Provide location(s) of sealant as follows:

LOCATION

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.

b. Joints between new and existing exterior masonry walls.

c. Masonry joints where shelf angles occur.

d. Expansion and control joints.

e. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.

f. Voids where items pass through exterior walls.

g. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.

h. Metal-to-metal joints where sealant is indicated or specified.

i. Joints between ends of gravel stops, fascias, copings, and adjacent walls.

2.2.3 Floor Joint Sealant

ASTM C 920, Type S or M, Grade P, Class 25, Use T. Color to match adjacent surfaces; provide custom colors as required to suit conditions at no additional cost to the Government. Provide location(s) and color(s) of sealant as follows:
LOCATION

a. Seats of metal thresholds for exterior doors.

b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.

2.2.4 Acoustical Sealant

Rubber or polymer-based acoustical sealant conforming to ASTM C 919 must have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E 84. Acoustical sealant must have a consistency of 250 to 310 when tested in accordance with ASTM D 217, and must remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C 734, and must be non-staining.

2.2.5 Preformed Sealant

Provide preformed sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, the sealant must be non-bleeding and no loss of adhesion.

2.2.5.1 Preformed Foam Joint Sealant

Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.

2.2.5.2 Weather-Faced Preformed Foam Joint Sealant

See Section 07 95 00.00 50 EXPANSION CONTROL.

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 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.
2.5.1 Cylindrical

Conform to ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2.6 CAULKING

Conform to ASTM C 834, Type OP, Grade NF, acrylic latex or siliconized acrylic latex caulking.

2.7 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum surfaces that will be in contact with sealant.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, contact sealant manufacturer for specific recommendations.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.1.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.1.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity.

3.1.4 Wood Surfaces

Keep wood surfaces to be in contact with sealants free of splinters and sawdust or other loose particles.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix
multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

<table>
<thead>
<tr>
<th>JOINT WIDTH</th>
<th>JOINT DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
</tr>
<tr>
<td>For metal, glass, or other nonporous surfaces:</td>
<td></td>
</tr>
<tr>
<td>1/4 inch (minimum)</td>
<td>1/4 inch</td>
</tr>
<tr>
<td>over 1/4 inch</td>
<td>1/2 of width</td>
</tr>
<tr>
<td>For wood, concrete, masonry:</td>
<td></td>
</tr>
<tr>
<td>1/4 inch (minimum)</td>
<td>1/4 inch</td>
</tr>
<tr>
<td>Over 1/4 inch to 1/2 inch</td>
<td>1/4 inch</td>
</tr>
<tr>
<td>Over 1/2 inch to 2 inch</td>
<td>1/2 inch</td>
</tr>
<tr>
<td>Over 2 inch</td>
<td>(As recommended by sealant manufacturer)</td>
</tr>
</tbody>
</table>

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 Installation of Preformed Foam Joint Sealants

Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient
temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.3.5 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.

3.3.6 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.

3.3.7 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 FIELD QUALITY CONTROL

3.4.1 Field-Adhesion Testing

Field test joint-sealant adhesion to exterior joint substrates as follows:

3.4.1.1 Extent of Testing

Test completed and cured sealant joints as follows:

a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.

b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.

3.4.1.2 Test Method


a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3.4.1.3 Inspect tested joints and report on the following

a. Whether sealants filled joint cavities and are free of voids.

b. Whether sealant dimensions and configurations comply with specified requirements.

c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

3.4.2 Evaluation of Field-Adhesion Test Results

Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 PROTECTION AND CLEANING

3.5.1 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.

3.5.2 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.

3.6 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2010; Change 2010; Change 2011; Errata 2011; Change 2011) Minimum DesignLoads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)


INTERNATIONAL CODE COUNCIL (ICC)


1.2 SUBMITTALS

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

SD-02 Shop Drawings

Architectural joint assemblies; G

Submittal Requirements

SD-03 Product Data
Architectural joint assemblies; G

SD-05 Design Data

Performance Requirements Validation; G

For products and systems indicated to validate compliance with specified wind load performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

1.3 QUALITY ASSURANCE

1.3.1 Performance Characteristics

Expansion joint sections shall expand and contract freely while mechanically locked in place on anchor cleats. Provide additional components as required to meet specified seismic criteria.

1.3.2 Fire-Test-Response Characteristics

Where indicated, provide joint systems incorporating fire barriers that are identical to those of assemblies tested for fire resistance per ASTM E 119 and ASTM E 814, including hose-stream test of vertical wall assemblies, by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.4 PERFORMANCE REQUIREMENTS

Provide exterior architectural joint assemblies capable of withstanding structural loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.

Interior architectural joint assemblies indicated are excluded from meeting specified performance requirements, except as noted otherwise.

1.4.1 Wind and Seismic Load Requirements

Design and fabricate exterior architectural joint assemblies provided to resist wind load and seismic load criteria indicated on Structural drawings in accordance with ICC IBC and ASCE 7 requirements for Components and cladding.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum

ASTM B 221, alloy 6063-T5 for extrusions; ASTM B 209, alloy 6061-T6 for sheet and plate. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

2.1.2 Fire Barriers

Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement
joint.

2.1.3 Accessories

Manufacturer’s standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.2 ARCHITECTURAL JOINT ASSEMBLIES

Of design, basic profile, materials, and operation indicated and with the capability to accommodate joint widths indicated and variations in adjacent surfaces.

a. Furnish units in longest practicable lengths to minimize number of end joints.

b. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required for continuous joint systems.

c. Frames for Strip Seals: Designed with semiclosed cavity that provides a mechanical lock for seals of type indicated.

d. Public Area Seals: Non-slip seals designed for installation on treads and risers and to lie flat with adjacent surfaces, and complying with ADA guidelines for public areas.

e. Cyclic-Movement-Test-Response Characteristics: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E 1399, including Appendix X3.

2.2.1 Building Interior

a. Description: Flush seismic, having minimum exposed surface; pan to receive terrazzo finish and gaskets.

b. Use: Pedestrian traffic joints, wall and ceiling joints and as indicated.

c. Nominal Joint Width: 4.0 inches unless otherwise indicated.

d. Maximum Joint Width: 6.0 inches.

e. Minimum Joint Width: 0.75 inches.

f. Type of Movement Capability: Expansion and contraction and seismic.

g. Exposed Cover Material: Aluminum.

h. Exposed Frame Material: Same material and finish as exposed cover material.

i. Moisture Barrier: Provide manufacturer's standard unit as required.
j. Fire-Resistance Ratings: Provide manufacturer's standard fire barrier where required, with a rating not less than that of adjacent construction.

2.2.1.1 Floor-to-Floor, Typical; Recessed Cover

a. Description: Exposed metal cover that spans the joint and slides between the frame assemblies to allow movement. Frame shall provide edge for finish floor materials.

b. Use: Pedestrian traffic joints.

c. Nominal Joint Width: 4.0 inches unless otherwise indicated.

d. Minimum Joint Width: 0.88 inches.

e. Maximum Joint Width: 7.0 inches.

f. Exposed Surface: 6.44 inches.

g. Type of Movement Capability: Expansion and contraction.

h. Exposed Cover Material: Aluminum.

i. Exposed Frame Material: Same material and finish as exposed cover material.

j. Moisture Barrier: Provide manufacturer's standard unit as required.

k. Fire-Resistance Ratings: Provide manufacturer's standard fire barrier where required, with a rating not less than that of adjacent construction.

2.2.1.2 Floor-to-Floor, Typical; Surface Mounted Cover

a. Description: Exposed metal cover that spans the joint and slides between the frame assemblies to allow movement.

b. Use: Pedestrian traffic joints.

c. Nominal Joint Width: 4.0 inches unless otherwise indicated.

d. Minimum Joint Width: 6.75 inches.

e. Maximum Joint Width: 0.0 inches.


g. Type of Movement Capability: Expansion and contraction.

h. Exposed Cover Material: Aluminum.

i. Exposed Frame Material: Same material and finish as exposed cover material.

j. Moisture Barrier: Provide manufacturer's standard unit as required.
k. Fire-Resistance Ratings: Provide manufacturer's standard fire barrier where required, with a rating not less than that of adjacent construction.

2.2.1.3 Wall-to-Wall

a. Description: Exposed metal plate that spans the joint appearing to be "free floating" between slides in the frame assemblies. Frame shall be flush with adjacent gypsum board.

b. Nominal Joint Width: 4.0 inches unless otherwise indicated.

c. Minimum Joint Width: 1.0 inches.

d. Maximum Joint Width: 7.38 inches.

e. Exposed Surface: 11.75 inches.

f. Type of Movement Capability: Expansion and contraction.

g. Exposed Cover Material: Aluminum; accommodate field painting of frame and cover where indicated.

h. Exposed Frame Material: Same material and finish as exposed cover material.

i. Moisture Barrier: Provide manufacturer's standard unit as required.

j. Fire-Resistance Ratings: Provide manufacturer's standard fire barrier where required, with a rating not less than that of adjacent construction.

2.2.1.4 Ceiling-to-Ceiling, Metal

a. Description: Dual elastomeric seal.

b. Nominal Joint Width: 4.0 inches unless otherwise indicated.

c. Minimum Joint Width: 0.0 inches.

d. Maximum Joint Width: 10.0 inches.

e. Exposed Surface: 4.0 inches.

f. Type of Movement Capability: Expansion and contraction.

g. Exposed Seal Material: Manufacturer's standard resilient; white color.

h. Exposed Frame Material: Manufacturer's standard; field paintable.

i. Moisture Barrier: Provide manufacturer's standard unit as required.

j. Fire-Resistance Ratings: Provide manufacturer's standard fire barrier where required, with a rating not less than that of adjacent construction.
2.2.2 Exterior Expansion Control Systems

2.2.2.1 Weather-Faced Preformed Foam Joint Sealant

Preformed, precompressed, open-cell polyurethane foam sealant having water-repellent properties manufactured with a weather resistant covering that is factory applied and cured. Foam shall not be impregnated with wax or asphalt compounds. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated.

2.2.2.2 Exposed Face Color

Match adjacent substrates unless otherwise indicated.

2.2.2.3 Fire-Rated Foam Joint Sealant

Incorporate fire-retardant impregnated foam and intumescent material factory pre-coated on both faces under weather-faced coating. Product shall comply with UL rating requirements.

2.3 FINISHES

Apply a strippable, temporary protective covering on exposed surfaces to protect mechanical finishes from damage by before shipping.

2.3.1 Aluminum

2.3.1.1 Mill Finish

AA-M10 Mechanical finish as fabricated.

PART 3 EXECUTION

3.1 INSTALLATION

Cut, drill, and fit architectural joint systems as required for complete installation. Install with hairline mitered corners where units change directions and hairline joints where unit lengths abut or units abut other materials. Secure to in-place construction.

3.1.1 Fire Barriers

Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and end joints.

3.1.2 Weather-Faced Preformed Foam Joint Sealant

Maintain continuity of seal through changes in plane as recommended by the foam joint sealant manufacturer. Where exposed to exterior elements, provide beads of sealant where weather-faced covering is in contact with adjacent substrate. In rated walls, install foam sealant to ensure maintaining the fire rating of the wall assembly.

3.2 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.
-- 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 within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


ANSI A250.6 (2003) Hardware on Steel Doors (Reinforcement - Application)

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M (2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)


INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2009; Errata First Printing)
International Building Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 105 (2010) Standard for Installation of Smoke Door Assemblies and Other Opening Protectives
NFPA 80 (2010; TIA 10-2) Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI)

SDI 105 (2001) Recommended Erection Instructions for Steel Frames
SDI 111-C (2000) Recommended Louver Details for Standard Steel Doors
SDI 113 (2001) Determining the Steady State Thermal Transmittance of Steel Door and Frame Assemblies

UNDERWRITERS LABORATORIES (UL)

UL 10B (2008; Reprint Apr 2009) Fire Tests of Door Assemblies

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01 (2003; Change 1 2007) DoD Minimum Antiterrorism Standards for Buildings

U.S. GREEN BUILDING COUNCIL (USGBC)


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. Group submittals of complementary and related products and materials as needed to represent total assemblies and facilitate concurrent coordination review. Example: Submit doors, door frames, door
hardware and door operators together. The Government may withhold action on submittals requiring coordination with other submittals until related submittals are received. 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

Doors; G
Frames; G
Accessories; G

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.
Schedules; G

SD-03 Product Data

Doors; G
Frames; G
Accessories; G

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 A250.8 requirements.

Recycled Content (LEED Credit MR 4); G

Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content included in this Section. Include a statement indicating material only costs for each product having recycled content. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-05 Design Data

Performance Requirements Validation; G

For products and systems indicated to validate compliance with specified performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

SD-07 Certificates

Exterior steel door and frame assemblies

Submit written certificate, signed and sealed by a professional engineer, certifying that design and anchorage of exterior steel
door and frame assemblies complies with specified performance requirements.

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Structural

Exterior steel door and frame assemblies, shall be designed as a system to resist minimum load requirements as indicated below. Meeting UFC 4-010-01, Standard 10 requirements. Design of the assembly shall include associated hardware, connections of the hardware, anchorage components and supporting structural connections.

1.3.1.1 Frames

In accordance with ASTM F2248, ensure that the framing members restrict deflections to L/60 of the length of the supported edge at allowable stress levels under the equivalent 3-second design loading of 136 pounds per square foot.

Use ASTM F2248 for glazing bite requirements for structurally or non-structurally exterior steel door and frame assemblies.

1.3.1.2 Connections

The design of connections of exterior steel door and frame assemblies to surrounding walls, of hardware and associated connections, of glazing stop connections, and of other elements in shear will be based on allowable stress levels. The connection design will be determined in accordance with ASTM F2248 based on two times the equivalent 3-second design loading of 136 pounds per square foot. Additionally, the allowable fastener loads will be as recommended by the fastener manufacturer for the materials to which the door systems are being connected.

Connections must be capable of preventing the frame from being dislodged from the supporting structural element.

1.3.1.3 Wind Load Criteria

Design and fabricate all exterior steel door and frame assemblies provided to resist wind load criteria as indicated on Structural drawings in accordance with ICC IBC and ASCE 7 requirements for Components and Cladding.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. 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.

1.5 SCHEDULES

Submit door and frame locations.
1.6 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT OF PRODUCTS

Provide products with post-consumer recycled content plus one-half of pre-consumer recycled content to the greatest extent possible.

2.2 STANDARD STEEL DOORS

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

2.2.1 Classification - Level, Performance, Model

2.2.1.1 Heavy Duty Doors

SDI 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. Fabricate of cold-rolled or hot-rolled steel sheet. Provide Level 2 typically at mechanical rooms, stairwells, cross corridor and locations where indicated.

2.2.1.2 Maximum Duty Doors

SDI A250.8, Level 4, physical performance Level A, Model 1 with core construction as required by the manufacturer for interior doors where specified and for exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with insulation. Provide Level 4 typically at pharmacy or secured rooms where indicated and at exterior applications. Fabricate from metallic-coated steel sheet.

2.3 INSULATED STEEL DOOR SYSTEMS

Door size(s), design, and material shall be as specified for maximum duty doors. Insulated steel doors shall have a core of polyurethane foam and an R factor of 10.0 or more (based on a k value of 0.16); face sheets, edges, and frames of galvanized steel; magnetic weatherstripping; nonremovable-pin hinges; thermal-break aluminum threshold; and vinyl door bottom. Doors and frames shall receive phosphate treatment, and rust-inhibitive primer, and baked acrylic enamel finish. Doors shall have been tested in accordance with ANSI A250.4 and shall have met the requirements for Level C. Prepare doors to receive hardware specified in Section 08 71 00 DOOR HARDWARE. Provide insulated steel doors and frames at building entrances.
2.4 ACCESSORIES

2.4.1 Louvers

2.4.1.1 Interior Louvers

SDI 111-C, Louvers shall be stationary sightproof type. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 20 gage steel and louver blades of a minimum 24 gage. Sightproof louvers to be inverted "V" blade design with minimum 55 percent net-free opening.

2.4.1.2 Exterior Louvers

Louvers shall be inverted "Y" type with minimum of 30 percent net-free opening. Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. Louvers shall have steel-framed bird screens secured to room side and readily removable. Provide galvanized steel, 1/2 by 1/2 inch mesh hardware cloth, for bird screens. Net-free louver area to be before screening.

2.4.2 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 71 00 DOOR HARDWARE, provide overlapping steel astragals with the doors.

2.4.3 Moldings

Provide moldings around glass of interior and exterior doors and louvers of interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

2.5 INSULATION CORES

Provide insulated cores at exterior doors. Insulated cores shall be of type specified, and provide an apparent U-factor of 0.48 in accordance with SDI 113 and shall conform to:

a. Rigid Polyurethane Foam: ASTM C 591, Type I or II, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863; or

b. Rigid Polystyrene Foam Board: ASTM C 578, Type I or II; or

c. Mineral board: ASTM C 612, Type I.

2.6 STANDARD STEEL FRAMES

SDI A250.8, Level 2 for interior applications and Level 4 for exterior applications, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, transoms, sidelights, mullions, cased openings, and interior glazed panels, unless otherwise indicated. Fabricate interior frames of cold or hot rolled sheet steel. Fabricate exterior frames of zinc coated steel sheet.
2.6.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

2.6.2 Mullions and Transom Bars

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

2.6.3 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 inches on centers. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.6.4 Terminated Stops

Where indicated, terminate interior door frame stops 6 inches above floor. Do not terminate stops of frames for lead-lined doors.

2.6.5 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.

2.6.6 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.

2.6.6.1 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 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 111-P.

2.7 FIRE AND SMOKE DOORS AND FRAMES

NFPA 80 and NFPA 105 and this specification. The requirements of NFPA 80 and NFPA 105 shall take precedence over details indicated or specified.
2.7.1 Labels

Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10B. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

2.7.2 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.

2.7.3 Astragal on Fire and Smoke Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements. On smoke control doors, conform to NFPA 105.

2.8 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in ANSI 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 A250.8 and ANSI A250.6. For additional requirements refer to BHMA A115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping or soundproof gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.9 FINISHES

2.9.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI A250.8, or paintable A25 galvannealed steel without primer. Where coating is removed by welding, apply touchup of factory primer.

2.9.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior doors and frames from hot dipped zinc coated steel, that complies with ASTM A 653/A 653M Commercial Steel (CS) Type B. The Coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI A250.8.
2.10  FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

2.10.1  Grouted Frames

Frames to be installed in exterior concrete or masonry walls shall be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3  EXECUTION

3.1  INSTALLATION

3.1.1  Frames

Set frames in accordance with SDI 105. 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 in masonry walls with mortar or grout. Provide an additive in the 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 A250.8. After erection and glazing, clean and adjust hardware.

3.1.3  Fire and Smoke Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80. Install fire rated smoke doors and frames in accordance with NFPA 80 and NFPA 105.

3.2  PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3  CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.
3.4 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19
CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 A208.1 (1999) Mat-Formed Wood Particle Board

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWS (Edition 1) Architectural Woodwork Standards

ASTM INTERNATIONAL (ASTM)

ASTM E 152 (1981ae1) Fire Tests of Door Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


NFPA 80 (2010; TIA 10-2) Standard for Fire Doors and Other Opening Protectives

UNDERWRITERS LABORATORIES (UL)

UL 10B (2008; Reprint Apr 2009) Fire Tests of Door Assemblies

U.S. GREEN BUILDING COUNCIL (USGBC)


WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)


1.2   SUBMITTALS

Government approval is required for submittals with a "G" designation;
Submit all submittals not having a "G" designation are for Contractor Quality Control approval. Group submittals of complementary and related products and materials as needed to represent total assemblies and facilitate concurrent coordination review. Example: Submit doors, door frames, door hardware and door operators together. The Government may withhold action on submittals requiring coordination with other submittals until related submittals are received. 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

Doors; G

Submit drawings or catalog data showing each type of door unit. Drawings and data shall indicate door type and construction, sizes, thickness, methods of assembly, door louvers, and glazing. Submit schedule with door and door frame locations identified with same numbers as shown on drawings.

SD-03 Product Data

Doors; G

Accessories

Sample warranty

Fire resistance rating; G

Regional Materials (LEED Credit MR 5); G

Product data indicating location of material manufacturer and distance from manufacturer to Project Site for regional materials materials that are extracted, harvested or recovered, and manufactured or processed within 500 miles by air of the Project Site. Indicate distance from point of extraction, harvest, recovery to Project Site for each raw or recycled material used in regionally manufactured materials included in this Section. Indicate material only cost for each regional material included in this Section. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

FSC Certified Wood (LEED Credit MR 7); G

Provide chain-of-custody documentation for all FSC Certified wood products. Indicate material only cost for each FSC Certified wood product, and each non-certified wood product, included in this Section. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-04 Samples

Doors

Prior to the fabrication of wood doors, submit a sample section of each type of door which shows the stile, rail, veneer, finish, and core construction.
Door finish colors; G
Submit a minimum of three color selection samples.

SD-06 Test Reports
Split resistance
Cycle-slam
Hinge loading resistance
Submit split resistance test report for doors tested in accordance with WDMA TM-5, cycle-slam test report for doors tested in accordance with WDMA TM-7, and hinge loading resistance test report for doors tested in accordance with WDMA TM-8.

SD-11 Closeout
All approved LEED Submittals specified under SD-03 Product Data; S

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 inches 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
Warranty shall warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

1.5 SUSTAINABLE DESIGN REQUIREMENTS
See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS
2.1 REGIONAL MATERIALS OF PRODUCTS
Raw or recycled materials in wood doors shall be extracted, harvested, or recovered and manufacturer or processed within 500 miles by air of the Project Site.

2.2 FSC CERTIFIED WOOD PRODUCTS
Wood materials used for products within this Section shall be FSC Certified products by the Forest Stewardship Council (FSC). Manufacturer and vendor shall be certified for chain-of-custody by a FSC-accredited certification body.
2.3   DOORS

Provide doors of the types, sizes, and designs indicated and specified.

2.3.1   Flush Doors

Flush doors shall conform to WDMA I.S. 1-A. Stile edge bands of doors to receive natural finish shall be hardwood, compatible with face veneer. Stile edge bands of doors to be painted shall be mill option specie. No visible finger joints will be accepted in stile edge bands. When used, locate finger-joints under hardware.

2.3.1.1   Interior Flush Doors

Provide either staved lumber or particleboard core, Type II flush doors conforming to WDMA I.S. 1-A with faces of premium grade white oak. Hardwood veneers shall be plain sliced book matched.

   a. Conventional particleboard complying with ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde resin.
   
   b. Straw-based particleboard complying with ANSI A208.1, Grade LD-2 or M-2, except for density.
   
   c. Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.

2.3.2   Composite-Type Fire Rated Doors

Doors specified or indicated to have a fire resistance rating shall conform to the requirements of UL 10B, ASTM E 152, or NFPA 252 for the class of door indicated. Affix a permanent metal label with raised or incised markings indicating testing agency's name and approved hourly fire rating to hinge edge of each door.

2.4   ACCESSORIES

2.4.1   Door Light Openings

Provide glazed openings with the manufacturer's standard wood moldings except that moldings for doors to receive natural finish shall be of the same specie and color as the face veneers. Moldings for flush doors shall be lip type. Provide glazed openings in fire-rated doors with fire rated frames. Glazing is specified in Section 08 81 00 GLAZING.

2.4.2   Additional Hardware Reinforcement

Provide fire rated doors with hardware reinforcement blocking. Size of lock blocks shall be as required to secure the hardware specified. Top, bottom and intermediate rail blocks shall measure 5 inches minimum by full core width. Reinforcement blocking shall be in compliance with the manufacturer's labeling requirements and shall not be mineral material similar to the core.

2.4.3   Door Louvers

Fabricate from wood and of sizes indicated. Louvers shall be of the manufacturer's standard design and shall transmit a minimum of 35 percent free air. Louvers shall be the slat type. Louver finish to match door.
2.5 FABRICATION

2.5.1 Marking

Each door shall bear a stamp, brand, or other identifying mark indicating quality and construction of the door.

2.5.2 Quality and Construction

Identify the standard on which the construction of the door was based.

2.5.3 Adhesives and Bonds

WDMA I.S. 1-A. Use Type II bond for interior doors. Adhesive for doors to receive a natural finish shall be nonstaining.

2.5.4 Prefitting

At the Contractor's option, doors may be provided factory pre-fit. Doors shall be sized and machined at the factory by the door manufacturer in accordance with the standards under which they are produced. The work shall include sizing, bevelling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules as required to coordinate the work.

2.5.5 Finishes

2.5.5.1 Factory Finish

Provide doors finished at the factory by the door manufacturer as follows: AWS Section 5, specification for System 11 and 12, catalyzed polyurethane. The coating shall be premium, medium rubbed sheen, closed grain effect. Use stain when required to produce the finish specified for color. Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

2.5.5.2 Color

Provide door finish colors as indicated on drawings.

2.6 SOURCE QUALITY CONTROL

Stiles of "B" and "C" label fire rated doors utilizing standard mortise leaf hinges shall meet the following performance criteria:

a. Split resistance: Average of ten test samples shall be not less than 500 pounds load when tested in accordance with WDMA TM-5.

b. Cycle-slam: 200,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with the requirements of WDMA TM-7.

c. Hinge loading resistance: Average of ten test samples shall be not less than 700 pounds load when tested for direct screw
withdrawal in accordance with WDMA TM-8 using a No. 12, 1 1/4 inch long, steel, fully threaded wood screw. Drill 5/32 inch pilot hole, use 1 1/2 inch opening around screw for bearing surface, and engage screw full, except for last 1/8 inch. Do not use a steel plate to reinforce screw area.

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 inches. Door warp shall not exceed 1/4 inch when measured in accordance with WDMA I.S. 1-A.

3.1.1   Fire Rated Doors

Install fire rated doors in accordance with NFPA 80. Do not paint over labels.

3.2   CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 08 31 13.00 50
ACCESS DOORS AND FRAMES
01/16

PART 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)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


NFPA 80 (2010; TIA 10-2) Standard for Fire Doors and Other Opening Protectives

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-P-664 (Rev D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant

UNDERWRITERS LABORATORIES (UL)

UL 10B (2008; Reprint Apr 2009) Fire Tests of Door Assemblies


THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Access door, non-fire rated; G
Access door, fire rated; G

Provide schedule of sizes, types and locations of access doors required. Provide installation drawing details and rough opening sizes required in wall and ceiling framing.

SD-03 Product Data

Access door, non-fire rated; G
Access door, fire rated; G

Identify each model number in product data on schedule furnished with shop drawings.

1.3 QUALITY ASSURANCE

1.3.1 Fire-Rated Access Doors and Frames

Units complying with NFPA 80 and that are labeled and listed by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction per test method indicated.

a. Vertical Access Doors: NFPA 252 or UL 10B.

b. Horizontal Access Doors and Frames: ASTM E 119 or UL 263.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Plates, Shapes, and Bars

ASTM A 36/A 36M.

2.1.1.1 Hot-Dip Galvanized Steel

Coat to comply with ASTM A 123/A 123M for steel and iron products and ASTM A 153/A 153M for steel and iron hardware.

2.1.2 Drywall Beads

Edge trim formed from 0.03 inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum panels indicated.
2.1.3 Paint

2.1.3.1 Shop Primer for Ferrous Metal

Fast curing, lead- and chromate-free, universal modified alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide sound foundation for field-applied topcoats despite prolonged exposure.

2.1.3.2 Shop Primer for Metallic-Coated Steel

Organic zinc-rich primer complying with SSPC Paint 20 and compatible with topcoat.

2.2 ACCESS DOOR, NON-FIRE RATED

Premanufactured flush type access doors for non-fire rated walls and ceilings.

2.2.1 Drywall Access Door

Provide flush type access door designed for installation in gypsum board walls and ceilings.

a. Frame: 0.06 in. steel metallic-coated steel with prepunched holes to facilitate fastening flange to framing member. Frame trim shall be galvanized steel drywall bead.

b. Door: 0.075 in. steel metallic-coated steel with stiffened edges and reinforcing angles on inside face to prevent warping, except provide 0.0625 in. stainless steel exposed surfaces at doors located in ceramic tile wall finishes.

2.2.2 Door Size

Provide opening size as indicated or, if not indicated, provide opening size sufficient for comfortable access to the component requiring access. Minimum size for hand/arm access shall be 16 in. x 16 in.; minimum size for body access shall be 24 in. x 48 in.

2.2.3 Finish

Manufacturers standard prime coat of rust inhibitive baked-on white enamel.

2.2.4 Hardware

a. Hinges: Concealed continuous piano hinge.

b. Latch: Flush, screwdriver operated stainless steel cam latch. Provide one latch for each 14 in. of door height.

c. Fasteners: Sheet metal screws for metal studs; wood screws for wood blocking.

2.3 ACCESS DOOR, FIRE RATED

Premanufactured flush type fire-rated access doors for fire rated walls and ceilings. Provide fire rating as required by the wall or ceiling...
rating.

2.3.1 Non-Insulated Fire Rated Access Door

Provide flush type non-insulated, fire-rated access door designed for installation in gypsum board walls and ceilings.

   a. Frame: 0.06 in. steel metallic-coated steel with anchor straps and prepunched holes to facilitate fastening flange to framing member. Frame trim shall be minimum one inch wide galvanized steel drywall bead.

   b. Door: 0.06 in. steel metallic-coated steel with stiffened edges and reinforcing angles on inside face to prevent warping.

2.3.2 Door Size

Provide opening size as indicated or, if not indicated, provide opening size sufficient for comfortable access to the component requiring access. Minimum size for hand/arm access shall be 16 in. x 16 in.; minimum size for body access shall be 24 in. x 48 in.

2.3.3 Finish

Manufacturers standard prime coat of rust inhibitive baked-on white enamel, except stainless steel access doors in ceramic tile finishes shall be directional satin polish.

2.3.4 Hardware


   b. Latch: Self-latching with automatic spring closer, allowing opening of door to 175 deg. Provide bolt type latch with ring turn. Provide one latch for each of door height.

   c. Fasteners: Sheet metal screws for metal studs; wood screws for wood blocking.

2.4 FABRICATION AND WORKMANSHIP

Finished access 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.

PART 3 EXECUTION

3.1 INSTALLATION

Contractor shall provide access doors where indicated or, if not indicated, directly below or adjacent to each operable component concealed within walls and ceilings including, but not limited to, valves, flow indicators, dampers, air splitters, and equipment requiring access for repair and maintenance.
a. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
b. Install access doors flush with adjacent finish surfaces.
c. Provide type door required by wall type. Provide fire rated access doors in fire rated walls and ceilings.

3.2 ADJUSTMENT

Adjust doors and hardware after installation for proper operation.

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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)


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

16 CFR 1201   Safety Standard for Architectural Glazing Materials

1.2   SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Aluminum sliding glass panels; G
Frameless sliding glass panel; G

Submit drawings for aluminum sliding glass doors and accessories that indicate elevations of each door type, full size sections, thickness, nominal gages of metal, fastenings, proposed method of installation and anchoring, the size and spacing and method of glazing, details of operating hardware, method and material for weatherstripping, type of finish, and screen details.

SD-03 Product Data

Aluminum sliding glass panels; G
Frameless sliding glass panel; G

Describe each type of aluminum sliding glass panels, hardware, fastener, accessory, and finish. Include descriptive literature, detailed specifications, and performance test data.
SD-04 Samples

Finish; G,

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

SD-10 Operation and Maintenance Data

Aluminum sliding glass panels, Data Package 1; G
Frameless sliding glass panel; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 TEMPORARY PROTECTIVE COVERING

Prior to shipment from the factory, finished surfaces of aluminum sliding systems shall receive a protective covering of waterproof tape, strippable plastic, or cardboard to protect against discoloration and surface damage that may occur during transportation, storage, and construction activities. Also, no coatings or lacquers shall be applied to surfaces to which calking and glazing compounds must adhere. Covering shall be readily removable after installation.

1.4 DELIVERY AND STORAGE

Inspect aluminum sliding systems, hardware and accessories, for damage and unload and store doors upright on platforms in accessible spaces with a minimum of handling. The storage spaces shall be dry, adequately ventilated, free from heavy dust and not subject to combustion products, sources of water or other conditions that could damage the door. Storage spaces shall have easy access for inspection and handling of doors.

PART 2 PRODUCTS

2.1 ALUMINUM SLIDING GLASS PANELS

Design and construct with sliding panels in the sizes and arrangements indicated. Glazing shall be set in aluminum frames and roller assemblies of sufficient strength to withstand lateral live stresses and static load or weight requirements. Factory glazing is not required; refer to paragraph GLAZING.

2.1.1 Frames and Panels

Panel frames shall be extruded aluminum having profile standard to the manufacturer. System shall include head tracks supported from overhead framing or structure, stacking bays, side jambs, sliding panels, and sliding panels with incorporated swing panels. Panels shall be a single lite configuration with either bottom rail kickplate for the height indicated.

2.1.1.1 Aluminum

a. ASTM B 209 for sheet plate; alloy and temper as appropriate for
applications.

b. ASTM B 221 for extrusions; alloy and temper as appropriate for applications.

2.1.2 Locking Hardware and Handles

2.1.2.1 Main Entry Panel

Assemblies with swing panel, provide manufacturer's standard lever handles on the inside and outside and a mortised lock having a lockable latch and multi-point locking with a dead bolt and concealed rods to the top and bottom. Lock shall be capable of utilizing cylinders specified in Section 08 71 00 DOOR HARDWARE.

a. Lock Operation: Depression of handles shall withdraw the latch. Lifting of handles shall engage the rods and turn of key or thumb turn shall engage deadbolt and operate lock. If there are inactive swing panels, provide matching dummy lever handles on both sides and concealed flush bolts that operates the rods at the top and the bottom.

2.1.2.2 Secondary Panels

Manufacturer's standard flat handles and concealed two point locking hardware operated by 180 degree turn of handle. Face applied flush bolt locking is not acceptable.

2.1.2.3 Swing Panel

Provide crank handle stored in flap on panel stile to convert sliding panel to a swing panel and vice versa. Conversion Box shall be located on an upper arm of the top rail. Box cover shall blend with frame finish.

a. Lock Operation: If swing door to frame fixing hardware for operation of the incorporated door is above 7 feet utilize an integrated pole for single person operation; operation shall not require additional means to reach the fixing/locking mechanism other than the provided pole.

2.1.2.4 Handle Height

Centered at 41-3/8 inch above bottom of panel.

2.1.3 Suspension System

Provide a suspension system consisting of steel track connected to the structural support by threaded rods, and trolleys designed to support the weight of the partition. Provide 2 trolleys per panel with 2 ball bearing polymer or steel tired wheels.

2.1.4 Glazing

Field glaze sliding glass doors, including fixed panel, with glass type specified in Section 08 81 00 GLAZING. Glazing material must be certified as meeting CPSC 16 CFR 1201, Category II. Set glazing unit in polyvinyl-chloride or synthetic rubber glazing channels. Channels shall be reusable when replacing glass and have mitered or continuous corners. Channels exposed to view shall blend in color with the aluminum frame.
2.1.5 Finish

Before fabrication, clean sliding panel units and give a AA-M-10-C22-A31 clear anodized finish.

2.2 FRAMELESS SLIDING GLASS PANEL

Design and construct frameless sliding and fixed glass panels in the sizes and arrangements indicated.

2.2.1 Overhead Track

Manually operated, synchronized movement of two bi-parting glass panels at a corner by a single top track. Opening and closing shall not exceed 5 lbs of force, for compliance with ADA requirements.

2.2.1.1 Carriers

Top hung clamp-on roller type, having two FA Ball Bearing type wheels. Carrier shall engage glass panel by clamp-on pressure and not require glass drilling. Provide not less than two carriers per operable panel.

2.2.2 Hardware

Provide the following for each opening

a. Pressure clamps with rollers; quantity of 4.
b. Stoppers-brakes.
c. Guides, nominal 2 inch wide; quantity of 2.
d. Bottom extrusion for fixed glass panels.
e. Pulls for operating panels that do not require glass drilling and acceptable to the

2.2.3 Glass

Clear, tempered glass, 10 mm nominal 3/8 inch thick specified in Section 08 81 00 GLAZING. Exposed edges shall be flat polished.

2.3 CAULKING AND SEALING

As specified under Section 07 92 00 JOINT SEALANTS.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Doors, Frames, and Accessories

Install system components and accessories in accordance with approved shop drawings and the manufacturer's requirements. Set frames and supporting components securely anchored in place to straight, plumb, square, level condition without distortion and in alignment. Install panels to retain proper contact with opening. Calk metal-to-metal joints between frame
members and remove excess material. Finished work shall be rigid, neat in appearance, and free from defects. Upon completion, adjust sliding panels to operate properly. Thoroughly clean aluminum frames and glass in accordance with manufacturer's recommendation. Panels damaged prior to completion and acceptance shall be restored to original manufactured condition or replaced with new panels as directed.

3.1.1.1 Preparation Work

Verify dimensions and condition of openings scheduled to receive folding panel partitions. Provide structural support for the head track elements as indicated.

3.1.2 Protection of Aluminum from Dissimilar Materials

3.1.2.1 Aluminum to Dissimilar Metals

Prevent aluminum surfaces from contacting dissimilar metals other than stainless steel, zinc, or white bronze by one or a combination of the following:

a. Paint dissimilar metal with one coat of heavy-bodied bituminous paint.

b. Apply calking between aluminum and dissimilar metal.

c. Paint dissimilar metal with primer, followed by one coat of aluminum paint or other suitable lead-free coating.

d. Use nonabsorptive tape or gasket in permanently dry locations.

3.1.2.2 Drainage from Dissimilar Metals

Paint dissimilar metals located in areas where their drainage washes over aluminum to prevent the staining of aluminum.

3.1.2.3 Aluminum to Masonry and Concrete

Prevent aluminum surfaces from coming into contact with mortar, concrete, or other masonry materials by applying one coat of heavy-bodied bituminous paint to the aluminum surfaces.

3.1.2.4 Aluminum to Wood

Prevent aluminum surfaces from coming into contact with wood, treated wood, or similarly absorptive materials by one or a combination of the following methods:

a. Paint aluminum surfaces with two coats of aluminum paint or one coat of heavy-bodied bituminous paint.

b. Paint the wood, treated wood, or other absorptive surfaces with two coats of aluminum paint and seal contiguous joints with calking compound.

3.2 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.
PART 1   GENERAL

1.1   REFERENCES

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)


ASTM INTERNATIONAL (ASTM)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (2010; TIA 10-2) Standard for Fire Doors and Other Opening Protectives

1.2   SUBMITTALS

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

SD-02 Shop Drawings

Approved Detail Drawings; G

Drawings showing elevations of each door type, details of anchorage, details of construction, location and description of hardware, shape and thickness of materials, details of joints and connections, and details of guides and fittings. A schedule showing the location of each counter door shall be included with the drawings.

SD-03 Product Data

Rolling Counter Doors; G
Manufacturer's descriptive data and catalog cuts. For electrically operated system, submit wiring diagrams for motor and controls.

Installation; G

Cleaning

Manufacturer's preprinted installation and cleaning instructions.

SD-08 Manufacturer's Instructions

Rolling Counter Doors

Submit manufacturer's currently recommended installation procedures for doors with the shop drawings.

SD-10 Operation and Maintenance Data

Rolling Counter Doors, Data Package 2; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Include wiring diagrams, complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed.

1.3 GENERAL REQUIREMENTS

Rolling counter doors shall be of the type, size, and design indicated on the drawings, and shall be the standard product of a manufacturer regularly engaged in the production of rolling counter doors. Door shall be provided with a permanent label showing the manufacturer's name and address and the model number of the door.

1.4 DELIVERY AND STORAGE

Rolling counter door shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Rolling counter door shall be stored in accordance with the manufacturer's instructions in a dry location that is adequately ventilated and free from dust, water, or other contaminants, and in a manner that permits easy access for inspecting and handling. Door shall be handled carefully to prevent damage. Damaged items that cannot be restored to like-new condition shall be replaced.

PART 2 PRODUCTS

2.1 BASIC COMPONENTS

2.1.1 Curtain

The curtain shall be fabricated of extruded aluminum slats conforming to ASTM B 221, Alloy 6063; fire rated shall be fabricated of 22 gauge Type 304 stainless steel slats conforming to ASTM A 240/A 240M. Thickness of slat material shall be as required by width of opening. Slats shall be approximately 1-1/4 to 1-1/2 inch wide with a depth of crown of 1/2 inch.
Alternate slats shall be fitted with end locks to maintain curtain alignment. Bottom of curtain shall be provided with angle or tubular bar reinforcement matching the curtain, and fitted with a resilient bottom seal.

2.1.2 Jamb Guides

Guides shall be of 1/8 inch minimum thickness extruded aluminum conforming to ASTM B 221, Alloy 6063; fire rated shall be of 13 gauge minimum thickness stainless steel conforming to ASTM A 240/A 240M, Type 304. Guides shall be fitted with neoprene silencers or replaceable heavy nap striping to eliminate noise and dust infiltration.

2.1.3 Counterbalance Shaft Assembly

The curtain shall be coiled around a steel tube of sufficient thickness and diameter to prevent deflection exceeding 0.03 inch per foot. The barrel shall contain oil tempered helical steel torsion springs capable of sufficient torque to counterbalance the weight of the curtain. Springs shall be calculated to provide a minimum of 7,500 operating cycles (one complete cycle of door operation will begin with the door in the closed position, move to the full open position and return to the closed position).

2.1.4 Brackets

Brackets shall be a minimum 12 gauge thickness steel if flat plate, or 16 gauge thickness if there are a minimum of 3 returns of 3/4 inch width.

2.1.5 Hood

The hood shall be of 0.040 inch minimum thickness aluminum sheet conforming to ASTM B 209, Alloy 5005; fire rated shall be 24 gauge stainless steel conforming to ASTM A 240/A 240M, Type 304.

2.1.6 Locks

The curtain shall be locked at both sides of bottom bar by a chrome-plated cylinder lock keyed into the building keying system. Lock shall be on the office side of the counter door.

2.2 INTEGRAL FRAME ROLLING COUNTER DOOR (NON-RATED)

Rolling counter door shall conform to the requirements specified herein and shall be constructed of specified aluminum curtains, guides and hood components. Provide where indicated.

2.3 INTEGRAL FRAME FIRE-RATED ROLLING COUNTER DOOR

Fire-rated rolling counter door shall conform to the requirements specified herein and shall be constructed of specified stainless steel curtains, guides and hood components. Fire rated rolling counter door shall conform to the requirements specified and to NFPA 80 for the class indicated. Door shall bear the labels of a recognized testing agency indicating the applicable fire resistance rating. The construction details necessary for labeled rolling counter door shall take precedence over details indicated or specified herein. Fire-rated rolling counter door shall be complete with hardware, accessories, and automatic closing device. Rolling counter door in exit corridor walls shall be provided.
with perimeter smoke and draft control gasketing.

2.4 OPERATION

2.4.1 Power Operation

A high-starting torque, reversible type motor of sufficient power and torque output to move the door in either direction from any position at the required speed shall be furnished. Power operator shall have an emergency push-up operation, limit switch, three-button type control marked "OPEN", "CLOSE", and "STOP". Control voltage shall be 120 vac. Conduit and wiring necessary for proper operation shall be provided in accordance with Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS.

2.5 AUTOMATIC CLOSING DEVICE

Fire-rated and smoke-rated counter door shall be equipped with an automatic closing device which shall operate upon activation of the building's fire alarm system or smoke alarm system. Automated closing device shall provide controlled descent of the fire and smoke door. Fire and smoke door shall be easily reset by the facility user after they have been released by the detection system. Resetting the door shall not require the use of special tools.

2.6 FINISH

2.6.1 Appearance of Finished Work

Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.6.2 Aluminum

Clear anodic finish; AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.6.3 Stainless Steel

No. 4 brushed finish.

PART 3 EXECUTION

3.1 INSTALLATION

Door shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, door shall be free from warp, twist, or distortion. Door shall be lubricated, properly adjusted, and demonstrated to operate freely. Fire-door installation shall be in conformance with NFPA 80 for the class indicated and the manufacturer's instructions.

3.2 CLEANING

Aluminum and stainless steel door shall be cleaned in accordance with manufacturer's approved instructions.
3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of 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 SOCIETY OF CIVIL ENGINEERS (ASCE)

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

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


ASME INTERNATIONAL (ASME)

ASME B29.400 (2001; R 2008) Combination, "H" Type Mill Chains, and Sprockets

ASTM INTERNATIONAL (ASTM)


ASTM A 307 (2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength


ASTM A 653/A 653M (2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A 924/A 924M</td>
<td>(2009a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process</td>
</tr>
<tr>
<td>ASTM D 2244</td>
<td>(2009b) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates</td>
</tr>
</tbody>
</table>

**INTERNATIONAL CODE COUNCIL (ICC)**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
</table>

**NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEMA ICS 2</td>
<td>(2000; Errata 2006; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V</td>
</tr>
<tr>
<td>NEMA ICS 6</td>
<td>(1993; R 2011) Enclosures</td>
</tr>
<tr>
<td>NEMA MG 1</td>
<td>(2011) Motors and Generators</td>
</tr>
<tr>
<td>NEMA ST 1</td>
<td>(1988; R 1997) Standard for Specialty Transformers (Except General Purpose Type)</td>
</tr>
</tbody>
</table>

**NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA 70</td>
<td>(2011; Errata 2 2012) National Electrical Code</td>
</tr>
<tr>
<td>NFPA 80</td>
<td>(2010; Am 10-1) Standard for Fire Doors and Other Opening Protective</td>
</tr>
</tbody>
</table>

**UNDERWRITERS LABORATORIES (UL)**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
</table>
1.2 DESCRIPTION

Overhead coiling doors to be counterbalanced doors by methods of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed or self-lubricating bearings for rotating members. Doors to be coiling type, with interlocking slats, complete with anchoring and door hardware, guides, hood, and operating mechanisms, and designed for use on openings as indicated.

Fire-rated door assemblies must bear the Underwriters Laboratories, Warnock Hersey, Factory Mutual or other nationally recognized testing laboratory. Provide a permanent label for each door showing the manufacturer's name and address and the model/serial number of the door.

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Wind Load Requirements

Design and fabricate exterior door assemblies provided to resist wind load criteria indicated on Structural drawings in accordance with the ICC IBC and ASCE 7 requirements for Components and Cladding.

1.3.1.1 Interior Door Assemblies

Wind load requirements are not applicable to interior door assemblies.

1.3.2 Fire-Rated Doors, Frames, and Hardware

Provide fire-rated doors, frames, and hardware which are tested, rated, and labeled in accordance with Underwriters Laboratories, Factory Mutual or Warnock Hersey. The labels must indicate the rating in hours, per NFPA 80 of duration of exposure to fire, with a letter following the hourly rating to designate the location for which the assembly is designed and the temperature rise on the unexposed face of the door at the end of 30 minutes of fire exposure.

Provide and attach metal UL labels to each item of hardware in accordance with requirements specified in the UL Bld Mat Dir.

1.3.3 Operational Cycle Life

All portions of the door, hardware and operating mechanism that are subject to movement, wear, or stress fatigue must be designed to operate through a minimum number of 10 cycles per hour. One complete cycle of door operation is defined as when the door is in the closed position, moves to the fully open position, and returns to the closed position.

1.4 SUBMITTALS

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

SD-02 Shop Drawings

Provide fabrication drawings that show complete assembly with
hardware and framing details for the following items:

Overhead Coiling Doors; G
Counterbalancing Mechanism
Electric Door Operators; G
Bottom Bar
Guides
Mounting Brackets
Overhead Drum
Hood

Submit Installation Drawings in accordance with paragraph entitled, "Overhead Coiling Door Assemblies," of this Section.

SD-03 Product Data

Submit manufacturer's catalog data for the following items listing all accessories including supports, locks and latches, and weather stripping.

Overhead Coiling Doors; G
Hardware
Counterbalancing Mechanism
Electric Door Operators; G
Fire-Rated Door Assembly

SD-05 Design Data

Performance Requirements Validation; G

For products and systems indicated to validate compliance with specified wind load performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

SD-07 Certificates

Submit written certificate, signed and sealed by a qualified Professional Engineer, certifying that design and anchorage of overhead coiling doors complies with specified performance requirements.

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for Overhead Coiling Door Assemblies, including the following items:
Materials

Devices

1.5 WARRANTIES

1.5.1 Special Warranty

Manufacturer's standard form in which manufacturer agrees to repair or replace components of overhead coiling doors that fail in materials or workmanship within specified warranty period.

a. Failures include, but are not limited to, the following:

   1. Structural failures including rupturing, cracking, or puncturing.
   2. Deterioration of metals and other materials beyond normal weathering.

b. Warranty Period: Two years from date of final acceptance of the Work.

1.5.2 Special Warranty on Finishes

Manufacturer's standard form in which manufacturer agrees to repair finish or replace components of trellis framing system that show evidence of deterioration of factory-applied finishes within specified warranty period.

a. Exposed Finish: Deterioration includes, but is not limited to, the following:

   1. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   2. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   3. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

b. Finish Warranty Period: 20 years from date of final acceptance of the Work.

1.6 DELIVERY AND STORAGE

Delivered doors to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Store doors in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

PART 2 PRODUCTS

2.1 OVERHEAD COILING DOORS

2.1.1 Curtain Materials and Construction

Provide curtain slats which are fabricated from steel sheets conforming to ASTM A 653/A 653M, Grade A, with the additional requirement of a minimum yield point of 33,000 psi. Provide sheets which are galvanized in accordance with ASTM A 653/A 653M and ASTM A 924/A 924M.
Fabricate doors from interlocking cold-rolled slats, with section profiles as specified, designed to withstand the specified wind loading. Provide slats which are continuous without splices for the width of the door.

2.1.2 Insulated Curtains

Form Curtains from manufacturer's standard shapes of interlocking slats. Supply slat system with a minimum R-value of 4 when calculated in accordance with ASHRAE FUN IP. Slats to consist of a urethane or polystyrene core not less than 11/16 inch thick, completely enclosed within metal facings. Exterior face of slats must be the same gauge as specified for curtains. Interior face must be not lighter than 0.0219 inches. The insulated slat assembly is to have a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E 84.

2.1.3 Curtain Bottom Bar

Curtain bottom bars must be pairs of angles from the manufacturer's standard steel, stainless and aluminum extrusions not less than 2.0 by 2.0 inches by 0.188 inch. Steel extrusions must conform to ASTM A 36/A 36M. Stainless steel extrusions conforming to ASTM A 666, Type 304. Aluminum extrusions conforming to ASTM B 221 or (ASTM B 221M). Galvanize angles and fasteners in accordance with ASTM A 653/A 653M and ASTM A 924/A 924M. Coat welds and abrasions with paint conforming to ASTM A 780/A 780M.

2.1.4 Locks

Provide end and/or wind locks of cast steel conforming to ASTM A 27/A 27M, Grade B; galvanized in accordance with ASTM A 653/A 653M, ASTM A 153/A 153M and ASTM A 924/A 924M and secured at every other curtain slat.

2.1.5 Weather Stripping

Weather-stripping at the door-head and jamb must be 1/8-inch thick sheet of natural or neoprene rubber with air baffles, secured to the insides of hoods with galvanized-steel fasteners through continuous galvanized-steel pressure bars at least 5/8-inch wide and 1/8-inch thick.

Threshold weather-stripping must be 1/8-inch thick sheet natural or neoprene rubber secured to the bottom bars.

Provide weather-stripping of natural or neoprene rubber conforming to ASTM D 2000.

2.1.6 Locking Devices

Locking Device Assembly which includes cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

2.1.7 Safety Interlock

Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.
2.1.8 Overhead Drum

Fabricate drums from nominal 0.028-inch thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.

2.2 HARDWARE

All hardware must conform to ASTM A 153/A 153M, ASTM A 307, ASTM F 568M, and ASTM A 27/A 27M.

2.2.1 Guides

Fabricate curtain jamb guides from the manufacturer's standard angles or channels of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for track adjustment.

2.2.1.1 Exterior Doors

Galvanized after fabrication in accordance with ASTM A 653/A 653M and ASTM A 924/A 924M.

2.2.2 Equipment Supports

Fabricate door-operating equipment supports from the manufacturer's standard steel shapes and plates conforming to ASTM A 36/A 36M, galvanized in accordance with ASTM A 653/A 653M and ASTM A 924/A 924M. Size the shapes and plates in accordance with the industry standards for the size, weight, and type of door installation.

2.3 COUNTERBALANCING MECHANISM

Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed or self-lubricating bearings for rotating members.

2.3.1 Brackets

Provide the manufacturer's standard mounting brackets of either cast iron or cold-rolled steel with one located at each end of the counterbalance barrel conforming to ASTM A 48/A 48M.

2.3.2 Counterbalance Barrels

Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, conforming to ASTM A 53/A 53M, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 inch per foot of span under full load.

2.4 ELECTRIC DOOR OPERATORS

Provide electrical wiring and door operating controls conforming to the applicable requirements of NFPA 70.

Electric door-operator assemblies must be the sizes and capacities
recommended and provided by the door manufacturer for specified doors. Assemblies must be complete with electric motors and factory-prewired motor controls, starter, gear reduction units, solenoid-operated brakes, clutch, remote-control stations, manual or automatic control devices, and accessories as required for proper operation of the doors.

Design the operators so that motors may be removed without disturbing the limit-switch adjustment and affecting the emergency auxiliary operators.

Provide a manual operator of crank-gear or chain-gear mechanisms with a release clutch to permit manual operation of doors in case of power failure. Arrange the emergency manual operator so that it may be put into and out of operation from floor level, and its use will not affect the adjustment of the limit switches. Provide an electrical or mechanical device which will automatically disconnect the motor from the operating mechanism when the emergency manual operating mechanism is engaged.

2.4.1 Door-Operator Types

Provide an operator which is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.

2.4.2 Electric Motors

Provide motors which are the high-starting-torque, reversible, constant-duty electrical type with overload protection of sufficient torque and horsepower to move the door in either direction from any position and produce a door-travel speed of not less than 8 nor more than 12 inches per second without exceeding the horsepower rating.

Provide motors which conform to NEMA MG 1 designation, temperature rating, service factor, enclosure type, and efficiency to the requirements specified.

2.4.2.1 Electrical Characteristics

Exterior doors such as Loading docks shall be 480 volt, 3 phase. Interior doors shall be 208 volt, 3 phase.

2.4.3 Motor Bearings

Bearings must be bronze-sleeve or heavy-duty ball or roller antifriction type with full provisions for the type of thrust imposed by the specific duty load.

Pre-lubricate and factory seal bearings in motors less than 1/2 horsepower.

Equip motors coupled to worm-gear reduction units with either ball or roller bearings.

Equip bearings in motors 1/2 horsepower or larger with lubrication service fittings. Fit lubrication fittings with color-coded plastic or metal dust caps.

In any motor, bearings that are lubricated at the factory for extended duty periods do not need to be lubricated for a given number of operating hours. Display this information on an appropriate tag or label on the
motor with instructions for lubrication cycle maintenance.

2.4.4 Motor Starters, Controls, and Enclosures

Each door motor must have a factory-wired, unfused, disconnect switch; a reversing, across-the-line magnetic starter with thermal overload protection; operating coils with a control transformer limit switch; and a safety interlock assembled in a NEMA ICS 6 type enclosure as specified herein. Control equipment must conform to NEMA ICS 2.

Provide adjustable switches, electrically interlocked with the motor controls and set to stop the door automatically at the fully open and fully closed position.

2.4.5 Control Enclosures

Provide control enclosures that conform to NEMA ICS 6 for general purpose NEMA Type 1.

2.4.6 Transformer

Provide starters with 208/460 to 115 volt control transformers with one secondary fuse when it is required to reduce the voltage on control circuits to 120 volts or less. Provide transformer that conforms to NEMA ST 1.

2.4.7 Safety-Edge Device

Provide each door with a safety device extending the full width of the door and located within a U-section neoprene or rubber astragal mounted on the bottom rail of the bottom door section. Device must immediately stop and reverse the door upon contact with an obstruction in the door opening during downward travel and cause the door to return to full-open position. Safety device is not a substitute for a limit switch.

Connect safety device to the control circuit through a retracting safety cord and reel.

2.4.8 Remote-Control Stations

Provide interior remote control stations which are full-guarded, momentary-contact three-button, heavy-duty, surface-mounted NEMA ICS 6 type enclosures as specified. Mark buttons "OPEN," "CLOSE," and "STOP." The "CLOSE" button must be the type requiring a constant pressure to maintain the closing motion of the door. When the door is in motion and the "STOP" button is pressed, the door must stop instantly and remain in the stopped position; from the stopped position, the door may then be operated in either direction.

2.4.8.1 Key Switch

Where interior doors used to secure areas, provide key operated switches in lieu of push buttons. Key shall comply with building key system requirements specified in Section 08 71 00 DOOR HARDWARE.

2.4.9 Speed-Reduction Units

Provide speed-reduction units consisting of hardened-steel worm and bronze worm gear assemblies running in oil or grease and encased in a
sealed casing, coupled to the motor through a flexible coupling. Drive shafts must rotate on ball- or roller-bearing assemblies that are integral with the unit.

Provide minimum ratings of speed reduction units which are in accordance with AGMA provisions for class of service.

Ground worm gears to provide accurate thread form; machine teeth for all other types of gearing. Surface harden all gears.

Provide bearings which are the antifriction type equipped with oil seals.

2.4.10 Chain Drives

Provide roller chains that are power-transmission series steel roller type conforming to ASME B29.400, with a minimum safety factor of 10 times the design load.

Roller-chain side bars, rollers, pins, and bushings must be heat-treated or otherwise hardened.

Provide chain sprockets that are high-carbon steel with machine-cut hardened teeth, finished bore and keyseat, and hollow-head setscrews.

2.4.11 Brakes

Provide brakes which are 360-degree shoe brakes or shoe and drum brakes, solenoid-operated and electrically interlocked to the control circuit to set automatically when power is interrupted.

2.4.12 Clutches

Clutches must be the 4-inch diameter, multiple face, externally adjustable friction type or adjustable centrifugal type.

2.5 FIRE-RATED DOOR ASSEMBLY

Provide fire-rated door assemblies with the dimensions, fire rating, and operating type indicated with electric operators and assemblies that do not interfere with manufacturer's standard interconnecting fusible links.

2.5.1 Fire Ratings

Provide fire-rated door assemblies complying with NFPA 80 Standard for Fire Doors and Other Opening Protectives and UL Fire Resistance - Volume 3.

2.5.1.1 Smoke/Fire Seals; Interior Doors

Hood shall have automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

Equip each fire-rated door with smoke-seal perimeter gaskets for smoke and draft control as required for door listing and labeling by a qualified testing agency.

2.5.1.2 Automatic Closing

Device shall be easy to test and reset release mechanism with activation by the building fire-detection or smoke detection systems and
manufacturer's standard door-holder-release devices.

2.6 SURFACE FINISHING

Noticeable variations in the same metal component are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

2.6.1 Steel And Galvanized-Steel Finishes

Baked-enamel or powder-coat finish as standard with the manufacturer for a baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness. Colors shall be as indicated on drawings.

PART 3 EXECUTION

3.1 GENERAL

Install overhead coiling door assembly, anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories in accordance with approved detail drawings and manufacturer's written instructions. Upon completion of installation, doors must be free from all distortion.

Install overhead coiling doors, motors, hoods, and operators at the mounting locations as indicated for each door in the contract documents and as required by the manufacturer.

Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility and as required by the manufacturer.

3.2 FIELD PAINTED FINISH

Steel doors and frames which are to be field painted must accordance with Section 09 90 00 PAINTS AND COATINGS and manufacturer's written instructions. Protect weather stripping from paint. Finishes must be free of scratches or other blemishes.

3.3 ACCEPTANCE PROVISIONS

After installation, adjust hardware and moving parts. Lubricate bearings and sliding parts as recommended by manufacturer to provide smooth operating functions for ease movement, free of warping, twisting, or distortion of the door assembly.

Adjust seals to provide weather-tight fit around entire perimeter.

Engage a factory-authorized service representative to perform startup service and checks according to manufacturer's written instructions.

Test the door opening and closing operation when activated by controls or alarm-connected fire-release system. Adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Reset door-closing mechanism after successful test.

Test and make final adjustment of new doors at no additional cost to the
Government.

3.3.1 Maintenance and Adjustment

Not more than 90 calendar days after completion and acceptance of the project, the Contractor must examine, lubricate, test, and re-adjust doors as required for proper operation.

3.4 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   REFERENCES

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

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS AA-D-600 (Rev D, Am 1; Am 4) Door, Vault, Security

1.2   SYSTEM DESCRIPTION

The vault door unit shall be a steel security-vault type door with frame, day gate, and ramp type threshold, which is a standard product of a manufacturer specializing in this type of fabrication.

1.3   SUBMITTALS

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

SD-02 Shop Drawings

Vault door Unit; G
Day gate; G

Drawings showing head, jamb, and sill sections, and elevations of the doors and gate.

SD-03 Product Data

Vault Door and Frame; G

Manufacturer's catalog data including catalog cuts and brochures showing that the proposed vault door unit conforms with the requirements in FS AA-D-600, and has been tested and approved by the General Services Administration (GSA).

SD-07 Certificates

Vault Door and Frame; G

Certification stating that vault-door units that do not bear the GSA label are constructed to Class 5 standards.

SD-08 Manufacturer's Instructions

Installation
Printed instructions and drawings provided by the manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver door and frame assemblies to the jobsite in a protective covering with the brand and name clearly marked thereon. Inspect materials delivered to the jobsite for damage, and unload them with a minimum of handling. Store in a dry location with adequate ventilation, free from dust, water, and other contaminants, and allowing easy access for inspection and handling. Store door assemblies off the floor on nonabsorptive strips or wood platforms. Prevent damage to doors and frames during handling. Replace damaged items that cannot be restored to like-new condition.

PART 2 PRODUCTS

2.1 VAULT DOOR AND FRAME

Design and construction of the door and frame assembly shall conform to FS AA-D-600. Provide a door which is Class 5, Type IIR - right opening swing without optical device, Style K - key change combination lock, Design S - single lock.

2.2 DAY GATE

Provide a day gate which is the manufacturer's standard product designed for use with the vault door furnished, and that provides access control and visual security. The gate shall: be hinged on the same side as the vault door, swing into the vault, and have a locking device operable from outside by key and from inside by knob or handle. Provide the manufacturer's standard finish. The day gate shall not interfere with the operation of vault door inner escape device.

PART 3 EXECUTION

3.1 INSTALLATION

Install the vault door assembly in strict compliance with the printed instructions and drawings provided by the manufacturer. Install the day gate in a manner that does not interfere with operation of the release handle on the inside of the vault door. After installation, adjust the door, the locking mechanism, and the inner escape device for proper operation.

3.2 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   REFERENCES

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.2 (2009) Methods of Test for Exterior Walls


AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

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

ASTM INTERNATIONAL (ASTM)


ASTM E 331 (2000; R 2009) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

INTERNATIONAL CODE COUNCIL (ICC)


U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01 (2012) DoD Minimum Antiterrorism Standards for Buildings
1.2 PERFORMANCE REQUIREMENTS

Provide exterior entrance door assemblies capable of withstanding structural loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.

1.2.1 Structural

Exterior glazed door and frame assemblies shall be designed as a system with minimum properties and to resist minimum load requirements as indicated below meeting UFC 4-010-01, Standard 10 requirements. Design of the glazed assembly shall include associated hardware, connections of the hardware, anchorage components and supporting structural connections.

1.2.1.1 Frames

In accordance with ASTM F2248, ensure that the framing members restrict deflections to L/60 of the length of the supported edge at allowable stress levels under the equivalent 3-second design loading of 136 pounds per square foot.

Use ASTM F2248 for glazing bite requirements for structurally or non-structurally glazed exterior door and frame assemblies.

1.2.1.2 Connections

The design of connections of exterior glazed door and frame assemblies to surrounding walls, of hardware and associated connections, of glazing stop connections, and of other elements in shear will be based on allowable stress levels. The connection design will be determined in accordance with ASTM F2248 based on two times the equivalent 3-second design loading of 136 pounds per square foot. Additionally, the allowable fastener loads will be as recommended by the fastener manufacturer for the materials to which the door systems are being connected.

Connections must be capable of preventing the frame from being dislodged from the supporting structural element.

1.2.1.3 Wind Load Requirements

Design and fabricate exterior glazed door and frame assemblies provided to resist wind load criteria indicated on Structural drawings in accordance with ICC IBC and ASCE 7 requirements for Components and Cladding.

1.2.2 Air Infiltration

When tested in accordance with ASTM E 283, air infiltration shall not exceed 0.06 cubic feet per minute per square foot of fixed area at a test pressure of 6.24 pounds per square foot (50 mile per hour wind).

1.2.3 Water Penetration

When tested in accordance with ASTM E 331, there shall be no water
penetration at a minimum test pressure of 8 pounds per square foot of fixed area.

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. Group submittals of complementary and related products and materials as needed to represent total assemblies and facilitate concurrent coordination review. Example: Submit doors, door frames and door hardware together. The Government may withhold action on submittals requiring coordination with other submittals until related submittals are received. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors and frames; G

For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

a. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.

b. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing joinery, including concealed welds; anchorage; expansion provisions; glazing and flashing and drainage.

c. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

d. Field verify all related building dimensions prior to production of Shop Drawings.

Hardware schedule; G

SD-03 Product Data

Hardware items; G

Doors and frames; G

Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter less water and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-05 Design Data
Performance Requirements Validation; G

For products and systems indicated to validate compliance with specified performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

SD-08 Manufacturer’s Instructions

Doors and frames

Hardware installation

Submit detail specifications and instructions for installation, adjustments, cleaning, and maintenance.

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1; G

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout

All approved LEED Submittals specified under SD-03 Product Data; S

1.4 HARDWARE SCHEDULE

See Section 08 71 00 DOOR HARDWARE

1.5 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water, and easily accessible for inspection and handling. Stack materials on nonabsorptive strips or wood platforms. Do not cover doors and frames with tarps, polyethylene film, or similar coverings. Protect finished surfaces during shipping and handling using manufacturer’s standard method, except that no coatings or lacquers shall be applied to surfaces to which calking and glazing compounds must adhere.

1.6 WARRANTY

1.6.1 Special Assembly Warranty

Standard form in which manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1.6.1.1 Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.

b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals and other materials beyond normal weathering.

d. Water penetration through fixed glazing and framing areas.

e. Failure of operating components.

1.6.1.2 Warranty Period: Five years from date of final acceptance of the Work.

1.6.2 Special Finish Warranty

Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1.6.2.1 Warranty Period: 10 years from date of final acceptance of the Work.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.2 DOORS AND FRAMES

Swing-type aluminum doors and frames of size, design, and location indicated. Provide doors complete with frames, framing members, subframes, transoms, adjoining sidelights, adjoining window wall, trim, and accessories. Provide additional reinforcing and heavier thickness metal in frames as required to meet requirements specified in paragraph entitled "Performance Requirements" herein.

2.3 MATERIALS

2.3.1 Anchors

Stainless steel.

2.3.2 Weatherstripping

Continuous wool pile, silicone treated, or type recommended by door manufacturer.

2.3.3 Aluminum Alloy for Doors and Frames

ASTM B 221, Alloy 6063-T5 for extrusions. ASTM B 209, alloy and temper best suited for aluminum sheets and strips.
2.3.4 Fasteners

   Hard aluminum or stainless steel.

2.3.5 Structural Steel

   ASTM A 36/A 36M.

2.3.6 Aluminum Paint

   Type as recommended by aluminum door manufacturer.

2.4 FABRICATION

2.4.1 Aluminum Frames

   Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 12 inches o.c. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

2.4.1.1 Muntins

   Provide aluminum frame manufacturer's standard aluminum muntins in same finish as aluminum frame in configurations indicated. Muntins shall be designed for installation on the exterior side of glazing and secured to frame with manufacturer's corrosion-resistant concealed fasteners. Submit manufacturer's standard muntin profiles for selection by the Contracting Officer.

2.4.2 Aluminum Doors

   Of type, size, and design indicated and not less than 1 3/4 inches thick. Minimum wall thickness, 0.125 inch, except beads and trim, 0.050 inch. Door sizes shown are nominal and shall include standard clearances as follows: 0.093 inch at hinge and lock stiles, 0.125 inch between meeting stiles, 0.125 inch at top rails, 0.187 inch between bottom and threshold, and 0.687 inch between bottom and floor. Bevel single-acting doors 0.063 or 0.125 inch at lock, hinge, and meeting stile edges. Double-acting doors shall have rounded edges at hinge stile, lock stile, and meeting stile edges.

2.4.2.1 Full Glazed Stile and Rail Doors

   Doors shall have narrow medium stiles and rails as indicated, except that bottom rail shall be minimum 8 inches high. Fabricate from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Fasten top and bottom rail together by means of welding or by 3/8 or 1/2 inch diameter cadmium-plated tensioned steel tie rods. Provide an adjustable mechanism of jack screws or other methods in the top rail to allow for minor clearance adjustments after installation.

2.4.3 Welding and Fastening

   Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to...
produce a uniform texture and color in finished work. Remove flux and spatter from surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and shall have countersunk heads. Weld concealed reinforcements for hardware in place.

2.4.4 Weatherstripping

Provide on stiles and rails of exterior doors. Fit into slots which are integral with doors or frames. Weatherstripping shall be replaceable without special tools, and adjustable at meeting rails of pairs of doors. Installation shall allow doors to swing freely and close positively. Air leakage of a single leaf weatherstripped door shall not exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283.

2.4.5 Anchors

Provide additional anchors, higher strength anchors and additional reinforcing for securing frames as required to meet requirements specified in paragraph entitled "Performance Requirements" herein. On the backs of subframes, provide anchors of the sizes and shapes required for securing subframes to adjacent construction. Anchor transom bars at ends and mullions at head and sill. Reinforce vertical mullions with structural steel members of sufficient length to extend up to the overhead structural slab or framing and secure thereto. Reinforce and anchor freestanding door frames to floor construction as indicated on approved shop drawings and in accordance with manufacturer's recommendation. Place anchors near top and bottom of each jamb and at intermediate points not more than 25 inches apart.

2.4.6 Provisions for Hardware

Hardware is specified in Section 08 71 00 DOOR HARDWARE. Deliver hardware templates and hardware (except field-applied hardware items) to the door manufacturer for use in fabrication of aluminum doors and frames. Cut, reinforce, drill, and tap doors and frames at the factory to receive template hardware. Provide doors to receive surface-applied hardware, except push plates, kick plates, and mop plates, with reinforcing only; drill and tap in the field. Provide hardware reinforcements of stainless steel or steel with hot-dipped galvanized finish, and secure with stainless steel screws.

2.4.7 Provisions for Glazing

Design exterior framing and doors for inside glazing of types indicated and to meet requirements specified in paragraph entitled "Performance Requirements" herein. Provide extruded aluminum, theft-proof, snap-in glazing beads or fixed glazing beads on exterior or security side of doors. Glazing beads shall have vinyl insert glazing gaskets. Design glazing beads to receive glass of thickness indicated or specified. Glazing is specified in Section 08 81 00 GLAZING.

2.4.8 Finishes

Provide exposed aluminum surfaces with factory finish of anodic coating.

2.4.8.1 Clear Anodic Coating

AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
PART 3 EXECUTION

3.1 INSTALLATION

Plumb, square, level, and align frames and framing members to receive doors, transoms, adjoining sidelights, and adjoining window walls. Anchor frames to adjacent construction as indicated and in accordance with manufacturer's printed instructions. Anchor bottom of each frame to rough floor construction with 3/32 inch thick stainless steel angle clips secured to back of each jamb and to floor construction; use stainless steel bolts and expansion rivets for fastening clip anchors. Seal metal-to-metal joints between framing members as specified in Section 07 92 00 JOINT SEALANTS. Hang doors to produce clearances specified in paragraph entitled "Aluminum Doors," of this section. After erection and glazing, adjust doors and hardware to operate properly.

3.2 FIELD QUALITY CONTROL

3.2.1 Tests

Perform operational tests on all doors and frames to verify a smooth, snag-free operation of all components, including the following:

a. Adjust hardware for smooth and balanced door movement. Ensure hinges are not wobbly, but are rigidly anchored to structural members/doors.

b. Ensure that door closers are set so as to close the door as specified, without the arm hitting adjacent wall or frame when door is in open position.

c. Ensure that panic exit hardware is operating as specified.

3.2.2 Inspection

Inspect doors and frames to ensure the following:

a. Hardware sets, locksets, strikes, escutcheons, door stops are set in place as per manufacturer installation instructions.

b. Required gaps and clearances have been applied.

c. Trim and sealants have been properly applied to ensure a water-tight installation.

3.2.3 Field Test for Water-Tight Installation

3.2.3.1 Areas of Work

Typical areas of the work shall be checked for water penetration. Conduct field check test for water penetration by spraying water directly on window wall areas with a garden hose and nozzle, where designated by the Contracting Officer. Initial testing shall be in accordance with AAMA 501.2 and performed as early in the installation phase as possible, prior to application of interior finishes of gypsum board or plaster, on an area at least one bay wide by one story height.
3.2.3.2 Tests

The Contracting Officer will designate the areas of the completed work to be so checked (not less than one column bay in width and one story in height), and shall witness all tests. Contractor shall be required to perform three "initially successful" water tests. (3 consecutive successful tests). There shall be no water leakage. Water leakage is defined as any uncontrolled water that appears on any normal exposed interior surface, that is not contained or drained back to the exterior, or that can cause damage to adjacent materials or finishes.

3.2.3.3 Additional Tests

Depending upon the prevalence or absence of leakage in the initial water penetration tests, and upon the measures adopted by the Contractor to eliminate the source of leakage (if any) from subsequently erected work, the Contracting Officer will determine the necessity of (and scope of) additional tests. All retests required by the Contracting Officer due to repeated failures in "initial water tests" shall be performed by the Contractor at no additional cost to the Government. Corrective work required shall be the responsibility of the Contractor, along with the cost of retesting, the costs incurred by the Government and his Consultants. Remedial measures must maintain standards of quality and are subject to Contracting Officer approval.

3.3 PROTECTION FROM DISSIMILAR MATERIALS

3.3.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by one or a combination of the following methods:

a. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.

b. Apply a good quality elastomeric sealant between the aluminum and the dissimilar metal.

c. Paint the dissimilar metal with one coat of primer and one coat of aluminum paint.

d. Use a nonabsorptive tape or gasket in permanently dry locations.

3.3.2 Drainage from Dissimilar Metals

In locations where drainage from dissimilar metals has direct contact with aluminum, provide protective paint, to prevent aluminum discoloration.

3.3.3 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

3.3.4 Wood or Other Absorptive Materials

Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous
paint. In lieu of painting the aluminum, the Contractor shall have the option of painting the wood or other absorptive surface with two coats of aluminum paint and sealing the joints with elastomeric sealant.

3.4 CLEANING

Upon completion of installation, clean door and frame surfaces in accordance with door manufacturer's recommended procedure. Do not use abrasive, caustic, or acid cleaning agents.

3.5 PROTECTION

Protect doors and frames from damage and from contamination by other materials such as cement mortar. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

3.6 HARDWARE INSTALLATION

Install hardware in accordance with manufacturers' printed instructions. 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. See Section 08 71 00 DOOR HARDWARE.

3.7 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   REFERENCES

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)


AMERICAN ASSOCIATION OF AUTOMATIC DOOR MANUFACTURERS (AAADM)

AAADM American Association of Automatic Door Manufacturers

AMERICAN WELDING SOCIETY (AWS)

AWS A5.10/A5.10M (1999; R 2007) Specification for Bare Aluminum and Aluminum Alloy Welding Electrodes and Rods


AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)


ASTM INTERNATIONAL (ASTM)


BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.5 (2010) Auxiliary Locks and Associated Products

ANSI/BHMA A156.10 (2011) Power Operated Pedestrian Doors

INTERNATIONAL CODE COUNCIL (ICC)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 325 (2002; Reprint Jan 2012) Door, Drapery, Gate, Louver, and Window Operators and Systems

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01 (2003; Change 1 2007) DoD Minimum Antiterrorism Standards for Buildings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Group submittals of complementary and related products and materials as needed to represent total assemblies and facilitate concurrent coordination review. Example: Submit doors, door frames, door hardware and door operators together. The Government may withhold action on submittals requiring coordination with other submittals until related submittals are received. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Sliding automatic entrance door assemblies; G

For sliding automatic entrances.

a. Include plans, elevations, sections, hardware mounting heights, and attachment details.

b. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

c. Include diagrams for power, signal, and control wiring.
d. Indicate locations of activation and safety devices.

e. Include hardware schedule and indicate hardware types, functions, quantities, and locations.

f. Field verify all related building dimensions prior to production of Shop Drawings.

SD-03 Product Data

Sliding automatic entrance door assemblies; G
Components; G
Door Operators; G
Activation and safety devices; G
Hardware; G

SD-05 Design Data

Performance Requirements Validation; G

For products and systems indicated to validate compliance with specified performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

SD-07 Certificates

Special Warranty

Special Finish Warranty

Automatic entrance door assemblies

Submit written certificate, signed and sealed by a qualified Professional Engineer, certifying that design and anchorage of automatic entrance door assembly complies with paragraph entitled "Performance Requirements".

1.3 PERFORMANCE REQUIREMENTS

Provide interior and exterior sliding automatic entrance door assemblies capable of withstanding structural loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.

1.3.1 Structural

Exterior and interior sliding automatic entrance door assemblies shall be designed as a system with minimum properties and to resist minimum load requirements as indicated below meeting UFC 4-010-01, Standard 10 requirements. Design of the exterior sliding automatic entrance door assemblies shall include associated hardware, connections of the hardware, anchorage components and supporting structural connections.
1.3.1.1 Frames

In accordance with ASTM F2248, ensure that the framing members restrict deflections to L/60 of the length of the supported edge at allowable stress levels under the equivalent 3-second design loading of 136 pounds per square foot.

Use ASTM F2248 for glazing bite requirements for structurally or non-structurally glazed exterior sliding automatic entrance doors.

1.3.1.2 Connections

The design of connections of exterior sliding automatic entrance door frames to surrounding walls, of hardware and associated connections, of glazing stop connections, and of other elements in shear will be based on allowable stress levels. The connection design will be determined in accordance with ASTM F2248 based on two times the equivalent 3-second design loading of 136 pounds per square foot. Additionally, the allowable fastener loads will be as recommended by the fastener manufacturer for the materials to which the door systems are being connected.

Connections must be capable of preventing the frame from being dislodged from the supporting structural element.

1.3.1.3 Wind Load Requirements

Design and fabricate exterior sliding automatic entrance door assemblies provided to resist wind load criteria indicated on Structural drawings in accordance with ICC IBC and ASCE 7 requirements for Components and Cladding.

1.3.2 Thermal Movements

Provide exterior automatic entrance doors that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.3.3 Operating Range

Minus 20 deg F to 130 deg F.

1.3.4 Air Infiltration

When tested in accordance with ASTM E 283, air infiltration shall not exceed 0.06 cubic feet per minute per square foot of fixed area at a test pressure of 6.24 pounds per square foot (50 mile per hour wind).

1.3.5 Opening-Force Requirements for Exterior and Interior Vestibule Automatic Entrance Doors

a. Egress Doors: Not more than 50 lbf required to manually set door in motion if power fails, and not more than 15 lbf required to open door to minimum required width.
1.3.6 Closing-Force Requirements for Exterior and Interior Vestibule Automatic Entrance Doors

ANSI/BHMA A156.10. Not more than 30 lbf required to prevent door from closing.

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualifications

Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project and who employs a certified inspector.

1.4.2 Manufacturer Qualifications

A qualified manufacturer with company certificate issued by AAADM.

1.4.3 Certified Inspector

Certified by AAADM.

1.4.4 Welding

Qualify procedures and personnel according to AWS D1.2.

1.4.5 Power-Operated Door Standard

ANSI/BHMA A156.10.

1.4.6 Electrical Components, Devices, and Accessories

Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4.7 Emergency-Exit Door Requirements

Comply with requirements of authorities having jurisdiction for automatic entrance doors serving as a required means of egress.

1.5 COORDINATION

Coordinate size and location of recesses in concrete floors for recessed sliding tracks.

1.5.1 Templates

Obtain and distribute, to the parties involved, templates for doors, frames, and other work specified to be factory prepared for installing automatic entrance doors.

1.6 WARRANTY

1.6.1 Special Warranty

Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified
warranty period. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals and other materials beyond normal weathering.
d. Adhesive or cohesive sealant failures.
e. Water leakage through fixed glazing and framing areas.
f. Failure of operating components.

1.6.1.1 Warranty Period

Two years from date of final acceptance of the Work.

1.6.2 Special Finish Warranty

Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1.6.2.1 Warranty Period

10 years from date of final acceptance of the Work.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum

Alloy and temper recommended by manufacturer for type of use and finish indicated.

2.1.1.1 Extruded Bars, Rods, Profiles, and Tubes

ASTM B 221, Alloy 6063-T5 for extrusions.

2.1.1.2 Sheet and Plate

ASTM B 209, alloy and temper best suited for aluminum sheets and strips.

2.1.1.3 Welding Rods and Bare Electrodes

AWS A5.10/A5.10M.

2.1.2 Sealants and Joint Fillers

Refer to Section 07 92 00 JOINT SEALANTS.

2.1.3 Nonmetallic, Shrinkage-Resistant Grout

Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with
ASTM C 1107; of consistency suitable for application.

2.1.4 Bituminous Paint

Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos; formulated for 30 mil thickness per coat.

2.2 SLIDING AUTOMATIC ENTRANCE DOOR ASSEMBLIES

Provide manufacturer's standard automatic entrance door assemblies including doors, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, and accessories required for a complete installation.

2.2.1 Sliding Automatic Entrance Doors

2.2.1.1 Combination Activation and Safety Device

Combination motion/presence detector.

2.2.1.2 Activation Device

Motion detector mounted on each side of door header.

2.2.1.3 Safety Devices

Presence detector mounted on each side of door header and one photoelectric beam mounted in sidelite jambs.

2.3 COMPONENTS

2.3.1 Door Framing Members

Manufacturer's standard extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.

a. Nominal Size: Minimum 1-3/4 by 4-1/2 inches or as required to meet performance requirements.

b. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.

2.3.2 Stile and Rail Doors

Manufacturer's standard 1-3/4 inch thick glazed doors with minimum 0.125 inch thick, extruded aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.

a. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

b. Stile Design: Medium stile; 3-1/2 inch nominal width.

c. Rail Design: 6-1/2-inch nominal height. Accessible doors shall have smooth surfaced for width of door in area within 10 inches above floor or ground plane.
2.3.3 Glazing

As specified in Section 08 81 00, GLAZING.

2.3.3.1 Exterior Doors

Provide specified laminated glass.

2.3.3.2 Interior Vestibule Doors

Provide specified laminated glass.

2.3.4 Headers

Fabricated from minimum 0.125 inch thick extruded aluminum and extending full width of automatic entrance door units to conceal door operators, carrier assemblies, and roller tracks. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

a. Mounting: Concealed, with one side of header flush with framing.

b. Capacity: Capable of supporting doors up to 175 lb per leaf over spans up to 14 feet without intermediate supports.

2.3.5 Carrier Assemblies and Overhead Roller Tracks

Manufacturer's standard carrier assembly that allows vertical adjustment; consisting of nylon- or delrin covered ball-bearing center steel wheels operating on a continuous roller track, or ball-bearing center steel wheels operating on a nylon- or delrin covered continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly. Rollers: Minimum two ball-bearing roller wheels and two antirise rollers for each active leaf.

2.3.6 Threshold

Manufacturer's standard threshold members and bottom-guide track system, with stainless steel ball-bearing center roller wheels. Configuration: Saddle type threshold across door opening and inverted.

2.3.7 Brackets and Reinforcements

Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3.8 Fasteners and Accessories

Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.3.9 Caution Sign

ANSI/BHMA A156.10; 6 inches in diameter, with minimum 1/2-inch high, black lettering on a yellow background with the words "CAUTION AUTOMATIC DOOR."
2.4 DOOR OPERATORS

Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated. Provide door operators that will open and close doors and maintain them in fully closed position when subjected to Project's design wind pressures.

2.4.1 Electromechanical Operators

Self-contained overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; UL 325; and with manual operation including spring closing with power off.

2.4.1.1 Operation

Power opening and power closing.

2.4.1.2 Features

a. Adjustable opening and closing speeds.

b. Adjustable backcheck and latching.

c. Adjustable hold-open time between 0 and 30 seconds.

d. Obstruction recycle.

e. On-off/hold-open switch to control electric power to operator.

f. Energy conservation switch that reduces door-opening width.

g. Door position switch for interface with Security System.

2.4.1.3 Mounting

Concealed.

2.5 ACTIVATION AND SAFETY DEVICES

2.5.1 Combination Motion/Presence Detectors

Self-contained units; consisting of both motion and presence detectors in a single metal or plastic housing; adjustable to provide detection field sizes and functions required by ANSI/BHMA A156.10.

2.5.1.1 Motion Detector

K-band frequency, microwave scanner units; with relay hold time of not less than 2 to 10 seconds.

a. Provide capability for switching between bi-directional and uni-directional detection.
2.5.1.2 Presence Detector

Infrared-scanner units; with relay hold time of not less than 2 to 10 seconds. Detectors shall remain active at all times.

2.5.2 Photoelectric Beams

Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.

2.5.3 Electrical Interlocks

Unless units are equipped with self protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.5.4 Opening-Width Control Switch

Two position switch that in the normal position allows sliding doors to travel to full opening width and in the alternate position reduces opening to a selected partial opening width.

2.6 HARDWARE

Provide units in sizes and types recommended by automatic entrance door and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish, unless otherwise indicated.

2.6.1 Emergency Operation

Subject to approval by authority having jurisdiction, provide one of the following emergency operation systems:

2.6.1.1 Uninterruptible Power Supply (UPS)

Provide UPS on designated sliding automatic entrances in accordance with the following

a. UPS shall be fully integrated unit designed to fit within the door header and shall be UL listed for operation with the automatic door system provided herein.

b. Upon main power interruption to the door.

1. The UPS shall supply power to the operator, controls, activation, and safety systems of the sliding automatic entrance door.

2. The UPS shall provide up to 1.5 hours of normal operation.

c. UPS unit shall include a low battery shut down feature to safely open or close the door prior to complete battery discharge.

d. UPS unit shall include an audible battery replacement alarm to indicate that the battery will no longer accept a charge and replacement is required.
2.6.1.2 Fly Open Box

Provide Fly Open Box on designated doors in accordance with the following:

a. Fly Open Box shall be a fully integrated unit designed to fit within the door header and shall be UL listed for operation with the sliding automatic entrances provided herein.

b. Upon main power interruption to the door:
   1. The Fly Open Box shall supply power to the operator of the sliding automatic entrance door.
   2. The Fly Open Box shall provide one open or close operation.

c. Fly Open Box shall be configured for connection to a fire alarm system such that a signal from the fire alarm will open doors until fire alarm signal is terminated.

2.6.2 Deadlocks

Manufacturer's standard deadbolt operated by exterior cylinder and interior thumb turn; with minimum 1 inch long throw bolt; ANSI/BHMA A156.5, Grade 1.

2.6.2.1 Cylinders and Keying

As specified in Section 08 71 00, DOOR HARDWARE. Integrate into building master key system.

2.6.2.2 Deadbolts

Laminated-steel hook, mortise type, ANSI/BHMA A156.5, Grade 1.

2.6.3 Sliding Weather Stripping

Manufacturer's standard replaceable components made of wool, polypropylene, or nylon woven pile with nylon fabric or aluminum strip backing.

2.6.4 Weather Sweeps

Manufacturer's standard nylon brush sweep mounted to underside of door bottom.

2.7 FABRICATION

Factory fabricate automatic entrance door assembly components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

a. Form aluminum shapes before finishing.

b. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

c. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flathead
machine screws, finished to match framing. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices. Reinforce members as required to receive fastener threads.

d. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

2.7.1 Framing

Provide automatic entrance doors as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.

a. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.

b. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.

c. Form profiles that are sharp, straight, and free of defects or deformations.

d. Prepare components to receive concealed fasteners and anchor and connection devices.

e. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.

f. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.

g. Provide anchorage and alignment brackets for concealed support of assembly from the building structure.

h. Allow for thermal expansion of exterior units.

2.7.2 Doors

Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

2.7.3 Door Operators

Factory fabricated and installed in headers, including adjusting and testing.

2.7.4 Glazing

Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual," except as required to meet specified performance requirements.
2.7.5   Hardware

Factory install hardware to the greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes. Provide sliding weather stripping, mortised into door, at perimeter of sliding doors and breakaway sidelites.

2.7.6   Activation and Safety Devices

Factory install devices in doors and headers. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:

   b. Bottom Beam: 24 inches.

2.8   FINISHES

2.8.1   Clear Anodic Coating

AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3   EXECUTION

3.1   INSTALLATION

Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

   a. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

   b. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.1.1   Entrances

Install automatic entrance doors plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

   a. Install surface-mounted hardware using concealed fasteners to greatest extent possible.

   b. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.

   c. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

   d. Level recesses for recessed thresholds using nonshrink grout.
3.1.2 Door Operators

Connect door operators to electrical power distribution system as specified in Division 26 Sections.

3.1.3 Activation and Safety Devices

Adjust devices to provide detection field and functions indicated.

3.1.4 Glazing

Install glazing as specified in Section 08 81 00, GLAZING.

3.1.5 Sealants

Comply with requirements specified in Section 07 92 00, JOINT SEALANTS to provide weathertight installation.

   a. Set framing members, thresholds, bottom-guide track system, and flashings in full sealant bed.

   b. Seal perimeter of framing members with sealant.

3.1.6 Signage

Provide caution signs on each automatic entrance door, visible from both sides of door. Mount caution signs with centerline 58 inches above finished floor.

3.1.6.1 Emergency Breakaway Panels

Provide emergency breakaway sign visible to egress side of each automatic entrance door and sidelite that has emergency breakaway capability. Mount signs adjacent to lock stile with centerline between 36 and 60 inches above finished floor.

3.2 FIELD QUALITY CONTROL

3.2.1 Tests

Perform operational tests on all doors and frames to verify a smooth, snag-free operation of all components, including the following:

   a. Adjust hardware for smooth and balanced door movement. Ensure hinges are not wobbly, but are rigidly anchored to structural members/doors.

   b. Ensure that door closers are set so as to close the door as specified, without the arm hitting adjacent wall or frame when door is in open position.

   c. Ensure that panic exit hardware is operating as specified.

3.2.2 Inspection

Inspect doors and frames to ensure the following:

   a. Hardware sets, locksets, strikes, escutcheons, door stops are set in place as per manufacturer installation instructions.
b. Required gaps and clearances have been applied.

c. Trim and sealants have been properly applied to ensure a water-tight installation.

3.2.3 Field Test for Water-Tight Installation

3.2.3.1 Areas of Work

Typical areas of the work shall be checked for water penetration. Conduct field check test for water penetration by spraying water directly on window wall areas with a garden hose and nozzle, where designated by the Contracting Officer. Initial testing shall be in accordance with ASTM E 331 and performed as early in the installation phase as possible, prior to application of interior finishes of gypsum board or plaster, on an area at least one bay wide by one story height.

3.2.3.2 Tests

The Contracting Officer will designate the areas of the completed work to be so checked (not less than one column bay in width and one story in height), and shall witness all tests. Contractor shall be required to perform three "initially successful" water tests. (3 consecutive successful tests). There shall be no water leakage. Water leakage is defined as any uncontrolled water that appears on any normal exposed interior surface, that is not contained or drained back to the exterior, or that can cause damage to adjacent materials or finishes.

3.2.3.3 Additional Tests

Depending upon the prevalence or absence of leakage in the initial water penetration tests, and upon the measures adopted by the Contractor to eliminate the source of leakage (if any) from subsequently erected work, the Contracting Officer will determine the necessity of (and scope of) additional tests. All retests required by the Contracting Officer due to repeated failures in "initial water tests" shall be performed by the Contractor at no additional cost to the Government. Corrective work required shall be the responsibility of the Contractor, along with the costs incurred by the Government and his Consultants. Remedial measures must maintain standards of quality and are subject to Contracting Officer approval.

3.3 PROTECTION FROM DISSIMILAR MATERIALS

3.3.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by one or a combination of the following methods:

a. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.

b. Apply a good quality elastomeric sealant between the aluminum and the dissimilar metal.

c. Paint the dissimilar metal with one coat of primer and one coat of aluminum paint.
d. Use a nonabsorptive tape or gasket in permanently dry locations.

3.3.2 Drainage from Dissimilar Metals

In locations where drainage from dissimilar metals has direct contact with aluminum, provide protective paint, to prevent aluminum discoloration.

3.3.3 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

3.3.4 Wood or Other Absorptive Materials

Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous paint. In lieu of painting the aluminum, the Contractor shall have the option of painting the wood or other absorptive surface with two coats of aluminum paint and sealing the joints with elastomeric sealant.

3.4 CLEANING

Upon completion of installation, clean door and frame surfaces in accordance with door manufacturer's recommended procedure. Do not use abrasive, caustic, or acid cleaning agents.

3.5 PROTECTION

Protect doors and frames from damage and from contamination by other materials such as cement mortar. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

3.6 ADJUSTING

Adjust door operators, controls, and hardware for smooth and safe operation, for weathertight closure, and complying with requirements in ANSI/BHMA A156.10. Lubricate operating hardware and other moving parts. Readjust door operators and controls after repeated operation of completed installation equivalent to 3 days' use by normal traffic (100 to 300 cycles). Lubricate hardware, operating equipment, and other moving parts.

3.7 DEMONSTRATION

Engage a certified inspector to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrance doors and door operators.

3.8 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19, CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)


U.S. GREEN BUILDING COUNCIL (USGBC)


1.2   SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor's 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
Windows; G

Fabrication Drawings

SD-03 Product Data
Windows; G
Hardware; G
Accessories; G
Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter less water and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-10 Operation and Maintenance Data
Windows, Data Package 1; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout
All approved LEED Submittals specified under SD-03 Product Data; S

1.3 QUALITY ASSURANCE

1.3.1 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, method and materials for weatherstripping, material and method of attaching subframes, trim, installation details, and other related items.

1.4 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.

1.5 PROTECTION

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

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

1.7 DRAWINGS

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

1.8 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.2 WINDOWS

2.2.1 Hung Windows (H)

Single Hung, Type H-R15 R. Test and rate sash balance to conform with AAMA 902. Metal finish shall be organic coating in white color.

2.2.1.1 Window Materials

Window frames and sash members and glazing beads shall be fabricated in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.

Weatherstripping will be woven wool pile weatherstripping 0.210 inch thick, conforming to AAMA 701/702, or polypropylene multifilament fiber weatherstripping installed in an integral weatherstripping groove in the sash or frame, and flexible polyvinylchloride weatherstripping installed in the sill member.

2.2.2 Horizontal Sliding Windows (HS)

Sliding track assembly consisting of matching upper and lower channels, shoe extensions for each glass panel, insert rails with matching nylon wheels for each glass panel, and top guides for each glass panel. Finish shall be clear anodized aluminum.

2.2.2.1 Glass

Clear tempered glass, nominal 1/4 inch thick as specified in Section 08 81 00 GLAZING.

2.2.2.2 Hardware

a. Lock: Bypassing panel type mounted in lower track or on bottom shoe that easily engages and prevents movement of each panel. Both panels shall be secured by a single plunger style lock.
b. Finger Pull: Provide on the "inside" only. Mounting shall be secured to the edge with sufficient finger space. Finish shall match sliding track.

2.2.3 Glass and Glazing

Materials are specified in Section 08 81 00 GLAZING.

2.2.4 Calking and Sealing

Are specified in Section 07 92 00 JOINT SEALANTS.

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. Design sash for inside single glazing and for securing glass with metal beads, or glazing compound.

2.3.2 Fasteners

Fabricated from 100 percent re-melted steel. Use fasteners as standard with the window manufacturer for windows, trim, and accessories. Self-tapping sheet-metal screws are not acceptable for material more than 1/16 inch thick.

2.3.3 Accessories

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

2.3.3.1 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.

2.3.3.2 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.

2.3.3.3 Window Anchors

Anchoring devices for installing windows must be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA/WDMA/CSA 101/I.S.2/A440.
2.3.4 Finishes

Exposed aluminum surfaces must be factory finished with an anodic coating or organic coating. Color must be as specified.

2.3.4.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF-45 and AAMA 611. Finish must be:

a. Architectural Class II (0.4 mil to 0.7 mil), designation AA-M10-C22-A31, clear (natural) anodized.

2.3.4.2 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a baked enamel finish in accordance with AAMA 2603 with total dry film thickness not less than 0.8 mil.

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 operating parts against accumulation of dirt and building materials. 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.

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 operating components and hardware to operate smoothly. Lubricate hardware and operating parts as necessary. Adjust single hung windows to operate with maximum applied force of 25 pounds in either direction, not including breakaway friction force. Verify that products are properly installed, connected, and adjusted.
3.2 CLEANING

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

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1  GENERAL

1.1  REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E283  (2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1  (2013) Butts and Hinges
ANSI/BHMA A156.13 (2012) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.16 (2013) Auxiliary Hardware
ANSI/BHMA A156.18 (2012) Materials and Finishes
ANSI/BHMA A156.2  (2011) Bored and Preassembled Locks and Latches
ANSI/BHMA A156.21 (2014) Thresholds
ANSI/BHMA A156.22 (2012) Door Gasketing and Edge Seal Systems
ANSI/BHMA A156.25 (2013) Electrified Locking Devices
ANSI/BHMA A156.26 (2012) Continuous Hinges
ANSI/BHMA A156.3  (2014) Exit Devices
ANSI/BHMA A156.31 (2013) Electric Strikes and Frame Mounted Actuators
ANSI/BHMA A156.36 (2010) Auxiliary Locks
ANSI/BHMA A156.4  (2013) Door Controls - Closers
ANSI/BHMA A156.5  (2014) Cylinder and Input Devices for Locks
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
1.2 SUBMITTALS

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

SD-02 Shop Drawings

Manufacturer's Detail Drawings; G
Verification of Existing Conditions; G
Hardware Schedule; G
Keying System; G

SD-03 Product Data

Hardware Items; G

SD-08 Manufacturer's Instructions
Installation
SD-10 Operation and Maintenance Data
Hardware Schedule Items, Data Package 1; G
SD-11 Closeout Submittals
Key Bitting

1.3 SHOP DRAWINGS

Submit manufacturer's detail drawings indicating all hardware assembly components and interface with adjacent construction. Indicate power components and wiring coordination for electrified hardware. Base shop drawings on verified field measurements and include verification of existing conditions.

1.4 PRODUCT DATA

Indicate fire-ratings at applicable components. Provide documentation of ABA/ADA accessibility compliance of applicable components, as required by 36 CFR 1191 Appendix D - Technical.

1.5 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

<table>
<thead>
<tr>
<th>Hardware Item</th>
<th>Quantity</th>
<th>Size</th>
<th>Reference Publication Type No.</th>
<th>Finish Mfr Name and Catalog No.</th>
<th>Key Control Symbols UL Mark (If fire-rated and listed) BHMA Finish Designation</th>
</tr>
</thead>
</table>

In addition, submit hardware schedule data package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6 KEY BITTING CHART REQUIREMENTS

1.6.1 Requirements

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Complete listing of all keys (e.g. AA1 and AA2).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.
1.7 QUALITY ASSURANCE

1.7.1 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.

1.7.2 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 must meet to discuss and coordinate key requirements for the facility.

1.8 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 on hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware applied to metal doors must be manufactured using a template. Provide templates to door and frame manufacturers in accordance with ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, NFPA 252 for fire tests of door assemblies, ABA/ADA accessibility requirements, and all other requirements indicated, even if such hardware is not specifically mentioned in paragraph HARDWARE SCHEDULE. Provide Underwriters Laboratories, Inc. labels for such hardware in accordance with UL Bld Mat Dir or equivalent labels in accordance with another testing laboratory approved in writing by the Contracting Officer.

2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark is visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover. Coordinate electrified door hardware components with corresponding components specified in Division 28 ELECTRONIC SECURITY SYSTEMS (ESS).

2.3.1 Hinges

Provide in accordance with ANSI/BHMA A156.1. Provide hinges that are 4-1/2 by 4-1/2 inch unless otherwise indicated. Construct loose pin hinges for interior doors and reverse-bevel exterior doors so that pins are non-removable when door is closed. Other anti-friction bearing hinges may be provided in lieu of ball bearing hinges.
2.3.2 Continuous Hinges

Where continuous hinges are required, provide in accordance with ANSI/BHMA A156.26.

2.3.3 Locks and Latches

2.3.3.1 Bored Locks and Latches

Provide in accordance with ANSI/BHMA A156.2, Series 4000, Grade 1. Provide factory installed lead lining in locks for lead-shielded doors.

2.3.3.2 Hospital Latches

Push-pull latch set similar and equal to Glynn-Johnson HL6, 1/2 inch throw, 2-3/4 inch backset, to fit 161 cutout. Cover approximately 2-1/2 by 5-1/2 inch, handle approximately 1-1/2 by 4-1/2 inch, projection approximately 2-1/2 inch, covers and handles of stainless steel, BHMA 630 finish, engraved "PUSH" and "PULL" on handles, push handle pointing up, pull handle pointing down.

2.3.3.3 Auxiliary Locks

Provide in accordance with ANSI/BHMA A156.36, Grade 1.

2.3.3.4 Combination Locks

Heavy-duty, battery operated combination lockset with 12 pin push buttons, standard sized lever, 3/4 inch deadlocking latch, 2-3/4 inch backset. Locks to operate by pressing in the proper sequence. Inside lever operates the latch. Provide a keyed removable core cylinder on the exterior to permit bypassing the combination.

2.3.4 Exit Devices

Provide in accordance with ANSI/BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Provide touch bars in lieu of conventional crossbars and arms. Provide escutcheons not less than 7 by 2-1/4 inch. Provide all exit devices with touch-bar larger than device channel to prevent pinch points.

2.3.5 Cylinders and Cores

Provide cylinders for new locks, including locks provided under other sections of this specification. Provide fully compatible cylinders of Grade 1 products from products of one manufacturer with interchangeable cores that are removable by a special control key. Factory set the cores with seven pin tumblers in Key-way as directed by Ba: PWS - Locksmith. Submit a core code sheet with the cores. Provide master keyed cores in one system for this project. Provide construction interchangeable cores. Provide Cylinders and Cores manufactured by Best to ensure system compatibility for the base.

For medical projects, key pharmacy door locks separately from building master key system.
2.3.6  Electrified Hardware

Comply with the requirements of NFPA 70 for wiring of electrified hardware.

2.3.6.1  Electric Strikes and Frame Mounted Actuators

Provide in accordance with ANSI/BHMA A156.31, Grade 1. Provide electric strikes and actuators as required to meet operational requirements. Provide electric strikes that remain secure during power failure. Provide strikes and actuators with a minimum opening force of 2300 pounds.

Provide facility interface devices that use direct current (dc) power to energize the solenoids. Provide electric strikes and actuators that incorporate end-of-line resistors to facilitate line supervision by the system. If not incorporated into the electric strike or local controller, provide metal oxide resistors (MOVs) to protect the controller from reverse current surges.

2.3.6.1.1  Solenoid

Provide actuating solenoid for strikes and actuators that are rated for continuous duty, cannot dissipate more than 12 Watts and must operate on 12 or 24 Volts dc. Inrush current cannot exceed 1 ampere and the holding current cannot be greater than 500 milliamperes. Actuating solenoid must move from fully secure to fully open positions in less than 500 milliseconds.

2.3.6.1.2  Signal Switches

Provide strikes and actuators with signal switches to indicate to the system when the bolt is not engaged or the strike mechanism is unlocked. Signal switches must report a forced entry to the system.

2.3.6.1.3  Coordination

Provide electric strikes and actuators of a size, weight and profile compatible with each specified door frame. Field verify installation clearances prior to procurement.

2.3.6.1.4  Mounting Method

Provide electric strikes and actuators suitable for use with single and double doors, with mortise or rim type hardware specified, and for right or left hand mounting as specified. In double door installations, locate the lock in the active leaf and monitor the fixed leaf.

2.3.6.2  Electrified Bored Locks

Provide in accordance with ANSI/BHMA A156.25, Grade 1. Provide electrified bored locks that remain secure during power failure. Provide facility interface devices that use dc power to energize solenoids. Provide solenoids, resistors, and signal switches in accordance with paragraph ELECTRIC STRIKES AND FRAME MOUNTED ACTUATORS.

2.3.6.2.1  Power Transfer Device

Provide power transfer device with each electrified lock that route power and monitoring signals from the lockset to the door frame. Coordinate power transfer device with door frames. Provide transfer device equal to
2.3.6.3 Release Devices

Provide wall mounted Electromagnetic release devices connected to fire and smoke detecting devices.

2.3.7 Keying System

Provide an extension of the existing keying system. Existing locks were manufactured by Best and have interchangeable cores. Provide construction of the new keying system. Provide key cabinet as specified.

2.3.8 Lock Trim

Provide cast, forged, or heavy wrought construction and commercial plain design for lock trim.

2.3.8.1 Lever Handles

Provide lever handles. Provide in accordance with ANSI/BHMA A156.3 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. Provide lockset with this feature and lever trim design equal to Best 9K3-15D.

2.3.9 Keys

Provide one file key, one duplicate key, and one working key for each key change and for each master and grand master keying system. Provide 6 great grand master keys, 10 construction master keys, and 2 control keys for removable cores. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - do not duplicate." Do not place room number on keys.

2.3.10 Door Bolts

Provide in accordance with ANSI/BHMA A156.16. Provide dustproof strikes for bottom bolts, except at doors having metal thresholds. Provide automatic latching flush bolts in accordance with ANSI/BHMA A156.3, Type 25.

2.3.11 Self Closing Device

Units for smoke control shall be self-closing. Magnetic hold-open may be incorporated providing it is tied into the building fire/smoke/alarm system, which upon receiving a signal shall release the self closing door.

2.3.12 Closers

Provide in accordance with 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 printed recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.12.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation in locations that will be visible after installation.

2.3.13 Overhead Holders

Provide in accordance with ANSI/BHMA A156.8.

2.3.14 Door Protection Plates

Provide in accordance with ANSI/BHMA A156.6.

2.3.14.1 Sizes of Armor Mop and Kick Plates

2 inch less than door width for single doors; 1 inch less than door width for pairs of doors. Provide 10 inch kick plates for flush doors. Provide a minimum 36. Provide 4 inch mop plates.

2.3.15 Door Stops and Silencers

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

2.3.16 Thresholds

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

2.3.17 Weatherstripping Gasketing

Provide in accordance with ANSI/BHMA A156.22. Provide the type and function designation where specified in paragraph HARDWARE SCHEDULE. Provide a set to include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weatherstripped doors not to exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283. Provide weatherstripping with one of the following:

2.3.17.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with silicone rubber, or polyurethane inserts. Provide clear (natural) anodized aluminum. Provide Heavy Duty type as indicated with 1 1/2 inch width housing for use with surface mounted hardware.

2.3.18 Soundproofing Gasketing

Provide in accordance with ANSI/BHMA A156.22. Provide adjustable doorstops at heads, jambbs and automatic door bottoms in accordance with the hardware set, of extruded aluminum, clear (natural) anodized, surface applied, with fin seals between plunger and housing. Provide doorstops with solid neoprene tube, silicone rubber, or closed cell sponge gasket.
Provide door bottoms with adjustable operating rod and silicone rubber or closed cell sponge neoprene gasket. Provide doorstops that are mitered at corners. Provide type and function designation where specified in paragraph HARDWARE SETS.

2.3.19 Rain Drips

Provide in accordance with ANSI/BHMA A156.22. Provide extruded aluminum rain drips, not less than 0.08 inch thick, clear anodized finish. Provide rain drips with a 4 inch overlap on each side of each exterior door that is not protected by an awning, roof, eave or other horizontal projection. Set drips in sealant and fasten with stainless steel screws.

2.3.19.1 Overhead Rain Drips

Approximately 1-1/2 inch high by 2-1/2 inch projection. Align bottom with door frame rabbet.

2.3.20 Auxiliary Hardware (Other than locks)

Provide in accordance with ANSI/BHMA A156.16, Grade 1.

2.3.21 Special Tools

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

2.4 FASTENERS

Provide fasteners of type, quality, size, and quantity appropriate to the specific application. Fastener finish to match hardware. Provide stainless steel or nonferrous metal fasteners in locations exposed to weather. Verify metals in contact with one another are compatible and will avoid galvanic corrosion when exposed to weather.

2.5 FINISHES

Provide in accordance with ANSI/BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except aluminum paint finish for surface door closers, and except BHMA 652 finish (satin chromium plated) for steel hinges. Provide hinges for exterior doors in stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Furnish exit devices in BHMA 626 finish in lieu of BHMA 630 finish except where BHMA 630 is specified under paragraph HARDWARE SETS. Match exposed parts of concealed closers to lock and door trim. Match hardware finish for aluminum doors to the doors. Provide hardware with anti-microbial coating as indicated in the hardware sets for patient health and welfare.

2.6 KEY CABINET AND CONTROL SYSTEM

Provide in accordance with ANSI/BHMA A156.5, Type required to yield a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.
PART 3 EXECUTION

3.1 INSTALLATION

Provide 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 Weatherstripping Installation

Provide full contact, weathertight seals that allow operation of doors without binding the weatherstripping.

3.1.1.1 Stop Applied Weatherstripping

Fasten in place with color matched sheet metal screws not more than 9 inch on center after doors and frames have been finish painted.

3.1.2 Soundproofing Installation

Provide as specified for stop applied weatherstripping.

3.1.3 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 FIRE DOORS AND EXIT DOORS

Provide hardware in accordance with NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, and NFPA 252 for fire tests of door assemblies.

3.3 HARDWARE LOCATIONS

Provide in accordance with SDI/DOOR A250.8, unless indicated or specified otherwise.


b. Mop Plates: Bottom flush with bottom of door.

3.4 KEY CABINET AND CONTROL SYSTEM

Locate where directed. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Provide complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and
other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, errors in cutting and fitting and damage to adjoining work.

3.6 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

3.7 HARDWARE SETS

Provide hardware for aluminum doors under this section. Deliver Hardware templates and hardware, except field applied hardware, to the aluminum door and frame manufacturer for use in fabricating doors and frames.

Option List

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>QUICK CONNECT WIRING OPTION</td>
</tr>
<tr>
<td>HT</td>
<td>HOSPITAL TIP</td>
</tr>
<tr>
<td>FL</td>
<td>FIRE EXIT HARDWARE</td>
</tr>
<tr>
<td>PT</td>
<td>POWER TRANSFER PREP</td>
</tr>
<tr>
<td>SN</td>
<td>SEX NUTS</td>
</tr>
<tr>
<td>TS</td>
<td>TOUCHBAR MONITORING SWITCH</td>
</tr>
<tr>
<td>CSK</td>
<td>COUNTER SINKING OF KICK AND MOP PLATES</td>
</tr>
<tr>
<td>MLR</td>
<td>MOTORIZED LATCH RETRACTION</td>
</tr>
<tr>
<td>RQE</td>
<td>REQUEST TO EXIT</td>
</tr>
<tr>
<td>SDF</td>
<td>SAFETY STUD FEATURE</td>
</tr>
<tr>
<td>SNB</td>
<td>SEX BOLTS</td>
</tr>
</tbody>
</table>

Set Code

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td>CARD READER</td>
</tr>
<tr>
<td>ED</td>
<td>EXIT DEVICE</td>
</tr>
<tr>
<td>PR</td>
<td>PAIR</td>
</tr>
<tr>
<td>I/S</td>
<td>INSWING</td>
</tr>
<tr>
<td>O/S</td>
<td>OUTSWING</td>
</tr>
<tr>
<td>3/6</td>
<td>WIDE DOOR</td>
</tr>
<tr>
<td>UL</td>
<td>FIRE RATED</td>
</tr>
<tr>
<td>MON</td>
<td>MONITOR</td>
</tr>
<tr>
<td>OHS</td>
<td>O.H. STOP</td>
</tr>
<tr>
<td>SMK</td>
<td>SMOKE</td>
</tr>
</tbody>
</table>

Hardware Sets

<table>
<thead>
<tr>
<th>SET #1 - Alum Sliding Entry</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Mortise Cylinder</td>
<td>1E-74 L/C</td>
</tr>
<tr>
<td>1  Core</td>
<td>1C-7(X2) ((IN KEYWAY AS REQ'D))</td>
</tr>
<tr>
<td>1  Door Position Switch</td>
<td>DIVISION 28 - ESS (PREP ONLY)</td>
</tr>
</tbody>
</table>

NOTE: All remaining Hardware by Door Manufacturer
<table>
<thead>
<tr>
<th>SET #2 - HM - Exit (CR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hinges</td>
</tr>
<tr>
<td>1 Elec. Exit Device</td>
</tr>
<tr>
<td>1 Rim Cylinder</td>
</tr>
<tr>
<td>1 Core 1C-7(X2)</td>
</tr>
<tr>
<td>1 Door Closer</td>
</tr>
<tr>
<td>1 Kick Plate</td>
</tr>
<tr>
<td>1 Power Transfer</td>
</tr>
<tr>
<td>1 HD Weatherstrip</td>
</tr>
<tr>
<td>1 Threshold</td>
</tr>
<tr>
<td>1 Door Position Switch</td>
</tr>
<tr>
<td>1 Card Reader</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SET #3 - Decon \ Stor I/S UL</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 Hinges</td>
</tr>
<tr>
<td>1 Storeroom Lockset</td>
</tr>
<tr>
<td>1 Core 1C-7(X2)</td>
</tr>
<tr>
<td>1 Door Closer</td>
</tr>
<tr>
<td>1 Kick Plate</td>
</tr>
<tr>
<td>1 Floor Stop</td>
</tr>
<tr>
<td>1 Gasketing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SET #4 - HM - Exit (UL-CR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hinges</td>
</tr>
<tr>
<td>1 Elec. Fire Exit Device</td>
</tr>
<tr>
<td>1 Rim Cylinder</td>
</tr>
<tr>
<td>1 Core 1C-7(X2)</td>
</tr>
<tr>
<td>1 Door Closer</td>
</tr>
<tr>
<td>1 Kick Plate</td>
</tr>
<tr>
<td>1 Power Transfer</td>
</tr>
<tr>
<td>1 HD Weatherstrip</td>
</tr>
<tr>
<td>1 Threshold</td>
</tr>
<tr>
<td>1 Saddle Threshold</td>
</tr>
<tr>
<td>1 Door Position Switch</td>
</tr>
<tr>
<td>1 Card Reader</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SET #5 - HM - Exit (MON)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hinges</td>
</tr>
<tr>
<td>1 Elec. Fire Exit Device</td>
</tr>
<tr>
<td>1 Rim Cylinder</td>
</tr>
<tr>
<td>1 Core 1C-7(X2)</td>
</tr>
<tr>
<td>1 Door Closer</td>
</tr>
<tr>
<td>1 Kick Plate</td>
</tr>
<tr>
<td>1 Power Transfer</td>
</tr>
<tr>
<td>1 Drip Cap</td>
</tr>
<tr>
<td>1 HD Weatherstrip</td>
</tr>
<tr>
<td>1 Threshold</td>
</tr>
<tr>
<td>1 Door Position Switch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SET #6 - HM - Gas (CR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hinges</td>
</tr>
<tr>
<td>1 Electro-mech Lock</td>
</tr>
<tr>
<td>1 Core 1C-7(X2)</td>
</tr>
<tr>
<td>1 Door Closer</td>
</tr>
<tr>
<td>1 Armor Plate</td>
</tr>
<tr>
<td>1 Power Transfer</td>
</tr>
<tr>
<td>1 Door Sweep</td>
</tr>
</tbody>
</table>

SECTION 08 71 00 Page 12
1 HD Saddle Threshold J32130-HD (425 HD x SSMS/LA) AL
1 Door Position Switch DIVISION 28 - ESS (PREP ONLY)
1 Card Reader ACCESS CONTROL SECTION

SET #7 - HM - Mech (CR)
6 Hinges A5111 4 1/2 x 4 1/2 NRP 630
1 Keyed Mullion TYPE 22 (KEYED) 689
1 Elec. Fire Exit Device TYPE 1 - 03 x GRIP PULL x MLR x RQE x SNB x UL 630
1 Elec. Fire Exit Device TYPE 1 - 01 x BLANK TRIM x SNB x UL 630
1 Mortise Cylinder 1E-74 L/C 626
1 Rim Cylinder 12E-72 L/C 626
2 Core 1C-7(X2) ((IN KEYWAY AS REQ'D) 626
2 Door Closer | Stop C02021 PT4G PT4H 689
2 Power Transfer AS SPEC'D
2 Door Sweep R3B416 (200 NA - NGP)
1 Drip Cap R3Y976 - 4" ODW
1 HD Set Weatherstrip R3E156 (700 ES - HEAD & JAMBS - )
1 Mullion Seal R0E005 (5100 S - NGP)
1 HD Saddle Threshold J32130-HD (425 HD x SSMS/LA) AL
2 Door Position Switch DIVISION 28 - ESS (PREP ONLY)
1 Card Reader ACCESS CONTROL SECTION

SET #8 - HM - Roof (MON)
3 Hinges A5111 4 1/2 x 4 1/2 NRP 630
1 Dbl Key Lockset P91 626
2 Core 1C-7(X2) ((IN KEYWAY AS REQ'D) 626
1 Door Closer | Stop C02021 PT4F PT4H SNB 689
1 Drip Cap R3Y976 - 4" ODW
1 HD Set Weatherstrip R3E156 (700 ES - HEAD & JAMBS - )
1 Door Sweep R3B416 (200 NA - NGP)
1 Threshold J36100 x SSMS/LA (896 S - NGP) AL
1 Door Position Switch DIVISION 28 - ESS (PREP ONLY)

SET #M1 - OHD (CR)
1 Mortise Cylinder 1E-74 L/C 626
1 Core 1C-7(X2) (IN KEYWAY AS REQ'D) 626
1 Door Position Switch DIVISION 28 - ESS (PREP ONLY)

NOTE: All Remaining Hardware by Door Manufacturer -
Coordinate Cylinder Requirements

SET #100 - Stair
3 Hinges A8111 4 1/2 x 4 1/2 652
1 Fire Exit Device (Psg) TYPE 1 - 14 x LVR TRIM x UL x SNB 630
1 Door Closer C02011 PT4F PT4H SNB 689
1 Kick Plate J102 - 10" x 2" LDW CSK 630
1 Wall Bumper L02101 630
1 Gasketing R0Y154 (5040 B HEAD & JAMBS)

SET #101 - Vest Exit
3 Hinges A8111 4 1/2 x 4 1/2 652
1 Exit Device (Passage) TYPE 1 - 14 x LVR TRIM x SNB 630
1 Door Closer C02021 PT4F PT4H EDA SNB 689
1 Armor Plate J101 - 34" x 1-1/2" LDW CSK UL 630
1 Drip Cap R3Y976 - 4" ODW
1 Door Sweep R3B416 (200 NA - NGP)
1 HD Saddle Threshold J32130-HD (425 HD x SSMS/LA) AL
3 Door Silencers L03011 GREY
SET #102 - NOT USED

SET #103 - Corr Entry (UL CR)
3 Hinges A8111 4 1/2 x 4 1/2 NRP 652
1 Electro-mech Lock F86 x ELEC UNLOCK X RQE 626
1 Core 1C-7(X2) (IN KEYWAY AS REQ'D) 626
1 Door Closer C02021 PT4F PT4H EDA SNB 689
1 Kick Plate J102 - 10" x 2" LDW CSK 630
1 Wall Bumper L02101 630
1 Power Transfer AS SPEC'D
1 Gasketing R0Y154 (5040 B HEAD & JAMBS)
1 Door Position Switch DIVISION 28 - ESS (PREP ONLY)
1 Card Reader ACCESS CONTROL SECTION

SET #104 - NOT USED

SET #105 - Corr Entry (I/S UL)
3 Hinges A8111 4 1/2 x 4 1/2 652
1 Entry Lockset F109 626
1 Core 1C-7(X2) (IN KEYWAY AS REQ'D) 626
1 Magnetic Hold Open/Self-Closing 689
1 Door Closer C02011 PT4F PT4H SNB 689
1 Kick Plate J102 - 10" x 2" LDW CSK 630
1 Wall Bumper L02101 630
1 Gasketing R0Y154 (5040 B HEAD & JAMBS)

SET #106 - Corr Entry (O/S NonUL and UL)
3 Hinges A8111 4 1/2 x 4 1/2 NRP 652
1 Entry Lockset F109 626
1 Core 1C-7(X2) (IN KEYWAY AS REQ'D) 626
1 Door Closer C02021 PT4F PT4H EDA SNB 689
1 Kick Plate J102 - 10" x 2" LDW CSK 630
1 Wall Bumper L02101 630
1 Gasketing R0Y154 (5040 B HEAD & JAMBS)

SET #107 - Corr Pass (I/S)
3 Hinges A8111 4 1/2 x 4 1/2 652
1 Passage Set 9K3-0N15D 626
1 Door Closer C02011 PT4F PT4H SNB 689
1 Kick Plate J102 - 10" x 2" LDW CSK 630
1 Wall Bumper L02101 630
3 Door Silencers L03011 GREY

SET #108 - Corr Pass (O/S)
3 Hinges A8111 4 1/2 x 4 1/2 652
1 Passage Set 9K3-0N15D 626
1 Door Closer C02021 PT4F PT4H EDA SNB 689
1 Kick Plate J102 - 10" x 2" LDW CSK 630
1 Wall Bumper L02101 630
3 Door Silencers L03011 GREY

SET #109 - Elec Rm (UL CR)
3 Hinges A8111 4 1/2 x 4 1/2 NRP 652
1 Elec. Fire Exit Device TYPE 1 - 03 x ELEC LVR TRIM x UL x RQE x SNB 630
1 Rim Cylinder 12E-72 L/C 626
1 Core 1C-7(X2) (IN KEYWAY AS REQ'D) 626
1 Door Closer C02021 PT4F PT4H EDA SNB 689
<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kick Plate</td>
<td>J102</td>
<td>1</td>
<td>- 10&quot; x 2&quot; LDW CSK</td>
</tr>
<tr>
<td>Wall Bumper</td>
<td>L02101</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Power Transfer</td>
<td>AS SPEC'D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasketing</td>
<td>R0Y154</td>
<td>1</td>
<td>(5040 B HEAD &amp; JAMBS)</td>
</tr>
<tr>
<td>Door Position Switch</td>
<td>DIVISION 28 - ESS (PREP ONLY)</td>
<td>1</td>
<td>ACCESS CONTROL SECTION</td>
</tr>
<tr>
<td>Card Reader</td>
<td>ACCESS CONTROL SECTION</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**SET #110 - Mech (I/S CR)**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>A8112 4 1/2 x 4 1/2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Electro-mech Lock</td>
<td>F86</td>
<td>1</td>
<td>ELEC UNLOCK X RQE</td>
</tr>
<tr>
<td>Core</td>
<td>1C-7(X2)</td>
<td>1</td>
<td>(IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>Door Closer</td>
<td>C02011</td>
<td>1</td>
<td>PT4F PT4H SNB</td>
</tr>
<tr>
<td>Wall Bumper</td>
<td>L02101</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Power Transfer</td>
<td>AS SPEC'D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasketing</td>
<td>R0Y154</td>
<td>1</td>
<td>(5040 B HEAD &amp; JAMBS)</td>
</tr>
<tr>
<td>Auto Door Bottom</td>
<td>R3B344</td>
<td>1</td>
<td>(320 N)</td>
</tr>
<tr>
<td>Door Position Switch</td>
<td>DIVISION 28 - ESS (PREP ONLY)</td>
<td>1</td>
<td>ACCESS CONTROL SECTION</td>
</tr>
<tr>
<td>Card Reader</td>
<td>ACCESS CONTROL SECTION</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**SET #111 - Mech (PR UL)**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>A8111 4 1/2 x 4 1/2</td>
<td>6</td>
<td>NRP</td>
</tr>
<tr>
<td>Fire Exit Device</td>
<td>TYPE 2 - 01 x LBR x UL x SNB</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Fire Exit Device</td>
<td>TYPE 2 - 08 x LBR x UL x SNB</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Rim Cylinder</td>
<td>12E-72 L/C</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Core</td>
<td>1C-7(X2)</td>
<td>1</td>
<td>(IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>Door Closer</td>
<td>C02021</td>
<td>2</td>
<td>PT4F PT4H EDA SNB</td>
</tr>
<tr>
<td>Wall Bumper</td>
<td>L02101</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>HD Set Seal</td>
<td>R3E156</td>
<td>1</td>
<td>(700 ES - HEAD &amp; JAMBS - )</td>
</tr>
<tr>
<td>Set Stile Seals</td>
<td>R3A734</td>
<td>1</td>
<td>(672 A)</td>
</tr>
</tbody>
</table>

**SET #112 - Elev Mech (O/S CR) UL**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>A8112 4 1/2 x 4 1/2</td>
<td>3</td>
<td>NRP</td>
</tr>
<tr>
<td>Electro-mech Lock</td>
<td>F86</td>
<td>1</td>
<td>ELEC UNLOCK X RQE</td>
</tr>
<tr>
<td>Core</td>
<td>1C-7(X2)</td>
<td>1</td>
<td>(IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>Door Closer</td>
<td>C02021</td>
<td>1</td>
<td>PT4F PT4H EDA SNB</td>
</tr>
<tr>
<td>Wall Bumper</td>
<td>L02101</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Power Transfer</td>
<td>AS SPEC'D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasketing</td>
<td>R0Y154</td>
<td>1</td>
<td>(5040 B HEAD &amp; JAMBS)</td>
</tr>
<tr>
<td>HD Set Seal</td>
<td>R3E156</td>
<td>1</td>
<td>(700-ES HEAD &amp; JAMBS)</td>
</tr>
<tr>
<td>Auto Door Bottom</td>
<td>R3B344</td>
<td>1</td>
<td>(320 N)</td>
</tr>
<tr>
<td>Door Position Switch</td>
<td>DIVISION 28 - ESS (PREP ONLY)</td>
<td>1</td>
<td>ACCESS CONTROL SECTION</td>
</tr>
<tr>
<td>Card Reader</td>
<td>ACCESS CONTROL SECTION</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Dbl Seal for Sound

**SET #113 - Tech Office**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>A8112 4 1/2 x 4 1/2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Entry Lockset</td>
<td>F109</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Core</td>
<td>1C-7(X2)</td>
<td>1</td>
<td>(IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>Door Closer</td>
<td>C02011</td>
<td>1</td>
<td>PT4F PT4H SNB</td>
</tr>
<tr>
<td>Kick Plate</td>
<td>J102</td>
<td>1</td>
<td>- 10&quot; x 2&quot; LDW CSK</td>
</tr>
<tr>
<td>Wall Bumper</td>
<td>L02101</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Weatherstrip</td>
<td>R3E165</td>
<td>1</td>
<td>(160 S - NGP)</td>
</tr>
<tr>
<td>Brush Sweep</td>
<td>R3A154</td>
<td>1</td>
<td>(600 A - NGP)</td>
</tr>
</tbody>
</table>

**SET #114 - Rec Stor (PR CR)**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Hinge</td>
<td>A51031B</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Continuous Hinge</td>
<td>A51331B</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Flush Bolt</td>
<td>L04081</td>
<td>2</td>
<td>- 12&quot;</td>
</tr>
</tbody>
</table>

- Single unit for Sound
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electro-mech Lock</td>
<td>F86 x ELEC UNLOCK X RQE</td>
</tr>
<tr>
<td>Core</td>
<td>1C-7(X2) (IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>Door Closer</td>
<td>Stop</td>
</tr>
<tr>
<td>Armor Plate</td>
<td>J101 - 34&quot; x 1-1/2&quot; LDW CSK UL</td>
</tr>
<tr>
<td>Power Transfer</td>
<td>AS SPEC'D</td>
</tr>
<tr>
<td>Dustproof Strike</td>
<td>L04021</td>
</tr>
<tr>
<td>HD Set Weatherstrip</td>
<td>R3E156 (700 ES - HEAD &amp; JAMBS - )</td>
</tr>
<tr>
<td>Astragal</td>
<td>R3E634 (158 ) MTG INSIDE IN-ACT LEAF</td>
</tr>
<tr>
<td>Brush Sweep</td>
<td>R3A154 (600 A - NGP)</td>
</tr>
<tr>
<td>Door Position Switch</td>
<td>DIVISION 28 - ESS (PREP ONLY)</td>
</tr>
<tr>
<td>Card Reader</td>
<td>ACCESS CONTROL SECTION</td>
</tr>
</tbody>
</table>

**SET #115 - Stor 3/6 (I/S CR)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>A8111 4 1/2 x 4 1/2</td>
</tr>
<tr>
<td>Electro-mech Lock</td>
<td>F86 x ELEC UNLOCK X RQE</td>
</tr>
<tr>
<td>Core</td>
<td>1C-7(X2) (IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>Door Closer</td>
<td>Stop</td>
</tr>
<tr>
<td>Kick Plate</td>
<td>J102 - 10&quot; x 2&quot; LDW CSK</td>
</tr>
<tr>
<td>Wall Bumper</td>
<td>L02101</td>
</tr>
<tr>
<td>Power Transfer</td>
<td>AS SPEC'D</td>
</tr>
<tr>
<td>Gasketing</td>
<td>R0Y154 (5040 B HEAD &amp; JAMBS)</td>
</tr>
<tr>
<td>Door Position Switch</td>
<td>DIVISION 28 - ESS (PREP ONLY)</td>
</tr>
<tr>
<td>Card Reader</td>
<td>ACCESS CONTROL SECTION</td>
</tr>
</tbody>
</table>

**SET #116 - Trash 3/6 (I/S CR)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>A8111 4 1/2 x 4 1/2</td>
</tr>
<tr>
<td>Electro-mech Lock</td>
<td>F86 x ELEC UNLOCK X RQE</td>
</tr>
<tr>
<td>Core</td>
<td>1C-7(X2) (IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>Door Closer</td>
<td>Stop</td>
</tr>
<tr>
<td>Armor Plate</td>
<td>J101 - 34&quot; x 1-1/2&quot; LDW CSK UL</td>
</tr>
<tr>
<td>Wall Bumper</td>
<td>L02101</td>
</tr>
<tr>
<td>Gasketing</td>
<td>R0Y154 (5040 B HEAD &amp; JAMBS)</td>
</tr>
<tr>
<td>Door Position Switch</td>
<td>DIVISION 28 - ESS (PREP ONLY)</td>
</tr>
<tr>
<td>Card Reader</td>
<td>ACCESS CONTROL SECTION</td>
</tr>
</tbody>
</table>

**SET #117 - Eqp Hold**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>A8112 4 1/2 x 4 1/2 NRP</td>
</tr>
<tr>
<td>Electro-mech Lock</td>
<td>F109</td>
</tr>
<tr>
<td>Core</td>
<td>1C-7(X2) (IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>Door Closer</td>
<td>Stop</td>
</tr>
<tr>
<td>Kick Plate</td>
<td>J102 - 10&quot; x 2&quot; LDW CSK</td>
</tr>
<tr>
<td>Wall Bumper</td>
<td>L02101</td>
</tr>
<tr>
<td>Auto Door Bottom</td>
<td>R3B344 (423 N)</td>
</tr>
</tbody>
</table>

**SET #118 - Rec Stor UL (CR)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Hinge</td>
<td>A51031B</td>
</tr>
<tr>
<td>Continuous Hinge</td>
<td>A51331B</td>
</tr>
<tr>
<td>Set Auto Flush Bolts</td>
<td>4.4 TYPE 25 (TRIMCO 3825L x 3815L)</td>
</tr>
<tr>
<td>Electro-mech Lock</td>
<td>F86 x ELEC UNLOCK X RQE</td>
</tr>
<tr>
<td>Core</td>
<td>1C-7(X2) (IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>Coordinator</td>
<td>TYPE 4.1.1 TYPE 21 x BRKT'S AS REQ'D BLK</td>
</tr>
<tr>
<td>Door Closer</td>
<td>Stop</td>
</tr>
<tr>
<td>Armor Plate</td>
<td>J101 - 34&quot; x 1-1/2&quot; LDW CSK UL</td>
</tr>
<tr>
<td>Wall Bumper</td>
<td>L02101</td>
</tr>
<tr>
<td>Power Transfer</td>
<td>AS SPEC'D</td>
</tr>
<tr>
<td>Dustproof Strike</td>
<td>L04021</td>
</tr>
<tr>
<td>HD Set Weatherstrip</td>
<td>R3E156 (700 ES - HEAD &amp; JAMBS - )</td>
</tr>
</tbody>
</table>
1 Astragal
   R3E634 (158 NA) MTG INSIDE IN-ACT LEAF
2 Door Position Switch
   DIVISION 28 - ESS (PREP ONLY)
1 Card Reader
   ACCESS CONTROL SECTION

SET #119 - Jan | EVS | Eqp Stor I/S UL
3 Hinges
   A8111 4 1/2 x 4 1/2
1 Storeroom Lockset
   F84
1 Core
   1C-7(X2) (IN KEYWAY AS REQ'D)
1 Door Closer
   C02011 PT4F PT4H SNB
1 Kick Plate
   J102 - 10" x 2" LDW CSK
1 Floor Stop
   L02141
1 Gasketing
   R0Y154 (5040 B HEAD & JAMBS)

SET #120 - Stor (I/S CR) Smk | UL
3 Hinges
   A8112 4 1/2 x 4 1/2
1 Electro-mech Lock
   F86 x ELEC UNLOCK X RQE
1 Core
   1C-7(X2) (IN KEYWAY AS REQ'D)
1 Door Closer
   C02011 PT4F PT4H SNB
1 Kick Plate
   J102 - 10" x 2" LDW CSK
1 Wall Bumper
   L02101
1 Power Transfer
   AS SPEC'D
1 Gasketing
   R0Y154 (5040 B HEAD & JAMBS)
1 Card Reader
   ACCESS CONTROL SECTION

SET #121 - Stor (I/S) Smk | UL
3 Hinges
   A8112 4 1/2 x 4 1/2
1 Storeroom Lockset
   F84
1 Core
   1C-7(X2) (IN KEYWAY AS REQ'D)
1 Door Closer
   C02021 PT4F PT4H EDA SNB
1 Floor Stop
   L02141
1 Wall Bumper
   L02101
1 Gasketing
   R0Y154 (5040 B HEAD & JAMBS)

SET #122 - NOT USED

SET #123 - Elev Mach (O/S CR) UL
3 Hinges
   A8112 4 1/2 x 4 1/2 NRP
1 Electro-mech Lock
   F86 x ELEC UNLOCK X RQE
1 Core
   1C-7(X2) (IN KEYWAY AS REQ'D)
1 Door Closer
   C02021 PT4F PT4H EDA SNB
1 Floor Stop
   L02141
1 Power Transfer
   AS SPEC'D
1 Gasketing
   R0Y154 (5040 B HEAD & JAMBS)
1 HD Seal
   R3E156 (700-ES HEAD & JAMBS)
1 Auto Door Bottom
   R3B344 (423 N)
1 Sill
   AS REQ'D
1 Card Reader
   ACCESS CONTROL SECTION

NOTE: Dbl Seal for Sound

SET #124 - Bio Med (PR CR) I/S
6 Hinges
   A8112 4 1/2 x 4 1/2
2 Flush Bolt
   L04081 - 12"
1 Electro-mech Lock
   F86 x ELEC UNLOCK X RQE
1 Core
   1C-7(X2) (IN KEYWAY AS REQ'D)
2 Door Closer
   C02011 PT4F PT4H SNB

SECTION 08 71 00 Page 17
<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Kick Plate J102 - 10&quot; x 2&quot; LDW CSK</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Wall Bumper L02101</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Power Transfer AS SPEC'D</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Dustproof Strike L04021</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Astragal R3E634 (158 NA ) MTG OUTSIDE IN-ACT LEAF</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Door Silencers L03011 GREY</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Door Position Switch DIVISION 28 - ESS (PREP ONLY)</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Card Reader ACCESS CONTROL SECTION</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Hinges A8111 4 1/2 x 4 1/2</td>
<td>652</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Set Auto Flush Bolts 4.4 TYPE 25 (3825L x 3815L)</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Electro-mech Lock F86 x ELEC UNLOCK X RQE</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Core 1C-7(X2) (IN KEYWAY AS REQ'D)</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Coordinator TYPE 4.1.1 TYPE 21 x BRKT'S AS REQ'D BLK</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Door Closer C02011 PT4F PT4H SNB</td>
<td>689</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Armor Plate J101 - 34&quot; x 1-1/2&quot; LDW CSK UL</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Floor Stop L02141</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Power Transfer AS SPEC'D</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Gasketing R0Y154 (5040 B HEAD &amp; JAMBS)</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Astragal R3E634 (158 NA ) MTG OUSIDE IN-ACT LEAF</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Door Position Switch DIVISION 28 - ESS (PREP ONLY)</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Card Reader ACCESS CONTROL SECTION</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Hinges A8111 4 1/2 x 4 1/2 NRP</td>
<td>652</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Electo-mech Lock F86 x ELEC UNLOCK X RQE</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Core 1C-7(X2) (IN KEYWAY AS REQ'D)</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Door Closer C02011 PT4F PT4H SNB</td>
<td>689</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Armor Plate J101 - 34&quot; x 1-1/2&quot; LDW CSK UL</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Wall Bumper L02101</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Power Transfer AS SPEC'D</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Gasketing R0Y154 (5040 B HEAD &amp; JAMBS)</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Door Position Switch DIVISION 28 - ESS (PREP ONLY)</td>
<td>626</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Card Reader ACCESS CONTROL SECTION</td>
<td>626</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: Mount Dummy Trim at Lockset height - Cylinder 3-5/8 above - Adjust template.
<table>
<thead>
<tr>
<th>Set #</th>
<th>Description</th>
<th>Part #</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>129</td>
<td>Comm (O/S CR)</td>
<td>3 Hinges A8111 4 1/2 x 4 1/2 NRP</td>
<td>652</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Electro-mech Lock F86 x ELEC UNLOCK X RQE</td>
<td>626</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Core IC-7(X2) (IN KEYWAY AS REQ'D)</td>
<td>626</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Door Closer C02021 PT4F PT4H EDA SNB</td>
<td>689</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Wall Bumper L02101</td>
<td>630</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Power Transfer AS SPEC'D</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Gasketing R0Y154 (5040 B HEAD &amp; JAMBS)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Door Position Switch DIVISION 28 - ESS (PREP ONLY)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Card Reader ACCESS CONTROL SECTION</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set #</th>
<th>Description</th>
<th>Part #</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>130</td>
<td>RR-Multi</td>
<td>3 Hinges A8111 4 1/2 x 4 1/2</td>
<td>652</td>
</tr>
<tr>
<td></td>
<td>Push Pull Latch HL - WIDE x HORZ MTG(LR6000 2A-ABH)</td>
<td>630AM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Door Closer C02021 PT4F PT4H EDA SNB</td>
<td>689</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kick Plate J102 - 10&quot; x 2&quot; LDW CSK</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mop Plate J103 - 4&quot; x 1&quot; LDW CSK</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wall Bumper L02101</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gasketing R0Y154 (5040 B HEAD &amp; JAMBS)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set #</th>
<th>Description</th>
<th>Part #</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>131</td>
<td>RR-Multi</td>
<td>3 Hinges A8111 4 1/2 x 4 1/2</td>
<td>652</td>
</tr>
<tr>
<td></td>
<td>Door Closer C02021 PT4F PT4H EDA SNB</td>
<td>689</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kick Plate J102 - 10&quot; x 2&quot; LDW CSK</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wall Bumper L02101</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gasketing R0Y154 (5040 B HEAD &amp; JAMBS)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set #</th>
<th>Description</th>
<th>Part #</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>132</td>
<td>RR-Sgl</td>
<td>3 Hinges A8112 4 1/2 x 4 1/2</td>
<td>652</td>
</tr>
<tr>
<td></td>
<td>Privacy Set F76</td>
<td>626AM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Door Closer C02011 PT4F PT4H SNB</td>
<td>689</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kick Plate J102 - 10&quot; x 2&quot; LDW CSK</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wall Bumper L02101</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Door Silencers L03011</td>
<td>GREY</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gasketing R0Y154 (5040 B HEAD &amp; JAMBS</td>
<td>DR 1302)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set #</th>
<th>Description</th>
<th>Part #</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>133</td>
<td>RR</td>
<td>3 Hinges A8112 4 1/2 x 4 1/2</td>
<td>652</td>
</tr>
<tr>
<td></td>
<td>Privacy Set F76</td>
<td>626AM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Door Closer C02021 PT4F PT4H EDA SNB</td>
<td>689</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kick Plate J102 - 10&quot; x 2&quot; LDW CSK</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wall Bumper L02101</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conc. Overhead Stop C01541</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Door Silencers L03011</td>
<td>GREY</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set #</th>
<th>Description</th>
<th>Part #</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>134</td>
<td>RR-Sgl (I/S-OHS)</td>
<td>3 Hinges A8112 4 1/2 x 4 1/2</td>
<td>652</td>
</tr>
<tr>
<td></td>
<td>Privacy Set F76</td>
<td>626AM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Door Closer C02011 PT4F PT4H SNB</td>
<td>689</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kick Plate J102 - 10&quot; x 2&quot; LDW CSK</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mop Plate J103 - 4&quot; x 1&quot; LDW CSK</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Door Silencers L03011</td>
<td>GREY</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set #</th>
<th>Description</th>
<th>Part #</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>135</td>
<td>RR-Sgl (O/S-C/S)</td>
<td>3 Hinges A8112 4 1/2 x 4 1/2</td>
<td>652</td>
</tr>
<tr>
<td></td>
<td>Privacy Set F76</td>
<td>626AM</td>
<td></td>
</tr>
</tbody>
</table>
1  Door Closer | Stop  C02021 PT4F PT4G PT4H SNB  689
1  Kick Plate  J102 - 10'' x 2'' LDW CSK  630
3  Door Silencers  L03011  GREY

SET #136 - RR-Sgl (OHS)
3  Hinges  A8112 4 1/2 x 4 1/2  652
1  Privacy Set  F76  626AM
1  Conc. Overhead Stop  C01541  630
3  Door Silencers  L03011  GREY

SET #137 - Sld | Cln (I/S) SMK UL
3  Hinges  A8111 4 1/2 x 4 1/2  652
1  Entry Lockset  F109  626AM
1  Core  1C-7(X2) (IN KEYWAY AS REQ'D)  626
1  Door Closer  C02011 PT4F PT4H SNB  689
1  Kick Plate  J102 - 10'' x 2'' LDW CSK  630
1  Floor Stop  L02141  626
1  Gasketing  R0Y154 (5040 B HEAD & JAMBS)

SET #138 - Eqp Stor 3/6 (I/S) SMK UL
3  Hinges  A8111 4 1/2 x 4 1/2  652
1  Storeroom Lockset  F86  626AM
1  Core  1C-7(X2) (IN KEYWAY AS REQ'D)  626
1  Door Closer  C02011 PT4F PT4H SNB  689
1  Kick Plate  J102 - 10'' x 2'' LDW CSK  630
1  Wall Bumper  L02101  630
1  Gasketing  R0Y154 (5040 B HEAD & JAMBS)

SET #139 - Pat DTR
3  Hinges  A8112 4 1/2 x 4 1/2  652
1  Passage Set  F75  626AM
1  Door Closer | HO  C02051 PT4F PT4H SNB  689
1  Kick Plate  J102 - 10'' x 2'' LDW CSK  630
1  Mop Plate  J103 - 4'' x 1'' LDW CSK  630
1  Wall Bumper  L02101  630
3  Door Silencers  L03011  GREY

SET #140 - Pat | Sgry
3  Hinges  A8111 4 1/2 x 4 1/2  652
1  Push/Pull Latch  P/P Latch (TRIMCO - 1580 ENG x ASA)  710CU
1  Door Closer | HO  C02051 PT4F PT4H SNB  689
1  Kick Plate  J102 - 10'' x 2'' LDW CSK  630
1  Mop Plate  J103 - 4'' x 1'' LDW CSK  630
1  Wall Bumper  L02101  630
3  Door Silencers  L03011  GREY

SET #141 - Office
3  Hinges  A8112 4 1/2 x 4 1/2  652
1  Entry Lockset  F109  626
1  Core  1C-7(X2) (IN KEYWAY AS REQ'D)  626
1  Wall Bumper  L02101  630
3  Door Silencers  L03011  GREY

SET #142 - Stf Lng
3  Hinges  A8111 4 1/2 x 4 1/2  652
1  Passage Set  F75  626
1  Door Closer | HO  C02051 PT4F PT4H SNB  689
1  Kick Plate  J102 - 10'' x 2'' LDW CSK  630
1  Mop Plate  J103 - 4'' x 1'' LDW CSK  630
<table>
<thead>
<tr>
<th>Set #143 - Office (I/S CR)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hinges</td>
<td>A8112 4 1/2 x 4 1/2</td>
</tr>
<tr>
<td>1 Electro-mech Lock</td>
<td>F86 x ELEC UNLOCK X RQE</td>
</tr>
<tr>
<td>1 Core</td>
<td>1C-7(X2) (IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>1 Door Closer</td>
<td>HO</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>J102 - 10&quot; x 2&quot; LDW CSK</td>
</tr>
<tr>
<td>1 Wall Bumper</td>
<td>L02101</td>
</tr>
<tr>
<td>1 Power Transfer</td>
<td>AS SPEC'D</td>
</tr>
<tr>
<td>1 Gasketing</td>
<td>R0Y154 (5040 B HEAD &amp; JAMBS)</td>
</tr>
<tr>
<td>1 Door Position Switch</td>
<td>DIVISION 28 - ESS (PREP ONLY)</td>
</tr>
<tr>
<td>1 Card Reader</td>
<td>ACCESS CONTROL SECTION</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set #144 - Office (I/S CLS)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hinges</td>
<td>A8112 4 1/2 x 4 1/2</td>
</tr>
<tr>
<td>1 Entry Lockset</td>
<td>F109</td>
</tr>
<tr>
<td>1 Door Closer</td>
<td>HO</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>J102 - 10&quot; x 2&quot; LDW CSK</td>
</tr>
<tr>
<td>1 Wall Bumper</td>
<td>L02101</td>
</tr>
<tr>
<td>1 Gasketing</td>
<td>R0Y154 (5040 B HEAD &amp; JAMBS)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set #145 - Office (I/S OHS)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hinges</td>
<td>A8112 4 1/2 x 4 1/2</td>
</tr>
<tr>
<td>1 Entry Lockset</td>
<td>F109</td>
</tr>
<tr>
<td>1 Conc. Overhead Stop</td>
<td>C01541</td>
</tr>
<tr>
<td>3 Door Silencers</td>
<td>L03011</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set #146 - Ster Stor (Conn)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hinges</td>
<td>A8111 4 1/2 x 4 1/2 NRP</td>
</tr>
<tr>
<td>1 Dbl Key Lockset</td>
<td>F91</td>
</tr>
<tr>
<td>2 Core</td>
<td>1C-7(X2) (IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>1 Door Closer</td>
<td>C02021 PT4F PT4H EDA SNB</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>J102 - 10&quot; x 2&quot; LDW CSK</td>
</tr>
<tr>
<td>1 Mop Plate</td>
<td>J103 - 4&quot; x 1&quot; LDW CSK</td>
</tr>
<tr>
<td>1 Wall Bumper</td>
<td>L02101</td>
</tr>
<tr>
<td>3 Door Silencers</td>
<td>L03011</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set #147 - Suite (I/S UL CR)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hinges</td>
<td>A8111 4 1/2 x 4 1/2</td>
</tr>
<tr>
<td>1 Electro-mech Lock</td>
<td>F86 x ELEC UNLOCK X RQE</td>
</tr>
<tr>
<td>1 Core</td>
<td>1C-7(X2) (IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>1 Door Closer</td>
<td>C02011 PT4F PT4H SNB</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>J102 - 10&quot; x 2&quot; LDW CSK</td>
</tr>
<tr>
<td>1 Wall Bumper</td>
<td>L02101</td>
</tr>
<tr>
<td>1 Power Transfer</td>
<td>AS SPEC'D</td>
</tr>
<tr>
<td>1 Gasketing</td>
<td>R0Y154 (5040 B HEAD &amp; JAMBS)</td>
</tr>
<tr>
<td>1 Door Position Switch</td>
<td>DIVISION 28 - ESS (PREP ONLY)</td>
</tr>
<tr>
<td>1 Card Reader</td>
<td>ACCESS CONTROL SECTION</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set #148 - Suite (O/S CR)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hinges</td>
<td>A8111 4 1/2 x 4 1/2</td>
</tr>
<tr>
<td>1 Electro-mech Lock</td>
<td>F86 x ELEC UNLOCK X RQE</td>
</tr>
<tr>
<td>1 Core</td>
<td>1C-7(X2) (IN KEYWAY AS REQ'D)</td>
</tr>
<tr>
<td>1 Door Closer</td>
<td>C02021 PT4F PT4H EDA SNB</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>J102 - 10&quot; x 2&quot; LDW CSK</td>
</tr>
<tr>
<td>1 Wall Bumper</td>
<td>L02101</td>
</tr>
<tr>
<td>1 Power Transfer</td>
<td>AS SPEC'D</td>
</tr>
</tbody>
</table>
1. **Gasketing**  
   R0Y154 (5040 B HEAD & JAMBS)

2. **Door Position Switch**  
   DIVISION 28 - ESS (PREP ONLY)

3. **Card Reader**  
   ACCESS CONTROL SECTION

**SET #149 - Conf**

1. **Hinges**  
   A8112 4 1/2 x 4 1/2

2. **Passage Set**  
   F75

3. **Door Closer**  
   C02011 PT4F PT4H SNB

4. **Floor Stop**  
   L02141

5. **Gasketing**  
   R0Y154 (5040 B HEAD & JAMBS)

**SET #150 - NOT USED**

**SET #151 - NOT USED**

**SET #152 - Clsrm (O/S)**

1. **Hinges**  
   A8111 4 1/2 x 4 1/2 NRP

2. **Clsrm Lockset**  
   F84

3. **Core**  
   1C-7(X2) (IN KEYWAY AS REQ'D)

4. **Door Closer|Stop|HO**  
   C02061 PT4F PT4G PT4H SNB

5. **Kick Plate**  
   J102 - 10" x 2" LDW CSK

6. **Gasketing**  
   R0Y154 (5040 B HEAD & JAMBS)

**SET #153 - Med (I/S CR)**

1. **Hinges**  
   HT A8111 4 1/2 x 4 1/2 SEC STUD

2. **Electro-mech Lock**  
   F86 x ELEC UNLOCK X RQE

3. **Core**  
   1C-7(X2) (IN KEYWAY AS REQ'D)

4. **Door Closer**  
   C02061 PT4F PT4H SNB

5. **Kick Plate**  
   J102 - 10" x 2" LDW CSK

6. **Floor Stop**  
   L02141

7. **Gasketing**  
   R0Y154 (5040 B HEAD & JAMBS)

8. **Power Transfer**  
   AS SPEC'D

9. **Door Position Switch**  
   DIVISION 28 - ESS (PREP ONLY)

10. **Card Reader**  
    ACCESS CONTROL SECTION

**SET #154 - Mech (O/S PENT)**

1. **Hinges**  
   A8111 4 1/2 x 4 1/2 NRP

2. **Storeroom Lockset**  
   F86

3. **Core**  
   1C-7(X2) (IN KEYWAY AS REQ'D)

4. **Door Closer**  
   C02021 PT4F PT4H EDA SNB

5. **Wall Bumper**  
   L02101

6. **HD Set Seal**  
   R3E156 (700-ES HEAD & JAMBS)

**SET #155 - Mech (O/S PENT VEST)**

1. **Hinges**  
   A8111 4 1/2 x 4 1/2

2. **Passage Set**  
   F75

3. **Door Closer**  
   C02021 PT4F PT4H EDA SNB

4. **Wall Bumper**  
   L02101

5. **HD Set Seal**  
   R3E156 (700-ES HEAD & JAMBS)

**SET #156 - Alum - O/S (CR)**

1. **Continuous Hinge**  
   A31331G

2. **Electro-mech Lock**  
   F86 x ELEC UNLOCK X RQE

3. **Core**  
   1C-7(X2) (IN KEYWAY AS REQ'D)

4. **Door Closer**  
   C02011 PT4G PT4H

5. **Power Transfer**  
   AS SPEC'ED

6. **Wall Bumper**  
   L02101

7. **Premeter Gasket**  
   FRAME MFG

8. **Door Sweep**  
   R3B416 (200 NA - NGP)
<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model/Specification</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door Position Switch</td>
<td>DIVISION 28 - ESS (PREP ONLY)</td>
<td>1</td>
</tr>
<tr>
<td>Card Reader</td>
<td>ACCESS CONTROL SECTION</td>
<td>1</td>
</tr>
</tbody>
</table>

NOTE: Coordinate Hardware with Door and Frame Manufacturer

**SET #157 - Decon (PR CR) I/S**

<table>
<thead>
<tr>
<th>Item</th>
<th>Model/Specification</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>A8111 4 1/2 x 4 1/2</td>
<td>6</td>
</tr>
<tr>
<td>Set Auto Flush Bolt</td>
<td>TYPE 4.4 TYPE 25 CONST LATCH</td>
<td>1</td>
</tr>
<tr>
<td>Coordinator</td>
<td>TYPE 4.1.1 TYPE 21</td>
<td>1</td>
</tr>
<tr>
<td>Electro-mech Lock</td>
<td>F86 x ELEC UNLOCK X RQE</td>
<td>1</td>
</tr>
<tr>
<td>Core</td>
<td>1C-7(X2) (IN KEYWAY AS REQ'D)</td>
<td>1</td>
</tr>
<tr>
<td>Door Closer</td>
<td>C02011 PT4F PT4H SNB</td>
<td>2</td>
</tr>
<tr>
<td>Kick Plate</td>
<td>J102 - 10&quot; x 2&quot; LDW CSK</td>
<td>2</td>
</tr>
<tr>
<td>Wall Bumper</td>
<td>L02101</td>
<td>1</td>
</tr>
<tr>
<td>Power Transfer</td>
<td>AS SPEC'D</td>
<td>1</td>
</tr>
<tr>
<td>Dustproof Strike</td>
<td>L04021</td>
<td>1</td>
</tr>
<tr>
<td>Astragel</td>
<td>R3BE634 (158 NA ) MTG OUTSIDE IN-ACT LEAF</td>
<td>1</td>
</tr>
<tr>
<td>Gasketing</td>
<td>R0Y154 (5040 B HEAD &amp; JAMBS)</td>
<td>2</td>
</tr>
</tbody>
</table>

**SET #158 - Clsrn (I/S)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Model/Specification</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>A8111 4 1/2 x 4 1/2</td>
<td>3</td>
</tr>
<tr>
<td>Clsrn Lockset</td>
<td>F84</td>
<td>1</td>
</tr>
<tr>
<td>Core</td>
<td>1C-7(X2) (IN KEYWAY AS REQ'D)</td>
<td>1</td>
</tr>
<tr>
<td>Door Closer</td>
<td>C02011 PT4F PT4H SNB</td>
<td>1</td>
</tr>
<tr>
<td>Kick Plate</td>
<td>J102 - 10&quot; x 2&quot; LDW CSK</td>
<td>1</td>
</tr>
<tr>
<td>Wall Bumper</td>
<td>L02101</td>
<td>1</td>
</tr>
<tr>
<td>Gasketing</td>
<td>R0Y154 (5040 B HEAD &amp; JAMBS)</td>
<td>1</td>
</tr>
</tbody>
</table>

**SET #M100 - AL - Vest Slider**

NOTE: All Hardware by Door Manufacturer

-- End of Section --
PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 800 (2010) Back Bedding Mastic Type Glazing Tapes, AAMA 804.3, 806.3 and 807.3 Expanded Cellular Glazing Tapes, AAMA 810.1

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)


ASTM INTERNATIONAL (ASTM)


GLASS ASSOCIATION OF NORTH AMERICA (GANA)


1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor's Quality Control approval. Group submittals of complementary and related products and materials as needed to represent total assemblies and facilitate concurrent coordination review. The Government may withhold action on submittals requiring coordination with other submittals until related submittals are received. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:
SD-02 Shop Drawings

Installation; G

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

SD-03 Product Data

Insulating Glass; G
Float Glass; G
Laminated Glass; G
Low Emissivity (Low-E) Glass; G
Tempered Float Glass; G
Heat-Strengthened Float Glass; G
Fire/Safety Rated Glass; G
Ceramic Coated Spandrel Glass; G
Mirrors

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

SD-05 Design Data

Performance Requirements Verification; G

For products and systems indicated to validate compliance with specified performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

SD-07 Certificates

Insulating Glass; G

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

Warranty for insulating glass
Warranty for laminated 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

1.3.1 Performance Requirements

Provide and fabricate exterior glass and glazing for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to resist the following:

   a. Wind load based on design wind load criteria indicated on the Structural drawings in accordance with the ICC IBC and ASCE 7 requirements for Components and Cladding.

   b. Minimum load requirements as specified in Sections 08 11 13 STEEL DOORS AND FRAMES, 08 41 13 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS, and 08 42 29.23 50 SLIDING AUTOMATIC ENTRANCE DOORS, meeting UFC 4-010-01, Standard 10 requirements.

1.3.2 Safety Glazing

Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

1.3.3 Thermal and Optical Performance Properties

Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

   a. For monolithic-glass lites, properties are based on units with lites of thickness indicated.

   b. For laminated-glass lites, properties are based on products of construction indicated.

   c. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.

   d. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg. F.

   e. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.

   f. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

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.

1.6 WARRANTY

1.6.1 Warranty for Insulating Glass

Manufacturer agrees to replace insulating-glass units that deteriorate as defined herein within specified warranty period of 5 years from date of final acceptance of the work.

1.6.1.1 Deterioration of Insulating Glass

Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.6.2 Warranty for Laminated Glass

Manufacturer agrees to replace laminated-glass units that deteriorate as defined herein within specified warranty period of 5 years from date of final acceptance of the work.

1.6.2.1 Deterioration of Laminated Glass

Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 Glazing Publications

Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

2.1.1.1 GANA Publications


2.1.1.2 IGMA Publication for Insulating Glass

Glass Units for Commercial and Residential Use”.

2.1.2 Safety Glazing Labeling

Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicated manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

2.1.3 Insulating-Glass Certification Program

Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

2.2 GLASS

ASTM C 1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.2.1 Float Glass

ASTM C 1036 Type I, Class 1 (clear), Quality-Q3.

2.2.2 Laminated Glass

ASTM C 1172, fabricated from two nominal 6 mm thick specified heat-strengthened float glass. Glass shall be laminated together with a minimum of 0.090 inch thick, clear polyvinyl butyral interlayer. The minimum total thickness shall be nominally 9/16 inch (size as required to meet requirements of paragraph entitled "Performance Requirements"). Glass color shall be clear unless otherwise indicated.

2.2.2.1 Exterior Glazed Doors

Provide specified laminated glass, except outer lite shall be specified low emissivity glass.

2.2.3 Low Emissivity (Low-E) Glass

Minimum 6 mm thick (size as required to meet requirements of paragraph entitled "Performance Requirements") float glass, Class 2-tinted in hues indicated on Drawings, with anti-reflective low-emissivity coating on No. 2 surface.

2.2.4 Tempered Float Glass

ASTM C 1048, Kind FT, Condition A (uncoated), unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality Q3, minimum 6 mm thick. Color shall be clear for interior use.

2.2.5 Heat-Strengthened Float Glass

ASTM C 1048, Kind HS, Condition A (uncoated) unless otherwise indicated, Type I, Quality Q3, Class 1 (clear), or Class 2 (tinted) as indicated, minimum 6 mm thick.
2.2.6 Mirrors

2.2.6.1 Glass Mirrors

Glass for mirrors shall be Type I transparent flat type, Class 1-clear, Glazing Quality q1 1/4 inch thick conforming to ASTM C 1036. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint, and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.3 INSULATING GLASS UNITS

2.3.1 Insulating-Glass Units

Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.

2.3.1.1 Sealing System

Dual seal, with manufacturer's standard primary and secondary sealants.

2.3.1.2 Spacer

Manufacturer's standard spacer material and construction.

2.3.1.3 Desiccant

Molecular sieve or silica gel, or a blend of both.

2.4 CERAMIC COATED SPANDREL GLASS

ASTM C 1048, Condition B (spandrel glass, second surface ceramic coated), Type I (transparent flat glass), Quality-Q3, Class 2 (tinted), Kind HS (heat strengthened), float glass, minimum 6 mm thick (size as required to meet requirements of paragraph entitled "Performance Requirements").

2.4.1 Glass and Color

Match glass and tint color of exterior glass panels where spandrel glass is located.

2.4.2 Ceramic Color Coating

Match tint color of glass.
2.5 FIRE-PROTECTION-RATED GLAZING

2.5.1 Fire-Protection-Rated Glazing

Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.

   a. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test.

2.5.2 Fire-Protection-Rated Glazing Labeling

Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F temperature-rise limitation; and the fire-resistance rating in minutes.

2.5.3 Film-Faced Ceramic Glazing

Clear, ceramic flat glass; 5-mm thickness; faced on one surface with a clear glazing film; and complying with 16 CFR 1201, Category II.

2.5.4 Laminated Glass with Intumescent Interlayers

Laminated glass made from multiple plies of uncoated, ultraclear float glass; with Intumescent interlayers; and complying with 16 CFR 1201.

2.6 GLAZING SEALANTS

2.6.1 General

2.6.1.1 Compatibility

Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2.6.1.2 Suitability

Comply with sealant and glass manufacturer's written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

2.6.1.3 Colors of Exposed Glazing Sealants

Manufacturer's standard.

2.6.2 Glazing Sealant

Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 10//50, Use NT.
2.7 GLAZING TAPES

2.7.1 Back-Bedding Mastic Glazing Tapes

Performed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

a. AAMA 804.3 tape, where required.

b. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

c. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.7.2 Expanded Cellular Glazing Tapes

Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

a. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.

b. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

2.8.1 General

Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

2.8.2 Cleaners, Primers, and Sealers

Types recommended by sealant or gasket manufacturer.

2.8.3 Setting Blocks:

Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

2.8.4 Spacers

Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

2.8.5 Edge Blocks

Elastomeric material of hardness needed to limit glass lateral movement (side walking).
2.8.6 Cylindrical Glazing Sealant Backing

ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8.7 Accessories

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

2.9 MIRROR ACCESSORIES

2.9.1 Mastic

Mastic for setting mirrors shall be a polymer type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Mastic shall be compatible with mirror backing paint, and shall be approved by mirror manufacturer.

2.9.2 Mirror Clips

Concealed fasteners of type to suit wall construction material shall be provided with clips.

2.10 FABRICATION OF GLAZING UNITS

Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

a. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components. Temperature change shall be 120 deg F, ambient; 180 deg F material surfaces.

Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

Grind smooth and polish exposed glass edges and corners.

PART 3 EXECUTION

3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, SIGMA TB-3001, SIGMA 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.

SECTION 08 81 00 Page 10
3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, SIGMA TB-3001, SIGMA 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. Coordinate glass setting requirements with frame assemblies provided. Exterior glazing shall have a minimum frame bite of 3/8 inch for structurally glazed framing systems and one inch for framing glazing systems that are not structurally glazed.

3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

3.2.2 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of SIGMA TB-3001 and SIGMA TM-3000.

3.2.3 Installation of Laminated Glass

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

3.3 CLEANING

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

3.4 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Reflective glass shall be protected with a protective material to eliminate any contamination of the reflective coating. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

3.5 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.
3.6 FIRE-PROTECTION RATED GLAZING SCHEDULE

3.6.1 Glass Type: 20-Minutes and 45-Minute Fire-Protection-Rated Glazing

Film-faced ceramic glazing. Provide where 20-minute rated and 45-minute rated indicated.

3.6.2 Glass Type: 60-Minute Fire-Protection-Rated Glazing with 450 deg F Temperature-Rise Limitation

Laminated glass with Intumescent interlayers or double glazing units with clear gel fill. Provide where 60-minute rated indicated.

3.7 MONOLITHIC GLASS SCHEDULE

3.7.1 Glass Type: Clear, Fully Tempered Float Glass

a. Minimum Thickness shall be 6 mm.

b. Safety glazing required.

3.7.2 Glass Type: Clear Annealed Float Glass

a. Minimum thickness shall be 6 mm.

3.8 INSULATING-LAMINATED-GLASS SCHEDULE

3.8.1 Glass Type V: Low-E Coated, Tinted, Insulating, Laminated Glass

3.8.1.1 Overall Unit Thickness

Nominal 1-5/16 inches.

3.8.1.2 Minimum Thickness of Outdoor Lite

6 mm.

3.8.1.3 Outdoor Lite

Tinted heat-strengthened float glass.

3.8.1.4 Tint Color

As indicated on drawings.

3.8.1.5 Interspace Content

Air.

3.8.1.6 Indoor Lite

Clear laminated glass with two piles of heat-strengthened float glass.

a. Minimum thickness of each glass ply shall be 6mm.

b. Interlayer thickness shall be 0.090 inch.

c. Low-E Coating: When used in exterior glazed doors, manufacturer's standard process on No. 2 surface; hue to match tint color.
3.8.1.7 Low-E Coating
Manufacturer's standard process on No. 2 surface.

3.8.1.8 Winter U-Factor
0.29 maximum.

3.8.1.9 Summer U-Factor
0.26 maximum.

3.8.1.10 Visible Light Transmittance
57 percent.

3.8.1.11 Solar Heat Gain Coefficient
0.32 maximum.

3.8.1.12 Shading Coefficient
0.36 maximum.

3.8.1.13 Reflectance, Visible Light Exterior
9 percent.

3.8.1.14 Safety Glazing
Required.

3.9 INSULATING-LAMINATED SPANDREL-GLASS SCHEDULE

3.9.1 Glass Type: Low-E Coated, Tinted, Insulating, Laminated Glass

3.9.1.1 Overall Unit Thickness
Nominal 1-5/16 inches.

3.9.1.2 Minimum Thickness of Outdoor Lite
6 mm.

3.9.1.3 Outdoor Lite
Ceramic-coated spandrel glass.

3.9.1.4 Tint Color
As indicated on drawings.

3.9.1.5 Interspace Content
Air.

3.9.1.6 Indoor Lite
Clear laminated glass with two plies of heat-strengthened float glass.
a. Minimum thickness of each glass ply shall be 6 mm.
b. Interlayer thickness shall be 0.090 inch.

3.9.1.7 Winter U-Factor
0.29 maximum.

3.9.1.8 Summer U-Factor
0.26 maximum.

3.9.1.9 Solar Heat Gain Coefficient
0.32 maximum.

3.9.1.10 Safety
Glazing required.

-- End of Section --
PART 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 (2007) Laboratory Methods of Testing Dampers for Rating

AMCA 511 (2007) Certified Ratings Program for Air Control Devices

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)


AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)


ASTM INTERNATIONAL (ASTM)


ASTM D 1187 (1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal

INTERNATIONAL CODE COUNCIL (ICC)


U.S. GREEN BUILDING COUNCIL (USGBC)

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Wind Load Requirements

Provide exterior metal wall louvers capable of withstanding structural loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.

Design and fabricate all exterior wall louvers provided to resist wind load criteria indicated on Structural drawings in accordance with requirements of ICC IBC and ASCE 7 for Components and Cladding. Submit calculations to validate compliance signed and sealed by a qualified Professional Engineer responsible for their preparation.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor's Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wall louvers; G

Clearly indicate and emphasize louver drainage provisions.

SD-03 Product Data

Metal Wall Louvers; G

Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter less water and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-05 Design Data

Performance Requirements Validation; G

For products and systems indicated to validate compliance with specified performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.

SD-11 Closeout

All approved LEED Submittals specified under SD-03 Product Data; S
1.4 WARRANTY

1.4.1 Special Warranty

Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall louvers that fail in materials or workmanship within specified warranty period.

1.4.1.1 Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking or puncturing.

b. Deterioration of metals and other materials beyond normal weathering.

1.4.1.2 Warranty Period

Two years from date of final acceptance of the Work.

1.4.2 Special Finish Warranty

Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1.4.2.1 Warranty Period

10 years from date of final acceptance of the Work.

1.5 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.2 MATERIALS

2.2.1 Aluminum Sheet

ASTM B 209, alloy 3003 or 5005 with temper as required for forming.

2.2.2 Extruded Aluminum

ASTM B 221, alloy 6063-T5 or -T52.

2.3 METAL WALL LOUVERS

Weather resistant type with bird screens. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D and AMCA 511. The rating shall show a water penetration of 0.20 or less ounce per square foot of free
area at a free velocity of 800 feet per minute. Minimum louver free area shall be 45 percent. Intake pressure drop shall be a maximum of 0.12 inches of water and exhaust pressure drop shall be a maximum of 0.09 inches of water at free area face velocity. Minimum louver depth shall be 6 inches. Louver vanes shall be equipped with vertical fins or extrusions to impede the inflow of rain driven toward the louver face. Equip louver with drainage channels and spaces to allow in-driven moisture to weep to the exterior louver face.

2.3.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch. Size as indicated.

2.3.2 Screens and Frames

For aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3.3 Insulated, Blank-Off Panels

Laminated panels consisting of insulating core surfaced on back and front with metal sheets and attached to back of louver.

a. Thickness: 2 inches.

b. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.

c. Insulating Core: Extruded-polystyrene foam; LTTR Value 5.0 per inch.

d. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.

e. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.

f. Panel Finish: Same type of finish applied to louvers, but black color.

g. Attach blank-off panels with sheet metal screws.

2.4 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers. Provide other accessories as required for complete and proper installation, including sill flashings with end dams of same material and finish as louvers, and support angles. Where removable louvers indicated, provide suitable fasteners for convenient removal as required to suit conditions.

2.4.1 Bituminous Paint

Cold-applied asphalt with ASTM D 1187.
2.5 FINISHES

2.5.1 Factory Finish

2-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to expose metal surfaces to comply with coating and resin manufacturers written instructions.

2.5.2 Color

Color as indicated on Drawings.

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.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Aluminum

Where aluminum contacts dissimilar metal, concrete or masonry, apply a heavy coating of bituminous paint.

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 A 653/A 653M (2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM C 645 (2009a) Nonstructural Steel Framing Members

ASTM C 754 (2009a) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

ASTM F 1267 (2007) Metal, Expanded, Steel

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM ML/SFA MLF (1991) Metal Lathing and Furring

STEEL STUD MANUFACTURER'S ASSOCIATION

SSMA Details Cold-Formed Steel Details

U.S. GREEN BUILDING COUNCIL (USGBC)


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

Metal support systems; G,
Perimeter transition system; G
Submit for the erection of metal framing, furring, and ceiling suspension systems. Indicate materials, sizes, thicknesses, and fastenings.

SD-03 Product Data
Perimeter Transition System; G
Recycled Content (LEED Credit MR 4); G
Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content included in this Section. Include a statement indicating material only costs for each product having recycled content. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-11 Closeout
All approved LEED Submittals specified under SD-03 Product Data; S

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

1.4 SUSTAINABLE DESIGN REQUIREMENTS
See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT OF PRODUCTS
Provide products with post-consumer recycled content plus one-half of pre-consumer recycled content to the greatest extent possible.

2.2 MATERIALS
Provide steel materials for metal support systems with galvanized coating ASTM A 653/A 653M, G-60; aluminum coating ASTM A 463/A 463M, T1-25; or a 55-percent aluminum-zinc coating.

2.2.1 Materials for Attachment of Gypsum Wallboard

2.2.1.1 Suspended and Furred Ceiling Systems
ASTM C 645.

2.2.1.2 Nonload-Bearing Wall Framing and Furring
ASTM C 645. Minimum base metal thickness shall be 0.033 inch (20 gage). Dimpled wall framing and furring are NOT acceptable.
a. Maximum framing and furring spacing: As indicated on drawings or, if not indicated 16 in. on center.

b. Maximum fastener spacing: 24 inches.

c. Maximum stud height: As indicated on drawings.

d. Locate additional studs at partition intersections.

e. Locate additional studs at partition corners.

f. For stud heights greater than listed above, provide stud bracing to roof structure or exterior wall, spaced 48 in. o.c.

g. Stud heights shall be continuous lengths. Do not splice studs.

2.2.1.3 Z-Furring Channels with Wall Insulation

Not lighter than 26 gage galvanized steel, Z-shaped, with 1 1/4 inch and 3/4 inch flanges and depth as required by the insulation thickness provided.

2.2.2 Deep-Leg Deflection Track

Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

2.2.3 Firestop Track

Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

2.2.4 Flat Strap and Backing Plates

Sheet steel for blocking and bracing in length and width as needed to suit conditions. Minimum base-metal thickness shall be 0.033 inch (20 gage), unless otherwise indicated.

2.2.5 Security Mesh

ASTM F 1267, Type II, (expanded and flattened), Class 1 (uncoated) 3/4 number 9 steel expanded metal panels (used as a penetration shield behind drywall).

2.2.6 Steel Framing Shaft Wall Assemblies

2.2.6.1 Protective Coating

ASTM A 653/A 653M, G60, hot-dip galvanized unless otherwise indicated.

2.2.6.2 Depth

As indicated.
2.2.6.3 Minimum Base Metal Thickness

Minimum 0.033 inch (20 gage) unless otherwise recommended by the manufacturer to suit conditions.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Systems for Attachment of Lath

3.1.1.1 Nonload-Bearing Wall Framing

NAAMM ML/SFA MLF, except that framing members shall be 16 inches o.c. unless indicated otherwise.

3.1.2 Systems for Attachment of Gypsum Wallboard

3.1.2.1 Suspended and Furred Ceiling Systems

ASTM C 754, except that framing members shall be 16 inches o.c. unless indicated otherwise.

3.1.2.2 Nonload-Bearing Wall Framing and Furring

ASTM C 754, except as indicated otherwise.

Frame openings as recommended by SSMA Details, except as indicated otherwise.

3.1.2.3 Z-Furring Channels with Wall Insulation

Install Z-furring channels vertically spaced not more than 24 inches o.c. Locate Z-furring channels at interior and exterior corners in accordance with manufacturer's printed erection instructions. Fasten furring channels to masonry walls with powder-driven fasteners or hardened concrete steel nails through narrow flange of channel. Space fasteners not more than 24 inches o.c.

3.1.3 Vertical Steel Track

Provide metal track material vertically in place of metal studs where used with insulation board on exterior walls, spaced not more than 16 in. o.c. Fasten studs to concrete walls with powder-driven fasteners or hardened concrete steel nails through flange of channel. Space fasteners not more than 16 in. o.c.

3.1.4 Flat Strap and Backing Plate

As recommended by SSMA Details, except as indicated on Drawings. Install supplementary framing and blocking to support fixtures, equipment, heavy trim, grab bars, toilet accessories or similar elements.

3.1.5 Firestop Tracks

Where fire rated partitions are indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
3.1.6 Security Mesh

Weld security mesh directly to steel studs, tracks and horizontal brace framing with 1/8 inch x 1/2 inch long fillet welds, spaced maximum 8 inch on center. Edge welds shall be within 2 inch of edge of studs. End joints of security mesh shall be butted and occur over center of stud flanges. Side joint shall be butted and wire tied at mid-points between support studs. Security mesh sheets may be installed horizontally or vertically.

3.2 INSTALLATION OF FRAMING FOR SHAFT WALL ASSEMBLIES

3.2.1 General

Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.

a. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

b. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

c. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.

3.2.2 Reinforcing

Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.033-inch minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.

3.2.3 Penetrations

At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, and similar items.

3.2.4 Firestop Tracks

Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

3.2.5 Control Joints

Install control joints at locations indicated on Drawings while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
3.2.6 Sound-Rated Shaft Wall Assemblies

Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.

3.2.7 Installation Tolerance for Shaft Wall Framing

Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.3 ERECTION TOLERANCES

Framing members shall be 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.

3.4 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of 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 A 641  
(2009a) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

ASTM A 653  
(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM C 1002  
(2007) Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

ASTM C 1063  

ASTM C 150  

ASTM C 206  

ASTM C 207  

ASTM C 847  

ASTM C 897  
(2005; R 2009) Aggregate for Job-Mixed Portland Cement-Based Plasters

ASTM C 91  
(2005) Masonry Cement

ASTM C 926  

ASTM C 932  
ASTM C 954 (2007) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

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

SD-02 Shop Drawings

Lath; G

Drawings showing details of construction for reinforcement, furring, and grounds; including manufacturer's installation instructions for stucco materials, and locations where each mix and coating thickness will be used.

SD-03 Product Data

Recycled Content (LEED Credit MR 4); G

Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content included in this Section. Include a statement indicating material only costs for each product having recycled content. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

Materials; G

Detailed description of the proposed job-mix proportions for base and finish coats; including identification of thickness of coats.

SD-04 Samples

Sample Panel; G

Sample panel, as specified.

SD-11 Closeout

All approved LEED Submittals specified under SD-03 Product Data; S

1.3 DELIVERY AND STORAGE

Packaged materials shall be delivered to the site in the original packages and containers with labels intact and seals unbroken. Cementitious materials shall be kept dry and stored off the ground under cover away from damp surfaces until ready to be used. Aggregate shall be covered to prevent the absorption or loss of moisture.
1.4 ENVIRONMENTAL CONDITIONS

Comply with ASTM C 926 requirements.

1.4.1 Exterior Plasterwork

Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind. Apply plaster when ambient temperature is greater than 40 degrees F. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

1.4.2 Factory-Prepared Finishes

Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

1.5 SAMPLE PANEL

The Contractor shall submit: One 12 inch square stucco panel showing finish texture and color and exposed reinforcement at the edges, one 12 inchesquare of reinforcement, and a 12 inch length of each accessory proposed, prior to proceeding with stucco work.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT OF PRODUCTS

Provide products with post-consumer recycled content plus one-half of pre-consumer recycled content to the greatest extent possible.

2.2 PLASTER MATERIALS

2.2.1 Portland Cement

ASTM C 150, Type I; gray.

2.2.2 Masonry Cement

ASTM C 91, Type N; gray.

2.2.3 Lime

ASTM C 206, Type S; or ASTM C 207, Type S.

2.2.4 Sand Aggregate

ASTM C 897.

2.2.5 Factory-Mixed Acrylic-Based Finish Coatings

Factory-mixed acrylic-emulsion coating systems, formulated with colorfast mineral pigments and fine aggregates; for use over portland cement plaster
base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic-based finishes. Color, pattern and texture as indicated on drawings.

2.3 METAL LATH

2.3.1 Expanded-Metal Lath

ASTM C 847 with ASTM A 653, G60 (Z180), hot-dip galvanized zinc coating.

2.3.1.1 Diamond-Mesh Lath

Self-furring, 3.4 lb/sq. yd.

2.4 ACCESSORIES

2.4.1 General

Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

2.4.2 Metal Accessories:

2.4.2.1 Foundation Weep Screed

Fabricated from hot-dip galvanized-steel sheet, ASTM A 653, G60 zinc coating.

2.4.2.2 Cornerite

Fabricated from metal lath with ASTM A 653, G60, hot-dip galvanized zinc coating.

2.4.2.3 External-Corner Reinforcement

Fabricated from metal lath with ASTM A 653, G60, hot-dip galvanized zinc coating.

2.4.2.4 Cornerbeads

Fabricated from zinc.

a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.

b. Small nose cornerbead with perforated flanges; use on curved corners.

c. Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing masonry corners.

d. Bull nose cornerbead, radius 3/4 inch minimum, with expanded flanges; use at locations indicated on Drawings.

2.4.2.5 Casing Beads

Fabricated from zinc; square-edged style; with expanded flanges.
2.4.2.6 Control Joints

Fabricated from zinc; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.

2.4.2.7 Expansion Joints

Fabricated from zinc; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.

2.4.2.8 Two-Piece Expansion Joints

Fabricated from zinc; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch wide; with perforated flanges.

2.5 MISCELLANEOUS MATERIALS

2.5.1 Water for Mixing

Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

2.5.2 Bonding Compound

ASTM C 932.

2.5.3 Steel Drill Screws

For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.

2.5.4 Fasteners for Attaching Metal Lath to Substrates

Complying with ASTM C 1063.

2.5.5 Wire

ASTM A 641, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter, unless otherwise indicated.

2.6 PLASTER MIXES

2.6.1 General

Comply with ASTM C 926 for applications indicated.

2.6.2 Base-Coat Mixes for Use over Metal Lath

Scratch and brown coats for three-coat plasterwork as follows:

2.6.2.1 Portland Cement Mixes

a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

2.6.2.2 Masonry Cement Mixes

a. Scratch Coat: 1 part masonry cement and 2-1/2 to 4 parts aggregate.

b. Brown Coat: 1 part masonry cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.

2.6.2.3 Portland and Masonry Cement Mixes

a. Scratch Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

b. Brown Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

2.6.3 Factory-Prepared Finish-Coat Mixes

For acrylic-based finish coatings, comply with manufacturer's written instructions.

2.6.3.1 Integral Color

As indicated on Drawings.
the suction capability required to bond with plaster according to
ASTM C 926.

3.3 INSTALLING METAL LATH

3.3.1 Expanded-Metal Lath
Install according to ASTM C 1063.

3.4 INSTALLING ACCESSORIES

3.4.1 General
Install according to ASTM C 1063 and at locations indicated on Drawings.

3.4.2 Control Joints
Install control joints at locations indicated on Drawings.

3.5 PLASTER APPLICATION

3.5.1 General
Comply with ASTM C 926.

   a. Do not deviate more than plus or minus 1/4 inch in 10 feet from a
      true plane in finished plaster surfaces, as measured by a 10-foot
      straightedge placed on surface.

   b. Finish plaster flush with metal frames and other built-in metal
      items or accessories that act as a plaster ground unless otherwise
      indicated. Where casing bead does not terminate plaster at metal
      frame, cut base coat free from metal frame before plaster sets and
      groove finish coat at junctures with metal.

   c. Provide plaster surfaces that are ready to receive field-applied
      finishes indicated.

3.5.2 Bonding Compound
Apply on unit masonry and concrete plaster bases as indicated where metal
lath is not used.

3.5.3 Base-Coat Mixes for Use over Metal Lath
Scratch and brown coats for three-coat plasterwork; 3/4-inch thickness.

3.5.4 Acrylic-Based Finish Coatings
Apply coating system, including primers, finish coats, and sealing
topcoats, according to manufacturer's written instructions.

3.6 PLASTER REPAIRS
Repair or replace work to eliminate cracks, dents, blisters, buckles,
crazing and check cracking, dry outs, efflorescence, sweat outs, and
similar defects and where bond to substrate has failed.
3.7 PROTECTION

Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

3.8 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 A118.9 (1999) Cementitious Backer Units (CBU)

ASTM INTERNATIONAL (ASTM)

ASTM C 1002 (2007) Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs


ASTM C 475 (2002) Joint Compound and Joint Tape for Finishing Gypsum Board


ASTM C 954 (2010) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
ASTM C 1288/C 1325  

ASTM C1178/C1178M  

ASTM C1325  

ASTM C1396/C1396M  

ASTM C834  
(2014) Latex Sealants

ASTM D 3273  
(2000; R 2005) Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

ASTM D 3274  
(2009e1) Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation

ASTM D3273  

ASTM D3274  
(2009; R 2013) Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211  

NFPA 54  

NFPA 70  
(2011; Errata 2 2012) National Electrical Code

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED  

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

SECTION 09 29 00  Page 2
SUBMITTAL PROCEDURES:

SD-03 Product Data

Gypsum Board; G
Cementitious backer units; G
Glass-mat, Water-resistant Backing Board; G
Glass Mat Exterior Gypsum Sheathing Board; G
Sealant for Glass Mat Exterior Gypsum Sheathing Board; G
Flexible Gypsum Board; G
Gypsum Board, Acoustically Enhanced; G
Gypsum Board Shaftliner Panel; G
Glass-Mat Interior Gypsum Board; G
Sound Attenuation Blankets; G
Accessories; G
Trim; G

Recycled Content (LEED Credit MR 4); G

Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content included in this Section. Include a statement indicating material only costs for each product having recycled content. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

Regional Materials (LEED Credit MR 5); G

Product data indicating location of material manufacturer and distance from manufacturer to Project Site for regional materials (materials that are extracted, harvested or recovered, and manufactured or processed within 500 miles by air of the Project site. Indicate distance from point of extraction, harvest, recovery to Project Site for each raw or recycled material used in regionally manufactured materials included in this Section. Indicate material only cost for each regional material included in this Section. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4.1); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter less water and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-07 Certificates
Asbestos Free Materials; G

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

SD-11 Closeout

All approved LEED Submittals specified under SD-03 Product Data; S

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation.

1.3.3 Handling

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

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

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

1.5 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified and shall have a minimum of 5 years of documented successful experience. Installer shall specialize in the type of gypsum board work required and shall have a minimum of 3 years of documented successful experience.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.
PART 2 PRODUCTS

2.1 RECYCLED CONTENT OF PRODUCTS

Provide products with post-consumer recycled content plus one-half of pre-consumer recycled content to the greatest extent possible.

2.2 REGIONAL MATERIALS OF PRODUCTS

Raw or recycled materials in gypsum board products shall be extracted, harvested, or recovered and manufacturer or processed within 500 miles by air of the Project site.

2.3 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.4 MATERIALS

Conform to specifications, standards and requirements specified herein. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.

2.4.1 Gypsum Board

ASTM C 1396/C 1396M.

2.4.1.1 Regular

5/8 inch thick, tapered long edges.

2.4.1.2 Type X

5/8 inch thick, tapered.

2.4.1.3 Type C

Thickness as required by fire-resistance rated assembly indicated manufactured to have increase fire-resistive capability; tapered edges.

2.4.2 Glass Mat Exterior Gypsum Sheathing Board

ASTM C 1177/C 1177M with fiberglass mat laminated to both sides and with manufacturer's standard edges. Core shall be 5/8 inch, Type X, unless otherwise indicated.

2.4.2.1 Sealant for Glass Mat Exterior Gypsum Sheathing Board

Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

a. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in
sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

2.4.3 Flexible Gypsum Board

ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board. Board thickness as indicated.

2.4.4 Glass-Mat Interior Gypsum Board

ASTM C 1658. With fiberglass mat laminated to both sides; specifically designed for interior use; paintable. Core shall be 5/8 inch thick, Type X, unless otherwise indicated; tapered long edges. Mold resistance tested according to ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4.5 Gypsum Board, Acoustically Enhanced

ASTM C1396/C1396M. Two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core, 5/8 inch Type X, unless otherwise indicated; tapered long edges.

2.4.6 Tile Backing Panels

2.4.6.1 Glass-Mat, Water-Resistant Backing Board

ASTM C1178/C1178M with manufacturer's standard edges. Core shall be 5/8 inch, Type X, unless otherwise indicated. Mold resistance tested according to ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4.7 Cementitious Backer Units

ANSI A118.9 and ASTM C 1288/C 1325 or ASTM C1325, with manufacturer's standard edges; 1/2 inch or 5/8 inch thick, as indicated. Mold resistance tested according to ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4.8 Gypsum Board Shaftliner Panel

ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces. Fire-resistive-ratings as indicated on Drawings.

2.4.8.1 Thickness

1 inch.

2.4.8.2 Long Edges

Double bevel.

2.4.8.3 Gypsum Board Cants

Gypsum board, Type X, ASTM C1396/C1396M; thickness 1/2 inch or 5/8 inch as indicated and as required.

2.4.9 Joint Treatment Materials

ASTM C 475.
2.4.9.1 Embedding Compound
Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.4.9.2 Finishing or Topping Compound
Specifically formulated and manufactured for use as a finishing compound.

2.4.9.3 All-Purpose Compound
Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.4.9.4 Setting or Hardening Type Compound
Specifically formulated and manufactured for use with fiber glass mesh tape.

2.4.9.5 Joint Tape
Cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.4.10 Fasteners

2.4.10.1 Nails

ASTM C 514.

2.4.10.2 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, and steel framing members less than 0.033 inch thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

2.4.10.3 Staples

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

<table>
<thead>
<tr>
<th>Length of Legs (inch)</th>
<th>Thickness of Gypsum Board (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/8</td>
<td>1/2</td>
</tr>
<tr>
<td>1 1/4</td>
<td>5/8</td>
</tr>
</tbody>
</table>

2.4.11 Adhesives

Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene.

2.4.11.1 Adhesive for Laminating

For laminating two-ply gypsum board systems, provide adhesive recommended by gypsum board manufacturer.
2.4.12  Interior Trim

ASTM C 1047

2.4.12.1  Material

Galvanized or aluminum-coated steel sheet or rolled zinc.

2.4.12.2  Shapes

a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint.
g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.4.13  Aluminum Reveal Trim

Extruded accessories of profiles and dimensions indicated.

1. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
2. Finish: Factory-applied powder coat in colors to match adjacent walls, unless otherwise indicated.

2.4.14  Water

Clean, fresh, and potable.

2.2.15  Metal Support Assemblies

See Section 09 22 00 SUPPORTS FOR PLASTER AND GYPSUM BOARD for metal studs, miscellaneous metal furring and framing, suspended systems and framing for shaft wall assemblies.

2.4.15  Sound Attenuation Blankets

ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

2.4.15.1  Acoustical Joint Sealant

See Section 07 92 00 JOINT SEALANTS.

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 Sound Attenuation Blanket Installation

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

**b.** Blocking at Vents and Access Doors. Install permanent blocking to prevent sound attenuation blanket from slipping over, clogging, or restricting air flow through vents at eaves. Install permanent blocking to maintain accessibility to equipment or controls that require maintenance or adjustment.

**c.** Blocking Around Heat Producing Devices. Install non-combustible blocking around heat producing devices to provide the following clearances:

1. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless these are certified by the manufacturer for installation surrounded by sound attenuation blanket: 3 inches from outside face of fixtures and devices or as required by NFPA 70.

2. Vents and vent connectors used for venting the products of combustion, flues: Minimum clearances as required by NFPA 211.


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

**e.** Do not install sound attenuation blanket in a manner that would sandwich electrical wiring between two layers of sound attenuation blanket.

### 3.2 APPLYING AND FINISHING PANELS, GENERAL

Comply with ASTM C 840.

Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends.
Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

Form control and expansion joints with space between edges of adjoining gypsum panels.

Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.

b. Fit gypsum panels around ducts, pipes, and conduits.

c. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

3.2.1 Attachment to Steel Framing

Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.2.2 STC-Rated Assemblies

Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.3 APPLYING INTERIOR GYPSUM BOARD

Install interior gypsum board in the following locations:

a. Gypsum Wallboard: As indicated.

b. Type X: As indicated.

c. Flexible Type: Apply in double layer at curved assemblies.

d. Ceiling Type: Ceiling surfaces, except as otherwise specified.

e. Glass-Mat Interior Gypsum Board: At ceilings and walls of bathrooms, toilets and janitor closets, within 48 inches of sinks and drinking fountains and on the inside of exterior walls.

f. Type C: Where indicated for specific fire-resistance-rated assembly indicated.

g. Acoustically Enhanced Gypsum Board: Apply in STC-rated assemblies.

3.3.1 Single-Layer Application

On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless
otherwise indicated.

On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

   a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
   b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

Apply gypsum panels to supports with steel drill screws.

3.3.2 Multilayer Application

On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

Fasten base layers and face layers separately to supports with screws.

3.3.3 Laminating to Substrate

Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPL YING TILE BACKING PANELS

3.4.1 Glass-Mat, Water-Resistant Backing Panel and Cementitious Baker Units

Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.
3.4.2 Alignment

Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

3.5.1 General

For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

3.5.2 Control Joints

Install control joints according to ASTM C 840 and as indicated.

3.5.3 Interior Trim

Install in the following locations

a. Cornerbead: Use at outside corners.

b. LC-Bead: Use at exposed panel edges.

c. L-Bead: Use where indicated.

d. U-Bead: Use at exposed panel edges.

3.6 FINISHING GYPSUM BOARD

Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

Prefill open joints, rounded or beveled edges, and damaged surface areas.

Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

3.6.1 Gypsum Board Finish Levels

Finish panels to levels indicated below and according to ASTM C 840

a. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

b. Level 2: Panels that are substrate for tile and panels that are substrate for acoustical tile.

c. Level 3: In mechanical and electrical rooms.

d. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.

3.6.2 Glass-Mat Gypsum Sheathing Board

Finish according to manufacturer's written instructions.

3.6.3 Glass-Mat, Water-Resistant Backing Panels and Cementitious Baker Units

Finish according to manufacturer's written instructions.
3.7 INSTALLING AUXILIARY MATERIALS

Install in accordance with each manufacturer's written instructions.

3.8 EXTERIOR GLASS-MAT GYPSUM SHEATHING BOARD

Comply with Gypsum Association Publication GA-253 and manufacturer's written instructions.

3.8.1 Sealing for Exterior Glass-Mat Gypsum Sheathing Board

Apply sealant in a 3/8 inch bead to all joints and trowel flat. Apply enough of the same sealant to all fasteners penetrating through the glass mat gypsum board surface to completely cover the penetration when troweled flat. Construction and materials shall not be placed behind sheathing until a visual inspection of sealed joints during daylight hours has been completed by Contracting Officer.

3.9 GYPSUM BOARD SHAFT WALL ASSEMBLIES

Install gypsum board shaft wall assemblies to comply with requirements of fire resistance-rated assemblies indicated and manufacturer's written installation instructions.

3.9.1 Shaftliner

Provide shaftliner components for locations indicated.

3.9.2 Gypsum Board Cants

At projections into shaft where indicated, install gypsum board cants covering tops of projections.

a. Slope cant at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.

b. Where non-load-bearing steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.

3.10 PROTECTION

Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

Remove and replace panels that are wet, moisture damaged, and mold damaged.

a. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

b. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

3.11 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19.
CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 09 30 10

TILING

PART 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)**


**ASTM INTERNATIONAL (ASTM)**

- ASTM C373 (2014a) Water Absorption, Bulk Density,
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; G

SD-03 Product Data
   Waterproof Membrane; G
   Tile; G
   Wall Base; G
   Setting-Bed; G
   Mortar and Grout; G
   Reinforcing Wire Fabric; G

Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4.1); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

Low-Emitting Flooring Systems (LEED Credit IEQ 4.3); G
Manufacturers' product data for flooring systems installed in the interior of the building. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-04 Samples
- Tile; G
- Wall Base; G
- Transition Strips; G
- Grout; G
- Wall Base; G

SD-07 Certificates
- Tile
- Mortar and Grout

SD-08 Manufacturer's Instructions
- Maintenance Instructions

SD-10 Operation and Maintenance Data
- Installation; G

SD-11 Closeout Submittals
- All approved LEED Submittals specified under SD-03 Product Data; S

1.3 QUALITY ASSURANCE
Installers to be from a company specializing in performing this type of work and have a minimum of two years experience. Each type and color of tile to be provided from a single source. Each type and color of mortar, and grout to be provided from the same source.

1.4 DELIVERY, STORAGE, AND HANDLING
Ship tiles in sealed packages and clearly marked with the grade, type of tile, producer identification, and country of origin. Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Protect materials from weather, and store them under cover in accordance with manufacturer's printed instructions.

1.5 ENVIRONMENTAL REQUIREMENTS
Do not perform ceramic tile work unless the substrate and ambient temperature is at least 50 degrees F and rising. Maintain temperature above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

1.6 WARRANTY
Provide manufacturer's standard performance guarantees or warranties that
extend beyond a 1-year period.

1.7 EXTRA MATERIALS

Supply an extra 2 percent of each type tile used in clean and marked cartons.

1.8 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.2 LOW-EMITTING FLOORING SYSTEMS

For field applications that are used on the interior of the building, floor systems shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.3 TILE

Furnish tiles that comply with ANSI A137.1 and are standard grade tiles, the exception is glass tile. Furnish glass tiles that comply with ANSI A137.2. Provide a minimum breaking strength of 125 lbs. for wall tile and 250 lbs. for floor tile in accordance with ASTM C648. Provide exterior building tile for cold climate projects that is approved by the manufacturer for exterior use when tested in accordance with ASTM C1026. Provide floor tiles with a wet dynamic coefficient of friction (DCOF) value of 0.42 or greater when tested in accordance with ANSI A137.1 requirements. Provide glazed floor tile with a Class IV-Commercial classification as rated by the manufacturer when tested in accordance with ASTM C1027 for visible abrasion resistance as related to foot traffic. For materials like tile, accessories, and transition strips submit samples of sufficient size to show color range, pattern, type and joints. Submit manufacturer's catalog data.

2.3.1 Porcelain Tile PFT-1, PFT-2, PFT-4, PTB-1, PTB-2, PWT-1, PWT-2, PWT-3, PWT-4

Furnish large format glazed and rectified porcelain tile, bullnose base with color extending uniformly through the body of the tile. Blend tiles in factory and in a package to have same color range and continuous blend for installation. Provide nominal tile size(s) as indicated on the Drawings. Provide a 0.50 percent maximum water absorption in accordance with ASTM C373. PWT-3 and PWT-4 are large format three dimensional tiles.

2.3.2 Mosaic Tile, PWT-5

Furnish glazed, mosaic tile (with metal accent-PWT-5) composed of porcelain. Provide nominal tile size(s) of 2 by 2 inch. Provide porcelain mosaics with a water absorption up to 0.50 percent when tested in accordance with ASTM C373.
2.3.3 Glass and Stone Tile, GWT-1

Furnish glass and stone mosaic tile that complies with ANSI A137.2. Provide nominal tile size(s) of 1/2 x 3 inch, stacked pattern, 12 inch by 12 inch sheets, 1/4 inch thick.

2.4 SETTING-BED (Shower Locations)

Submit manufacturer's catalog data. Compose the setting-bed of the following materials:

2.4.1 Aggregate for Concrete Fill

Conform to ASTM C33/C33M for aggregate fill. Do not exceed one-half the thickness of concrete fill for maximum size of coarse aggregate.

2.4.2 Portland Cement

Conform to ASTM C150/C150M for cement, Type I, white for wall mortar and gray for other uses.

2.4.3 Sand

Conform to ASTM C144 for sand.

2.4.4 Hydrated Lime

Conform to ASTM C206 for hydrated lime, Type S or ASTM C207, Type S.

2.4.5 Metal Lath

Conform to ASTM C847 for flat expanded type metal lath, and weighing a minimum 2.5 pound/square yard.

2.4.6 Reinforcing Wire Fabric

Conform to ASTM A1064/A1064M for wire fabric. Provide 2 by 2 inch mesh, 16/16 wire or 1-1/2 by 2 inch mesh, 16/13 wire.

2.5 WATER

Provide potable water.

2.6 MORTAR AND GROUT

2.6.1 Latex-Portland Cement Mortar

TCNA Hdbk.

2.6.2 Ceramic Tile Grout

TCNA Hdbk; petroleum-free and plastic-free latex-portland cement grout where recommended by tile manufacturer.

2.6.3 Epoxy Resin Grout

TCNA Hdbk.
2.6.4 Sealants

Use where recommended by manufacturer. Comply with applicable regulations regarding toxic and hazardous materials and as specified. Grout sealant must not change the color or alter the appearance of the grout.

2.7 TRANSITION STRIPS TR-1 and TR-2 and Stainless Steel Base, SSB-1

Provide anodized aluminum transitions between tile and carpet or resilient flooring. Provide sizes as recommended by flooring manufacturer for both edges and transitions of flooring materials specified and as indicated on Drawings. Provide transition strips that comply with 36 CFR 1191 requirements. Provide bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2.

a. SSB-1: Stainless Steel Base Molding Grade CS304 with #4 Satin Polish, 0.125 inch tk (11 GA)

b. Pre-formed inside and outside corners with 12" wings, Straight molding can be installed onto curved walls - bendable down to 12" radius

c. Heights: 6 inch

d. 1/4 inch Cove Bend

e. Standard Lengths: Minimum 4 feet

2.8 WATERPROOF MEMBRANE

2.8.1 General

Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.8.2 Chlorinated Polyethylene Sheet

Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric.

a. Nominal Thickness: 0.040 inch.

2.9 COLOR, TEXTURE, AND PATTERN

Provide color, pattern and texture as indicated on Drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers. Provide floor patterns as specified on the drawings.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of TCNA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:
3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Close space, in which tile is being set, to traffic and other work. Keep closed until tile is firmly set. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even planes to the elevations and grades shown. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar. Do not walk or work on newly tiled floors without using kneeling boards or equivalent protection of the tiled surface. Keep traffic off horizontal portland cement mortar installations for at least 72 hours. Dimension and draw detail drawings at a minimum scale of 1/4 inch = 1 foot. Include drawings of pattern at inside corners, outside corners, termination points and location of all equipment items such as thermostats, switch plates, mirrors and toilet accessories mounted on surface. Submit drawings showing tile pattern elevations and floor plans. Submit manufacturer's preprinted installation instructions.

3.3 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCNA Hdbk, and with grout joints as recommended by the manufacturer for the type of tile. Install thinner wall tile flush with thicker wall tile applied on same wall and provide installation materials as recommended by the tile and setting materials manufacturer's to achieve flush installation.

3.3.1 Workable or Cured Mortar Bed

Install tile over workable mortar bed or a cured mortar bed at the option of the Contractor. Install a 4 mil polyethylene membrane, metal lath, and scratch coat. Conform to TCNA Hdbk for workable mortar bed, materials, and installation of tile. Conform to TCNA Hdbk for cured mortar bed and materials.

3.3.2 Latex-Portland Cement Mortar

Use Latex-Portland Cement to install tile in accordance with TCNA Hdbk. Use Latex Portland Cement when installing porcelain ceramic tile.

3.3.3 Tile Grout

Prepare and install tile grout in accordance with TCNA Hdbk. Provide and apply manufacturer's standard product for sealing grout joints in accordance with manufacturer's recommendations.

3.4 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with TCNA Hdbk method and with grout
joints as recommended by the manufacturer for the type of tile. Install shower receptors in accordance with TCNA Hdbk method B415. Install thinner floor tile flush with thicker floor tile and provide installation materials as recommended by the tile and setting materials manufacturer's to achieve flush installation.

3.4.1 Workable or Cured Mortar Bed

Install floor tile over a workable mortar bed or a cured mortar bed at the option of the Contractor. Conform to TCNA Hdbk for workable mortar bed materials and installation. Conform to TCNA Hdbk for cured mortar bed materials and installation. Provide minimum 1/4 inch to maximum 3/8 inch joints in uniformed width.

3.4.2 Latex-Portland Cement

Use Latex-Portland cement mortar to install tile directly over properly cured, plane, clean concrete slabs in accordance with TCNA Hdbk. Use Latex Portland cement when installing porcelain ceramic tile.

3.4.3 Resinous Grout (For use in restrooms)

When resinous grout is indicated, grout quarry tile with epoxy resin grout. Rake and clean joints to the full depth of the tile and neutralize when recommended by the resin manufacturer. Install epoxy resin grout in conformance with TCNA Hdbk. Install resin grout in accordance with manufacturer's printed installation instructions. Follow manufacturer's printed installation instructions of installed resin grout for proportioning, mixing, installing, and curing. Maintain the recommended temperature in the area and on the surface to be grouted. Protect finished grout of grout stain.

3.4.4 Tile Grout

Prepare and install tile grout in accordance with TCNA Hdbk and as recommended by tile manufacturer. Provide and apply manufacturer's standard product for sealing grout joints in accordance with manufacturer's recommendations.

3.4.5 Waterproofing Membrane

Install as indicated in accordance with manufacturer's written instructions.

3.4.6 Concrete Fill

Provide a 3500 psi concrete fill mix to dry as consistency as practicable. Spread, tamp, and screed concrete fill to a true plane, and pitch to drains or levels as shown. Thoroughly damp concrete fill before applying setting-bed material. Reinforce concrete fill with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped a minimum 2 inch. Tie laps together with 18 gauge wire every 10 inch along the finished edges and every 6 inch along the cut ends and edges. Provide reinforcement with support and secure in the centers of concrete fills. Provide a continuous mesh; except where expansion joints occur, cut mesh and discontinue across such joints. Provide reinforced concrete fill under the setting-bed where the distance between the under-floor surface and the finished tiles floor surface is a minimum of 2 inches, and of the same thickness that the mortar setting-bed
over the concrete fill with the thickness required in the specified TCNA Hdbk method.

3.5 INSTALLATION OF TRANSITION STRIPS

Install transition strips where indicated, in a manner similar to that of the ceramic tile floor and as recommended by the manufacturer. Provide thresholds full width of the opening. Install head joints at ends not exceeding 1/4 inch in width and grouted full.

3.6 INSTALLATION OF WALL BASE

Install stainless steel wall base where indicated with adhesive as recommended by manufacturer.

3.7 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

3.7.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

3.7.2 Floors

Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs. Extend expansion joints through setting-beds and fill.

3.8 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles. Submit copy of manufacturer's printed maintenance instructions.

3.9 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

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


ASTM C423 (2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method


ASTM C834 (2014) Latex Sealants

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
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 40 for when determined in accordance with ASTM E1414/E1414M. Provide fixture attenuators over light fixtures and other ceiling penetrations, and provide acoustical blanket insulation adjacent to partitions, as required to achieve the specified CAC. Provide test ceiling continuous at the partition and assembled in the suspension system in the same manner that the ceiling will be installed on the project.

1.2.2 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.

d. Reports by an independent testing laboratory attesting that acoustical ceiling systems meet specified sound transmission requirements. Data attesting to conformance of the proposed system to Underwriters Laboratories requirements for the fire endurance rating listed in UL Fire Resistance may be submitted in lieu of test reports.

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
  Approved Detail Drawings; G

SD-03 Product Data
  Acoustical Ceiling Systems; G
  Certification; G
  Recycled Content (LEED Credit MR 4); G
  Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content included in this Section. Include a statement indicating material only costs for each product having recycled content. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.
  Regional Materials: (LEED Credit MR 5); G
  Product data indicating location of material manufacturer and distance from manufacturer to Project site for regional materials (materials that are extracted, harvested or recovered, and manufactured or processed within 500 miles by air of the Project site). Indicate distance from point of extraction, harvest, recovery to Project site for each raw or recycled material used in regionally manufactured materials included in this Section. Indicate material only cost for each regional material included in this Section. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-04 Samples
  Acoustic Ceiling Tiles; G

SD-06 Test Reports
  Ceiling Attenuation Class and Test; G

SD-07 Certificates
  Acoustic Ceiling Tiles; G
SD-11 Closeout

All approved LEED Submittals specified under SD-03 Product Data; S

1.4 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.6 ENVIRONMENTAL REQUIREMENTS

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

1.7 SCHEDULING

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

1.8 WARRANTY

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

1.9 EXTRA MATERIALS

Furnish spare tiles, from the same lot as those installed, of each color at the rate of 5 tiles for each 1000 tiles installed.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT OF PRODUCTS

Provide products with post-consumer recycled content plus one-half of pre-consumer recycled content to the greatest extent possible.

2.2 REGIONAL MATERIAL OF PRODUCTS

Raw or recycled materials in acoustical ceiling products shall be extracted, harvested, or recovered and manufactured or processed within 500 miles by air of the Project site.
2.3 ACOUSTICAL UNITS

2.3.1 Affirmative Procurement

Mineral Wool, Cellulose, and Laminated Paperboard used in acoustic ceiling tiles are materials listed in the EPA's Comprehensive Procurement Guidelines (CPG) (http://www.epa.gov/cpg/). EPA's recommended Recovered Materials Content Levels for Mineral Wool, Cellulose, Structural Fiberboard and Laminated Paperboard are:

<table>
<thead>
<tr>
<th>Product</th>
<th>Material</th>
<th>Percent of Post Consumer Materials</th>
<th>Percent of Total Recovered Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laminate Paperboard</td>
<td>Post Consumer Paper</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Rock Wool</td>
<td>Slag</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Cellulose</td>
<td>Post Consumer Paper</td>
<td>75</td>
<td>75</td>
</tr>
</tbody>
</table>

a. The recommended recovered materials content levels are based on the weight (not volume) of materials in the insulating core only.

b. Submit recycled material content data for acoustic ceiling tiles indicating compliance with affirmative procurement.

c. Submit total weight and volume quantities of acoustic ceiling tiles with recycle material.

2.3.2 Units for Exposed-Grid System ACT-1

2.3.2.1 Type

IV (non-asbestos mineral fiber with membrane-faced overlay).

2.3.2.2 Flame Spread

Class A, 25 or less

2.3.2.3 Pattern

E

2.3.2.4 Minimum NRC

0.60 in conference rooms, executive offices, teleconferencing rooms, and in all other rooms and areas when tested on mounting Type E-400 of ASTM E795.

2.3.2.5 Minimum Light Reflectance Coefficient

0.90

2.3.2.6 Nominal Size

24 by 24 inch
2.3.2.7  Edge Detail
  Beveled Tegular

2.3.2.8  Finish
  Factory-applied standard finish.

2.3.2.9  Minimum CAC
  40

2.3.3  Units for Exposed Grid System (ACT-2)

2.3.3.1  Type
  IV (Non-asbestos mineral fiber with membrane-faced overlay)

2.3.3.2  Flame Spread
  Class A, 25 or less

2.3.3.3  Pattern
  E

2.3.3.4  Minimum NRC
  Not applicable.

2.3.3.5  Minimum Light Reflectance Coefficient
  0.80 or greater.

2.3.3.6  Nominal Size
  24 by 24 inch

2.3.3.7  Edge Detail
  Square Lay-in

2.3.3.8  Finish
  Factory applied standard vinyl faced membrane finish.

2.3.3.9  Minimum CAC
  40

2.3.4  Units for Exposed Grid System (ACT-3)

2.3.4.1  Type
  III (non asbestos mineral fiber with painted finish).

2.3.4.2  Flame Spread
  Class A, 25 or less.
2.3.4.3 Pattern
   C, E
2.3.4.4 Minimum NRC
   0.70 in all rooms and areas when tested on mounting Type E-400 of ASTM E795.
2.3.4.5 Minimum Light Reflectance Coefficient
   0.85 or greater
2.3.4.6 Nominal Size
   24 by 24 inch.
2.3.4.7 Edge Detail
   Beveled Tegular
2.3.4.8 Finish
   Factory applied standard finish.
2.3.4.9 Minimum CAC
   40.

2.3.5 Units for Exposed Grid System (ACT-4)

2.3.5.1 Type
   Glass reinforced gypsum coffer with Type IV (Non-asbestos mineral fiber with membrane-faced overlay) infill.

2.3.5.2 Flame Spread
   Class A, 25 or less

2.3.5.3 Pattern
   E
2.3.5.4 Minimum NRC
   0.70
2.3.5.5 Minimum Light Reflectance Coefficient
   0.85 or greater.
2.3.5.6 Nominal Size
   24 by 24 inch and inset 18 by 18 inch.
2.3.5.7 Edge Detail
   Beveled Tegular
2.3.5.8 Finish

Factory applied standard finish.

2.3.5.9 Minimum CAC

35

2.4 SUSPENSION SYSTEM

Provide as shown on drawings 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 15/16 inch. Provide mitered corners. Suspended ceiling framing system must have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Provide a suspension system with a maximum deflection of 1/360 of the span length.

2.5 HANGERS

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

2.5.1 Wires

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

2.5.2 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.

2.5.3 Rods

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

2.5.4 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.

2.5.5 Masonry Anchorage Devices

Comply with ASTM C636/C636M for anchorage devices.

2.6 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.
2.7 COLORS AND PATTERNS

Use colors and patterns for acoustical units and suspension system components as indicated on Drawings.

2.8 ACOUSTICAL SEALANT

Conform acoustical sealant to ASTM C834, nonstaining.

PART 3 EXECUTION

3.1 INSTALLATION

Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of the work. 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. 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.

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

3.3.1 Reclamation Procedures

Neatly stack ceiling tile, designated for recycling by the Contracting Officer, on 4 by 4 foot pallets not higher than 4 foot. Panels must be completely dry. Shrink wrap and symmetrically stack pallets on top of each other without falling over.

-- End of Section --
SECTION 09 65 00
RESILIENT FLOORING
08/10

PART 1   GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D4078 (2002; R 2008) Water Emulsion Floor Polish


ASTM F1303 (2004; R 2014) Sheet Vinyl Floor Covering with Backing

ASTM F1344 (2015) Rubber Floor Tile

ASTM F1482 (2004; E 2009; R 2009) Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring

ASTM F1700 (2013a) Solid Vinyl Floor Tile

ASTM 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 F2169 (2014) Resilient Stair Treads

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)

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.

1.2.2 Other Submittal Requirements

The following shall be submitted in accordance with LEED BD+C:

a. documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

b. documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

c. documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

1.3 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

Resilient Flooring and Accessories; G

SD-03 Product Data

Resilient Flooring and Accessories shown below; G

Sheet Vinyl Flooring
Rubber Tile
Solid Vinyl Tile and Plank
Wall Base
Stair Treads, Risers and Stringers
Transition Moulding

Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4.1); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.
Low-Emitting Flooring Systems (LEED Credit IEQ 4.3); G

Manufacturers' product data for flooring systems installed in the interior of the building. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-04 Samples
Resilient Flooring and Accessories; G

SD-06 Test Reports
Moisture, Alkalinity and Bond Tests; G

SD-08 Manufacturer's Instructions
Surface Preparation; G
Installation; G

SD-10 Operation and Maintenance Data
Resilient Flooring and Accessories; G

SD-11 Closeout Submittals
All approved LEED Submittals specified under SD-03 Product Data; S

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 free from strong contaminant sources and residues with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store exposed rubber surface materials in occupied spaces. Do not store near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 68 degrees F and below 85 degrees F for 3 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 55 degrees F thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.
1.6 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 and 5 square feet for each 1000 square feet of sheet flooring installed. Provide extra wall base material composed of 20 linear feet of each type, color and pattern. Package all extra materials in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Provide extra materials from the same lot as those installed. Leave extra stock at the site in location assigned by Contracting Officer.

1.9 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.2 LOW-EMITTING FLOORING SYSTEMS

For field applications that are used on the interior of the building, floor systems shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.3 SHEET VINYL FLOORING SV-2 and SV-1

Conform to ASTM F1303, Type II, Grade 1, without backing (minimum wear layer thickness 0.080 inch and minimum overall thickness 0.080 inch, and a minimum 6 feet, 6 inches wide. Extend color and pattern through the total thickness of the material.

2.4 RUBBER TILE RT-1

Conform to ASTM F1344 Class 1 homogeneous, Type A (solid color), 24 inch square. Provide pattern as indicated on Drawings. Provide 0.125 inch overall thickness.

2.5 SOLID VINYL TILE SVT-1 and SVT-2

Conform to ASTM F1700 Class I monolithic (minimum wear layer thickness 0.125 inch and minimum overall thickness 0.125 inch, Type A (smooth). Provide 16 inch square tile.
2.6  SOLID VINYL PLANK (LVP-1)

Conform to ASTM F1700 Class III printed film minimum wear layer thickness of 0.020 inch and minimum overall thickness 0.125 inch, Type B embossed. Provide 6 x 36 inch plank.

2.7  WALL BASE, RB-1

Conform to ASTM F1861, Type TP (thermoplastic rubber), Style A (straight). Provide 5.25 inch high and a minimum 3/8 inch thick wall base. Provide job formed corners in matching height, shape and color.

2.8  WALL BASE, RB-2

Conform to ASTM F1861, Type TP (thermoplastic rubber), Style B (coved). Provide 4 inch high a minimum of 1/8 inch thick wall base. Provide job formed corners in matching height, shape, and color.

2.9  INTEGRAL COVE BASE, IVB-1 and IVB-2

Extend integral coved base for sheet vinyl flooring up the wall 4 inch. Provide a vinyl or rubber, square cap strip and vinylor rubber, fillet strip with a minimum radius of 3/4 inch for integral coved bases as shown. Provide integral cove of the same material as flooring.

2.10  STAIR TREADS, RISERS AND STRINGERS, RST-1

Conform to ASTM F2169, Type TS (vulcanized thermoset rubber). Conform to ASTM F2169 for surface of treads Class 2 raised ribbed pattern and have Group 2 strip for visually impaired of contrasting color of same material. Provide square nosing. Provide either a one piece nosing/tread/riser or a two piece nosing/tread design with a matching coved riser.

2.11  MOULDING, TR-3 and TR-4

Provide tapered mouldings of rubber and types as indicated on Drawings for transitions of flooring materials specified. Provide horizontal line on moulding of maximum 5/8 inch. Provide bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2.

2.12  ADHESIVES

Provide high moisture 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.

2.13  SURFACE PREPARATION MATERIALS

Provide surface preparation materials, such as floor crack fillers as recommended by the flooring manufacturer for the subfloor conditions. Comply with ASTM F1482 for panel type underlayment products. Use one of the following substrates:

a. Concrete.
2.14 POLISH/FINISH

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

2.15 CAULKING AND SEALANTS

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

2.16 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers. Provide floor patterns as specified 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. Submit scaled drawings indicating patterns (including location of patterns and colors) and dimensions. Submit manufacturer's descriptive data and three samples of each indicated color and type of flooring, base, mouldings, and accessories sized a minimum 2-1/2 by 4 inch. Submit Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 3 EXECUTION

3.1 EXAMINATION

Examine and verify that site conditions are in agreement with the design package. Report all conditions that will prevent a proper installation. Do not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer. Submit manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

3.2 SURFACE PREPARATION

Provide a smooth, true, level plane for surface preparation of the flooring, except where indicated as sloped. Floor to be flat to within 3/16 inch in 10 feet. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Prepare the surfaces of lightweight concrete slabs (as defined by the flooring manufacturer) as recommended by the flooring manufacturer. Comply with ASTM F710 for concrete subfloor preparation. Floor fills or toppings may be required as recommended by the flooring manufacturer. Install underlayments, when required by the flooring manufacturer, in accordance with manufacturer's recommended printed installation instructions. 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 SOLID VINYL TILES

Install tile flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's directions. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary edge width as necessary to maintain full-size tiles in the field, no edge tile to be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe edge tile to walls and partitions after field flooring has been applied.

3.5 PLACING SHEET VINYL FLOORING

Install sheet vinyl flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Lay out sheets to minimize waste. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied. Provide heat welded seams and edges shown on the drawings in accordance with the manufacturer's written installation instructions. Finish joints flush, free from voids, recesses, and raised areas. Install flooring with an integral coved base where indicated on Drawings.

3.6 PLACING RUBBER TILE

Install rubber tile and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Vary width of edge tiles as necessary to maintain full-size tiles, except where irregular-shaped rooms makes it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied.

3.7 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.

3.8 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.

3.9 PLACING STAIR TREADS, RISERS, AND STRINGERS

Secure and install stair treads, risers, and stringers in accordance with manufacturer's printed installation instructions. Cover the surface of treads and risers the full width of the stairs. Provide equal length pieces butted together to cover the treads and risers for stairs wider than manufacturer's standard lengths.

3.10 PLACING INTEGRAL COVED BASE

Install integral cove base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Shape integral coved base by extending the flooring material 4 inch onto the wall surface. Support cove by a filler. Provide a cap strip at the top of the base in color to match integral base. Fill voids along the top edge of base at masonry walls with caulk.

3.11 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.

3.12 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.

3.13 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 107  (2013) Colorfastness to Water
AATCC 134  (2011; E 2013) Electrostatic Propensity of Carpets
AATCC 16   (2004; E 2008; E 2010) Colorfastness to Light
AATCC 165  (2013) Colorfastness to Crocking: Textile Floor Coverings - Crockmeter Method
AATCC 174  (2011) Antimicrobial Activity Assessment of Carpets

ASTM INTERNATIONAL (ASTM)

ASTM 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 D5848  (2010; E 2010) Mass Per Unit Area of Pile Yarn Floor Coverings

CARPET AND RUG INSTITUTE (CRI)

CRI CIS    (2011) Carpet Installation Standard
INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)


U.S. GREEN BUILDING COUNCIL (USGBC)


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

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

40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 SYSTEM DESCRIPTION

1.2.1 Scheduling

Install carpet systems after the installation and ventilation period of materials or finishes which have high short-term emissions of VOCs, formaldehyde, particulates, or other air-borne compounds which may be adsorbed by or settle on the carpet tiles, including.

1.3 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

Installation Drawings; G

SD-03 Product Data

Carpets; G

Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4.1); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

Low-Emitting Flooring Systems (LEED Credit IEQ 4.3); G

Manufacturers' product data for flooring systems installed in the interior of the building. Manufacturers' product data for carpet
and cushion installed in the interior of the building indicating product complies with the CRI Green Label Plus program. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-04 Samples
   Carpet; G

SD-06 Test Reports
   Moisture and Alkalinity Tests; G

SD-07 Certificates
   Carpet
   Regulatory Requirements

SD-08 Manufacturer's Instructions
   Surface Preparation
   Installation

SD-10 Operation and Maintenance Data
   Carpet; G
   Cleaning and Protection; G
   Maintenance Service

SD-11 Closeout Submittals
   All approved LEED Submittals specified under SD-03 Product Data; S

1.4 QUALITY ASSURANCE

Provide the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label for carpet, carpet cushion, and adhesives or demonstrate compliance with testing criteria and frequencies through independent laboratory test results. Carpet, carpet cushion, and adhesives bearing the label will indicate that the carpet has been tested and meets the Regulatory Requirements and criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality. Procure carpet in accordance with 40 CFR 247, and where possible, purchased locally to reduce emissions of fossil fuels from transporting.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Remove materials from packaging and store them in a clean, dry, well ventilated area (100 percent outside air supply, minimum of 1.5 air changes per hour, and no recirculation), protected from damage, soiling, and moisture, and strong contaminant sources and residues, and maintain at a temperature above 60 degrees F for 2 days prior to installation. Do not store carpet or carpet tiles with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants. Do not store carpet near materials that may off gas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.
1.6 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.

1.7 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.

1.8 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.2 LOW-EMITTING FLOORING SYSTEMS

For field applications that are used on the interior of the building, floor systems shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING, and carpet and cushion shall comply with the CRI Green Label Plus program specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.3 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 Carpet. 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

2.3.1 Physical Characteristics for Modular Tile Carpet, CPT-1 and Coordinating Pattern, CPT-2

2.3.1.1 Carpet Construction

Tufted
2.3.1.2 Type
Modular tile 18 by 36 inch square with 0.15 percent growth/shrink rate in accordance with ISO 2551.

2.3.1.3 Pile Type
Textured loop

2.3.1.4 Pile Fiber
Commercial 100 percent branded (federally registered trademark) type 6,6, 100% solution dyed nylon continuous filament.

2.3.1.5 Gauge or Pitch
Minimum 1/12 inch in accordance with ASTM D5793

2.3.1.6 Stitches or Rows/Wires
Minimum per 10 square inch

2.3.1.7 Surface Pile Weight
Minimum 30 ounces per square yard. This does not include weight of backings. Determine weight in accordance with ASTM D5848.

2.3.1.8 Pile Thickness
Minimum 0.190 inch in accordance with ASTM D6859

2.3.1.9 Pile Density
Minimum 5525

2.3.1.10 Dye Method
100% Solution dyed

2.3.1.11 Backing Materials
Provide primary backing materials like those customarily used and accepted by the trade for each type of carpet that are cradle to cradle certified. Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet.

2.4 PERFORMANCE REQUIREMENTS

2.4.1 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.

2.4.2 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.
2.4.3 Tuft Bind

comply with ASTM D1335 for tuft bind force required to pull a tuft or loop free from carpet backing with a minimum 8 pound average force for modular carpet tile.

2.4.4 Colorfastness to Crocking

Comply dry and wet crocking with AATCC 165 and with a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.

2.4.5 Colorfastness to Light

Comply colorfastness to light with AATCC 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and with a minimum 4 grey scale rating after 40 hours.

2.4.6 Colorfastness to Water

Comply colorfastness to water with AATCC 107 and with a minimum 4.0 gray scale rating and a minimum 4.0 transfer scale rating.

2.4.7 Delamination Strength

Provide delamination strength for tufted carpet with a secondary back of minimum 2.5 lbs/inch.

2.4.8 Antimicrobial

Nontoxic antimicrobial treatment in accordance with AATCC 174 Part I (qualitative), guaranteed by the carpet manufacturer to last the life of the carpet.

2.5 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers shall comply with applicable regulations regarding toxic and hazardous materials. Provide water resistant, mildew resistant, nonflammable, and nonstaining adhesives and concrete primers for carpet installation as required by the carpet manufacturer. Provide release adhesive for modular tile carpet as recommended by the carpet manufacturer. Provide adhesives flashpoint of minimum 140 degrees F in accordance with ASTM D3278.

2.6 TAPE

Provide tape for seams as recommended by the carpet manufacturer for the type of seam used in installation. Any seam sealant shall have a maximum VOC content of 50 grams/liter. Do not use sealants that contain 1,1,1-trichloroethane or toluene.

2.7 COLOR, TEXTURE, AND PATTERN

Provide color, texture, and pattern in accordance with the drawings.
PART 3 Execution

3.1 Surface Preparation

Do not install carpet on surfaces that are unsuitable and will prevent a proper installation. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Repair holes, cracks, depressions, or rough areas using material recommended by the carpet or adhesive manufacturer. Free floor of any foreign materials and sweep clean. Before beginning work, test subfloor with glue and carpet to determine "open time" and bond. Submit three copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

3.2 Moisture and Alkalinity Tests

Test concrete slab for moisture content and excessive alkalinity in accordance with CRI CIS. Submit three copies of test reports to the Contracting Officer of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

3.3 Preparation of Concrete Subfloor

Do not commence installation of the carpeting until concrete substrate is at least 90 days old. Prepare the concrete surfaces in accordance with the carpet manufacturer's instructions. Match carpet, when required, and adhesives to prevent off-gassing to a type of curing compounds, leveling agents, and concrete sealer.

3.4 Installation

Isolate area of installation from rest of building. Perform all work by manufacturer's approved installers. Conduct installation in accordance with the manufacturer's printed instructions and CRI CIS. Protect edges of carpet meeting hard surface flooring with molding and install in accordance with the molding manufacturer's printed instructions. Follow ventilation, personal protection, and other safety precautions recommended by the adhesive manufacturer. Continue ventilation during installation and for at least 72 hours following installation. Do not permit traffic or movement of furniture or equipment in carpeted area for 24 hours after installation. Complete other work which would damage the carpet prior to installation of carpet. Submit three copies of installation drawings for 1) Carpet, 2) Moldings indicating areas receiving carpet, carpet types, patterns, direction of pile, location of seams, and locations of edge molding.

3.4.1 Modular Tile Installation

Install modular tiles with permanent vinyl-compatible adhesive and snug joints. Use installation method indicated on Drawings. Provide accessibility to the subfloor where required.

3.5 Cleaning and Protection

Submit three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.
3.5.1 Cleaning

As specified in Section 01 78 00 CLOSEOUT SUBMITTALS. After installation of the carpet, remove debris, scraps, and other foreign matter. Remove soiled spots and adhesive from the face of the carpet with appropriate spot remover. Cut off and remove protruding face yarn. Vacuum carpet clean with a high-efficiency particulate air (HEPA) filtration vacuum.

3.5.2 Protection

Protect the installed carpet from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Lap and secure edges of kraft paper protection to provide a continuous cover. Restrict traffic for at least 48 hours. Remove protective covering when directed by the Contracting Officer.

3.6 MAINTENANCE

3.6.1 Extra Materials

Provide extra material from same dye lot consisting of uncut carpet tiles for future maintenance. Provide a minimum of 10 percent of total square yards of each carpet type, pattern, and color.

3.6.2 Maintenance Service

Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. Service shall reclaim materials for recycling and/or reuse. Service shall not landfill or burn reclaimed materials. When such a service is not available, seek local recyclers to reclaim the materials. Submit documentation of manufacturer's take-back program for carpet. Include contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

3.7 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of 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 CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100Doc (2005) Documentation of the Threshold Limit Values and Biological Exposure Indices

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


ASTM INTERNATIONAL (ASTM)


ASTM D 2092 (1995; R 2001e1) Standard Guide for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting


ASTM D 4263 (1983; R 2005) Indicating Moisture in Concrete by the Plastic Sheet Method


ASTM E 84 (2009c) Standard Test Method for Surface
Burning Characteristics of Building Materials

ASTM F 1869 (2010) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 10  (Oct 2009) Exterior Latex, Flat, MPI Gloss Level 1

MPI 101  (Oct 2009) Epoxy Anti-Corrosive Metal Primer

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

MPI 116  (Oct 2009) Epoxy Block Filler

MPI 145  (Oct 2009) Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 3

MPI 23  (Oct 2009) Surface Tolerant Metal Primer

MPI 4  (Oct 2009) Interior/Exterior Latex Block Filler

MPI 42  (Oct 2009) Latex Stucco and Masonry Textured Coating

MPI 47  (Oct 2009) Interior Alkyd, Semi-Gloss, MPI Gloss Level 5

MPI 50  (Oct 2009) Interior Latex Primer Sealer

MPI 56  (Oct 2009) Interior Oil Modified Urethane Clear Gloss

MPI 72  (Oct 2009) Polyurethane, Two Component, Pigmented, Gloss

MPI 77  (Oct 2009) Epoxy Gloss

MPI 79  (Oct 2009) Alkyd Anti-Corrosive Metal Primer

MPI 90  (Oct 2009) Interior Wood Stain, Semi-Transparent

MPI 94  (Oct 2009) Exterior Alkyd, Semi-Gloss, MPI Gloss Level 5

MPI 95  (Oct 2009) Quick Drying Primer for Aluminum

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SP01-01 (2000) Environmentally Preferable Product Specification for Architectural and
Anti-Corrosive Paints

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1 (2000; E 2004) Shop, Field, and Maintenance Painting of Steel
SSPC SP 1 (1982; E 2004) Solvent Cleaning
SSPC SP 10 (2000; R 2004) Near-White Blast Cleaning
SSPC SP 12 (2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating
SSPC SP 2 (1982; R 2004) Hand Tool Cleaning
SSPC SP 3 (1982; E 2004) Power Tool Cleaning
SSPC SP 6 (2000; R 2004) Commercial Blast Cleaning
SSPC SP 7 (2000; R 2004) Brush-Off Blast Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Change 1-2010; Change 3-2010; Errata 1-2010) Safety and Health Requirements Manual

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313 (Rev D; Am 1) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

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

29 CFR 1910.1000 Air Contaminants

U.S. GREEN BUILDING COUNCIL (USGBC)

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

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

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

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP01-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Coating; G

Manufacturer's Technical Data Sheets; G

Low-Emitting Paints and Coatings (LEED Credit IEQ 4.2); G

Manufacturers' product data for paints and coatings used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in grams per liter and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-04 Samples

Color; G

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

Textured Wall Coating System; G

SD-07 Certificates
Applicator's qualifications

Qualification Testing laboratory for coatings; G

SD-08 Manufacturer's Instructions

Application instructions

Mixing

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

Manufacturer's Material Safety Data Sheets

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

SD-10 Operation and Maintenance Data

Coatings; G

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

SD-11 Closeout

All approved LEED Submittals specified under SD-03 Product Data; S

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 buildings 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
1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.4.2 Textured Wall Coating System

Three complete samples of each indicated type, pattern, and color of textured wall coating system applied to a panel of the same material as that on which the coating system will be applied in the work. Samples of wall coating systems shall be minimum 125 x 175 mm (5 x 7 inches) and of
sufficient size to show pattern repeat and texture.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.5.2 Lead Content

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

1.5.3 Chromate Content

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

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasives blast media shall not contain free crystalline silica.

1.5.7 Human Carcinogens

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

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 GOVERNMENTAL SAFETY
REQUIREMENTS and in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC Guide 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100Doc, threshold limit values.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.9 COLOR SELECTION

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

1.10 LOCATION AND SURFACE TYPE TO BE PAINTED

1.10.1 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.

1.10.1.1 Exterior Painting

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

1.10.1.2 Interior Painting

Includes new surfaces, existing uncoated surfaces, and existing coated surfaces of the buildings and appurtenances as indicated. 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.

1.10.2 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.

1.10.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new 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.

1.10.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

a. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.

b. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 1.0 mil. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals throughout the piping systems.

1.10.4 Exterior Painting of Site Work Items

Field coat the following items:

<table>
<thead>
<tr>
<th>New Surfaces</th>
<th>Existing Surfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Backflow Preventers</td>
<td>Items as indicated on drawings</td>
</tr>
<tr>
<td>b. Other items as indicated</td>
<td></td>
</tr>
<tr>
<td>on drawings</td>
<td></td>
</tr>
</tbody>
</table>

1.10.5 Rated Wall Identification

Above decorative ceilings and in concealed spaces, identify with sign stencils, all rated corridor partitions, smoke stop partitions, horizontal exit partitions, exit enclosures and fire rated walls. Lettering shall be minimum 6 inches high and read as follows:

a. On 1 hour fire barrier type partitions: "1 Hour Fire Barrier - Protect All Openings".

b. On 2 hour fire barrier type partitions: "2 Hour Fire Barrier - Protect All Openings".

c. On 1 hour smoke barrier type partitions: "1 Hour Smoke Barrier - Protect All Openings".

d. On 2 hour smoke barrier type partitions: "2 Hour Smoke Barrier -
In sprinklered Storage Rooms, paint a graphic line on the walls at 18 inches below the sprinkler head. Width of line and color as required; place a visible sign above the line stating "STORAGE NOT PERMITTED ABOVE LINE".

1.10.6 Definitions and Abbreviations

1.10.6.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.10.6.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.10.6.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendering, 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.

1.10.6.4 DFT or dft

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

1.10.6.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.10.6.6 EPP

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

1.10.6.7 EXT

MPI short term designation for an exterior coating system.

1.10.6.8 INT

MPI short term designation for an interior coating system.
1.10.6.9 micron / microns

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

1.10.6.10 mil / mils

The English measurement for 0.001 in or one/thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.10.6.11 mm

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

1.10.6.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

<table>
<thead>
<tr>
<th>Gloss Level</th>
<th>Description</th>
<th>@ 60 degrees</th>
<th>@ 85 degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>Matte or Flat</td>
<td>0 to 5</td>
<td>10 max</td>
</tr>
<tr>
<td>G2</td>
<td>Velvet</td>
<td>0 to 10</td>
<td>10 to 35</td>
</tr>
<tr>
<td>G3</td>
<td>Eggshell</td>
<td>10 to 25</td>
<td>10 to 35</td>
</tr>
<tr>
<td>G4</td>
<td>Satin</td>
<td>20 to 35</td>
<td>35 min</td>
</tr>
<tr>
<td>G5</td>
<td>Semi-Gloss</td>
<td>35 to 70</td>
<td></td>
</tr>
<tr>
<td>G6</td>
<td>Gloss</td>
<td>70 to 85</td>
<td></td>
</tr>
<tr>
<td>G7</td>
<td>High Gloss</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.10.6.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.10.6.14 Paint

See Coating definition.

1.10.6.15 REX

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

1.10.6.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.
1.11 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 LOW-EMITTING PAINTS AND COATINGS

For field applications that are used on the interior of the building, paints and coatings shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.2 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

2.3 SPECIALTY PAINTS

2.3.1 Abrasion Resistant Paint

Water based polyurethane/acrylic eggshell coating which produces a durable and cleanable finish. Formulation shall be low-odor and contain an anti-microbial to inhibit the growth of mold, mildew and bacteria.

2.3.1.1 Performance Criteria

a. VOC: Content shall be less than 110 g/l.

b. Fire Rating: Type I or Class A fire-rated per ASTM E 84.

c. Scrub Test: Greater than 25,000 cycles per ASTM D2486.


e. Chemical Resistance: 10 (test maximum) for all chemicals tested, ASTM D 1308.

f. Stain Removal: 8 to 10 (test maximum) for all stains tested, four-hour Open Spot Test.

2.3.2 Static Control Sealer

Static conductive concrete sealer with manufacturer's standard urethane topical concrete sealer.

2.3.2.1 Performance Criteria


b. Compressive Strength: ASTM D695, 5,000 psi.

c. Electrical Surface Resistance: ANSI/ESD S7.1, greater than 1.0E04, less than 1.0E09.

d. Colors: As indicated.
2.3.2.2 Grounding System

a. Static control sealer manufacturer's standard ground kit designed for static control sealers, including ground connection plates, cables, fasteners, high conductivity fabric tape, conductive adhesives, and ancillary items as required for a complete grounding system. Provide ground kit quantities as required to suit conditions per manufacturer's written instructions.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

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

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 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. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits, ASTM D 235. Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

b. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.

c. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer.

d. Previously painted surfaces specified to be repainted shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter.
e. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.

f. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8.

g. 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.

h. Edges of chipped paint shall be feather edged and sanded smooth.

i. 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.

j. 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 or blasting so that when tested in accordance with ASTM D 4214, 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, SSPC SP 3, SSPC SP 6, or SSPC SP 10. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.
b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/SSPC SP 12 WJ-3.

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 SP 7, SSPC SP 6, and SSPC SP 10. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4.

3.3.3 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 D 2092, Appendix X2, and remove by one of the methods described therein.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

3.3.4 Non-Ferrous Metallic Surfaces

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

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

3.4 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 and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, and 4 quarts of warm

SECTION 09 90 00 Page 16
water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new 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 D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 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 D 4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D 4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New 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.

b. Removal of Fungus and Mold: Wash existing coated surfaces with a solution composed of 3 ounces (2/3 cup) trisodium phosphate, 1 ounce (1/3 cup) household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

c. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D 4444, Method A, unless otherwise authorized.

d. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.

e. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

f. Cosmetic Repair of Minor Defects:

   (1) Knots and Resinous Wood: 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.

3.5.2 Interior Wood Surfaces, Stain Finish

Interior wood surfaces to receive stain shall be sanded. Oak and other open-grain wood to receive stain shall be given a coat of wood filler not less than 8 hours before the application of stain; excess filler shall be removed and the surface sanded smooth.

3.6 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. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated.
Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

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

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

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

Apply paint to new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads which have been painted and replace with new sprinkler heads. For piping in unfinished spaces, provide primed surfaces with one coat of red alkyd gloss enamel to a minimum dry film thickness of 1.0 mil. Unfinished spaces include attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted or not constructed of a prefinished material. For piping in finished areas, provide prime surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel. Upon completion of painting, remove protective covering from sprinkler heads.

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

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

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

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

e. Floors: For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing U.S. Standard Sieve No. 40 less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused.
and vacuum up remaining residue before application of the topcoat.

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>
<thead>
<tr>
<th>Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Division 3. Exterior Concrete Paint Table</td>
</tr>
<tr>
<td>Division 4. Exterior Concrete Masonry Units Paint Table</td>
</tr>
<tr>
<td>Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table</td>
</tr>
<tr>
<td>Division 4. Interior Concrete Masonry Units Paint Table</td>
</tr>
<tr>
<td>Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table</td>
</tr>
<tr>
<td>Division 6. Interior Wood Paint Table</td>
</tr>
<tr>
<td>Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table</td>
</tr>
</tbody>
</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 ANSI A13.1. Place stenciling in clearly visible locations. On piping not covered by ANSI 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 PAINT TABLES

All DFT's are minimum values.

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

A. New and uncoated existing and existing, previously painted concrete; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. Latex
   New; MPI EXT 3.1A-G2 (Flat) / Existing; MPI REX 3.1A-G2 (Flat)
   Primer: Intermediate: Topcoat:
   MPI 10  MPI 10  MPI 10
   System DFT: 3.5 mils

   New concrete at retaining walls as indicated:
   1. Textured Coating, Latex; MPI EXT 3.1N-G2 (Flat, Sand Texture)
      Primer: Topcoat:
      Manufacturer's Recommendation
      MPI 42
      System DFT: 15 mils

DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New and existing concrete masonry on uncoated surface:

1. Latex
   New; MPI EXT 4.2A-G1 (Flat) / Existing; MPI REX 4.2A-G1 (Flat)
   Block Filler: Primer: Intermediate: Topcoat:
   MPI 4 N/A  MPI 10  MPI 10
   System DFT: 11 mils

3.12.1 EXTERIOR PAINT TABLES

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

1. Alkyd
   New; MPI EXT 5.1Q-G5 (Semi gloss) Existing; MPI REX 5.1D-G5
   Primer: Intermediate: Topcoat:
   MPI 23  MPI 94  MPI 94
   System DFT: 5.25 mils
DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

B. New Steel that has been blast-cleaned to SSPC SP 6:

1. Alkyd
   New; MPI EXT 5.1D-G5 (Semigloss) / Existing; MPI REX 5.1D-G5
   Primer: MPI 79       Intermediate: MPI 94       Topcoat: MPI 94
   System DFT: 5.25 mils

EXTERIOR GALVANIZED SURFACES

C. New Galvanized surfaces:

1. Pigmented Polyurethane
   MPI EXT 5.3L-G6 (Gloss)
   Primer: MPI 101       Intermediate: N/A       Topcoat: MPI 72
   System DFT: 5 mils

D. Galvanized surfaces with slight coating deterioration; little or no rusting:

1. Pigmented Polyurethane
   MPI REX 5.3D-G6 (Gloss)
   Primer: MPI 101       Intermediate: N/A       Topcoat: MPI 72
   System DFT: 5 mils

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

E. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd
   MPI EXT 5.4F-G5 (Semigloss)
   Primer: MPI 95       Intermediate: MPI 94       Topcoat: MPI 94
   System DFT: 5 mils

F. Surfaces adjacent to painted surfaces; Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd
   MPI EXT 5.1D-G5 (Semigloss)
   Primer: MPI 79       Intermediate: MPI 94       Topcoat: MPI 94
   System DFT: 5.25 mils

3.12.2 INTERIOR PAINT TABLES

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. New concrete floors in areas indicated on Drawings for CONCS 2:

SECTION 09 90 00 Page 23
DIVISION 3: INTERIOR CONCRETE PAINT TABLE

1. Static Control Sealer

<table>
<thead>
<tr>
<th>Primer:</th>
<th>Intermediate:</th>
<th>Topcoat:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mfr Std</td>
<td>Mfr Std</td>
<td>Mfr Std</td>
</tr>
<tr>
<td>System DFT:</td>
<td>Mfr Std</td>
<td>Mfr Std</td>
</tr>
</tbody>
</table>

Note: "Mfr Std" represents manufacturer's standard requirements.

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New and uncoated Existing Concrete masonry:

1. Institutional Low Odor / Low VOC Latex

   New; MPI INT 4.2E-G3 (Eggshell)

<table>
<thead>
<tr>
<th>Filler</th>
<th>Primer:</th>
<th>Intermediate:</th>
<th>Topcoat:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI 4</td>
<td>N/A</td>
<td>MPI 145</td>
<td>MPI 145</td>
</tr>
<tr>
<td>System DFT:</td>
<td>4 mils</td>
<td>System DFT:</td>
<td>4 mils</td>
</tr>
</tbody>
</table>

B. Existing, previously painted Concrete masonry:

1. Institutional Low Odor / Low VOC Latex

   Existing; MPI RIN 4.2L-G3 (Eggshell)

<table>
<thead>
<tr>
<th>Spot Primer:</th>
<th>Intermediate:</th>
<th>Topcoat:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI 50</td>
<td>MPI 145</td>
<td>MPI 145</td>
</tr>
<tr>
<td>System DFT:</td>
<td>4 mils</td>
<td>System DFT:</td>
</tr>
</tbody>
</table>

C. New and uncoated Existing Concrete masonry units in toilets, shower areas and other high humidity areas unless otherwise specified:

1. Epoxy

   MPI INT 4.2G-G6 (Gloss)

<table>
<thead>
<tr>
<th>Filler:</th>
<th>Primer:</th>
<th>Intermediate:</th>
<th>Topcoat:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI 116</td>
<td>N/A</td>
<td>MPI 77</td>
<td>MPI 77</td>
</tr>
<tr>
<td>System DFT:</td>
<td>10 mils</td>
<td>System DFT:</td>
<td>10 mils</td>
</tr>
</tbody>
</table>

   Fill all holes in masonry surface

D. Existing, previously painted, concrete masonry units in toilets, shower areas, and other high humidity areas unless otherwise specified:

1. Epoxy

   MPI RIN 4.2D-G6 (Gloss)

<table>
<thead>
<tr>
<th>Spot Primer:</th>
<th>Intermediate:</th>
<th>Topcoat:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI 77</td>
<td>MPI 77</td>
<td>MPI 77</td>
</tr>
<tr>
<td>System DFT:</td>
<td>5 mils</td>
<td>System DFT:</td>
</tr>
</tbody>
</table>

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, Surfaces adjacent to painted surfaces (Match surrounding finish), and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. Alkyd

   MPI INT 5.1E-G5 (Semigloss)

   Primer:       | Intermediate: | Topcoat: |
   |---------------|---------------|----------|

SECTION 09 90 00 Page 24
DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE
INTERIOR STEEL / FERROUS SURFACES
MPI 79               MPI 47               MPI 47
System DFT: 5.25 mils

B. Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd
   MPI INT 5.4J-G5 (Semigloss)
   Primer: MPI 95              Intermediate: MPI 47              Topcoat: MPI 47
   System DFT: 5 mils

DIVISION 6: INTERIOR WOOD PAINT TABLE

A. New Wood; natural finish or stained:

1. Stained, oil-modified polyurethane
   New; MPI INT 6.4E-G6 (Gloss) / Existing; MPI RIN 6.4G-G6 (Gloss)
   Stain: MPI 90              Primer: MPI 56              Intermediate: MPI 56              Topcoat: MPI 56
   System DFT: 4 mils

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

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

1. Institutional Low Odor / Low VOC Latex
   New; MPI INT 9.2M-G3 (Eggshell) / Existing; MPI RIN 9.2M-G3 (Eggshell)
   Primer: MPI 50              Intermediate: MPI 145              Topcoat: MPI 145
   System DFT: 4 mils

B. New and Existing, previously painted Wallboard in toilets, and other high humidity areas not otherwise specified:

1. Epoxy
   New; MPI INT 9.2E-G6 (Gloss) / Existing; MPI RIN 9.2D-G6 (Gloss)
   Primer: MPI 50              Intermediate: MPI 77              Topcoat: MPI 77
   System DFT: 4 mils

3.13 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 09 96 00
HIGH-PERFORMANCE COATINGS
11/14

PART 1   GENERAL

1.1   REFERENCES

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

ASTM INTERNATIONAL (ASTM)

MASTER PAINTERS INSTITUTE (MPI)
MPI 101 (Oct 2009) Epoxy Anti-Corrosive Metal Primer
MPI 72 (Oct 2009) Polyurethane, Two Component, Pigmented, Gloss
MPI 77 (Oct 2009) Epoxy Gloss

SOCIETY FOR PROTECTIVE COATINGS (SSPC)
SSPC 7/NACE No.4 (2007; E 2004) Brush-Off Blast Cleaning

U.S. GREEN BUILDING COUNCIL (USGBC)

1.2   SUMMARY

Section includes surface preparation and the application of high-performance coating systems for painting of concrete housekeeping pads, ferrous pipe support components; pipe hangers, trapeze pipe hangers, metal framing systems, exterior pipe supports, and non-insulated carbon steel piping on the following substrates:

1.2.1   Exterior Substrates

a. Steel and Carbon (Black) Steel, including steel door canopy and related components.

b. Galvanized metal.

c. Copper.

1.2.2   Interior Substrates

a. Concrete, horizontal surfaces.
b. Steel and Carbon (Black) Steel.

c. Galvanized metal.

d. Copper.

1.2.3 Related Requirements

a. Section 09 90 00 PAINTS AND COATINGS for general field painting.

b. Division 22 and 23 Sections for specific steel, carbon (black) steel, galvanized metal and copper items to receive high-performance coatings.

c. Divisions 22 and 23 Sections for concrete housekeeping pads to receive high-performance coatings.

1.3 DEFINITIONS

1.3.1 MPI Gloss Level 6

70 to 85 units at 60 degrees, according to ASTM D523.

1.3.2 MPI Gloss Level 7

More than 85 units at 60 degrees, according to ASTM D523.

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

Product List; G

Submit product list for each product indicated, including the following:

a. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

b. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

SD-03 Product Data

Low-Emitting Paints and Coatings (LEED Credit IEQ 4); G

Manufacturers' product data for paints and coatings used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in grams per liter and material safety data sheets.
Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

Metal Primers; G
Epoxy Coatings; G
Polyurethane Coatings; G

SD-04 Samples

Color; G
Submit samples for verification for each type of coating system and in each color and gloss of topcoat indicated.

a. Submit Samples on ridid backing, 8 inches square.
b. Apply coats on Samples in steps to show each coat required for system.
c. Label each coat of each Sample.
d. Label each Sample for location and application area.

SD-11 Closeout

All approved LEED Submittals specified under SD-03 Product Data; S

1.5 FIELD CONDITIONS

Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.

Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

Do not apply exterior coatings in snow, rain, fog, or mist.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver special coating materials to the project in their original containers bearing manufacturer's name, descriptive label, and coating formulations. Provide new and unopened containers.

Store special coating materials in tightly closed containers in a covered, well-ventilated area where they are not exposed to excessive heat, fumes, sparks, flame, or direct sunlight. Protect water-based coatings against freezing.

Store solvents, thinners, and equipment cleaners with the same care as the coating materials with ambient temperatures continuously maintained at a minimum 45 degrees F.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.
PART 2 PRODUCTS

2.1 LOW-EMITTING PAINTS AND COATINGS

For field applications that are used on the interior of the building, paints and coatings shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.2 PERFORMANCE REQUIREMENTS

2.2.1 Master Painters Institute (MPI) Standards

Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists".

2.2.2 Material Compatibility

a. All coatings specified herein to be indicated in Product List.

b. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

c. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

d. Products shall be of same manufacturer for each coat in a coating system.

2.2.3 Color

As indicated on drawings, and as indicated on the Mechanical drawings and specified in applicable Division 22 and 23 Sections for pipe color coding.

2.3 METAL PRIMERS

2.3.1 Primer, Epoxy, Anti-Corrosive, for Metal

MPI 101.

2.4 EPOXY COATINGS

2.4.1 Epoxy, Gloss (Gloss Level 6)

MPI 77.

2.5 POLYURETHANE COATINGS

2.5.1 Polyurethane, Two-Component, Pigmented, Gloss (Gloss Level 6)

MPI 72.
PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

3.1.1 Maximum Moisture Content of Substrates

When measured with an electronic moisture meter as follows:

a. Concrete shall be 12 percent.

Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

Proceed with coating application only after unsatisfactory conditions have been corrected.

a. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

a. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

a. Remove incompatible primers and reprime substrates with compatible primers or apply tie coat as required to produce coating systems indicated.

3.2.1 Concrete Substrates

Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

3.2.2 Steel Substrates

Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:

a. SSPC 7/NACE No.4, "Brush-Off Blast Cleaning."
3.2.3 Shop-Primed Steel Substrates
As recommended in writing by topcoat manufacturer.

3.2.4 Galvanized-Metal Substrates
Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.2.5 Copper Substrates
As recommended in writing by topcoat manufacturer.

3.3 APPLICATION
Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

a. Use applicators and techniques suited for coating and substrate indicated.

b. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.

c. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

d. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

3.4.1 Dry Film Thickness Testing
Engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

a. Contractor shall touch up and restore coated surfaces damaged by testing.

b. If test results show that dry film thickness of applied coating does
not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Contracting Officer, and leave in an undamaged condition.

At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

3.6.1 Steel and Carbon (Black) Steel Substrates

3.6.1.1 Pigmented Polyurethane Over Epoxy System (EXT 5.1H, except as modified herein:

   a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI #101, except as otherwise recommended in writing by topcoat manufacturer.

   b. Intermediate Coat: Epoxy, gloss, MPI #77.

   c. First Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6), MPI 72.

   d. Second topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6), MPI 72.

3.6.2 Galvanized-Metal and Copper Substrates

3.6.2.1 Pigmented Polyurethane System (EXT 5.3L for Galvanized; EXT 5.5B for Copper):


   b. Intermediate Coat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6), MPI 72.

   c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6), MPI 72.
3.7 INTERIOR HIGH PERFORMANCE COATING SCHEDULE

3.7.1 Concrete Substrates, Horizontal Surfaces, Housekeeping Pads and Safety Striping:

3.7.1.1 Epoxy System (INT 3.2C-G6):
   a. Prime Coat: Epoxy gloss, MPI 77.
   b. Intermediate Coat: Epoxy, gloss, MPI 77.
   c. Topcoat: Epoxy, gloss, MPI 77.

3.7.2 Steel Substrates and Carbon (Black) Steel:

3.7.2.1 Epoxy System (INT 5.1L-G6, except as modified herein):
   a. Prime Coat: Primer, epoxy, anti-corrosive, for metal, MPI 101, except as otherwise recommended in writing by topcoat manufacturer.
   b. Intermediate Coat: Epoxy, gloss, MPI 77.
   c. Topcoat: Epoxy, gloss, MPI 77.

3.7.3 Galvanized-Metal and Copper Substrates (INT 5.3D for Galvanized; INT 5.5B for Copper):

3.7.3.1 Epoxy System
   b. Intermediate Coat: Epoxy, gloss, MPI 77.
   c. Topcoat: Epoxy, gloss, MPI 77.

3.8 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 10 11 00
VISUAL DISPLAY UNITS
02/09

PART 1   GENERAL

1.1 REFERENCES

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

U.S. GREEN BUILDING COUNCIL (USGBC)


1.2 SUMMARY

The term visual display board when used herein includes presentation boards, marker boards, tackboards, board cases, display track system and horizontal sliding units; submit manufacturer's descriptive data and catalog cuts plus manufacturer's installation instructions, and cleaning and maintenance instructions. Visual display boards shall be from manufacturer's standard product line. Submit certificate of compliance signed by Contractor attesting that visual display boards conform to the requirements specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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

Item M0400, Screen, Projection, Remote Control; G

Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4.1); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-04 Samples
Screen Fabric; G
SD-07 Certificates
Item M0400, Screen, Project, Remote Control
SD-11 Closeout
All approved LEED Submittals specified under SD-03 Product Data; S

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in the manufacturer's original unopened containers and store them in a clean dry area with temperature maintained above 50 degrees F. Stack materials according to manufacturer's recommendations. Visual display boards shall be allowed to acclimate to the building temperature for 24 hours prior to installation.

1.5 WARRANTY

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

1.6 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.2 Item M0400, Screen, Projection, Remote Control

Roll-up type, recessed ceiling mounted projection screen. Electrical operation, 120 volt, 84 inches high by 108 inches wide. Shall have two motors, one to operate door and one to operate screen.

Door motor electrically operated 120 volts mounted inside roller, to be three wire with ground, quick reversal type. Shall have pre-set but adjustable limit switches to automatically stop fabric door in the down position.

Screen motor is electrically operated 120 volt inside the roller, to be three wire with ground quick reversal type. To have pre-set but adjustable limit switches to automatically stop picture surface in the up and down positions.

Roller shall be rigid metal. Screen fabric to be flame retardant and mildew resistant fiber glass with black masking borders standard. Bottom of fabric shall be formed into a pocket holding a metal rod with plastic caps.
Case shall be a white powder coated aluminum extrusion. Bottom of case to be self-trimming with a built-in flange around bottom of case.

Shall be equipped with concealed hinges. Junction box shall be internally integrated into the housing. Junction box shall contain a quick connect connector that shall be mounted in the housing for easy plug-in connection. Shall include integrated low voltage control unit and three position control switch with cover plate. Shall include Wireless remote control. Provide Matte White viewing surface.

PART 3  EXECUTION

3.1  INSTALLATION

Perform installation and assembly in accordance with manufacturer's printed instructions. Use concealed fasteners. Visual display boards shall be attached to the walls with suitable devices to anchor each unit. Furnish and install trim items, accessories and miscellaneous items in total, including but not limited to hardware, grounds, clips, backing materials, adhesives, brackets, and anchorages incidental to or necessary for a sound, secure, complete and finished installation. Installation shall not be initiated until completion of room painting and finishing operations. Visual display boards shall be installed in locations and at mounting heights indicated. Visual display boards shall be installed level and plumb, and if applicable doors shall be aligned and hardware shall be adjusted. Damaged units shall be repaired or replaced as directed by the Contracting Officer.

3.2  CLEANING

Writing surfaces shall be cleaned in accordance with manufacturer's instructions.

3.3  CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 10 14 00.10

EXTERIOR SIGNAGE

04/06

PART 1  GENERAL

1.1  REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA DAF45 (2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

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

AMERICAN WELDING SOCIETY (AWS)


AWS D1.1/D1.1M (2010; Errata 2011) Structural Welding Code - Steel

AWS D1.2/D1.2M (2014) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)


All exterior signage shall be provided by a single manufacturer. Exterior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Submit exterior signage schedule in electronic media with spread sheet format. Spread sheet shall include sign location, sign type, and message. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Each sample shall consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Submit three color samples for each material requiring color and 12 inch square sample of sign face color sample.

1.2.1 Performance Requirements

Exterior signage shall be designed to withstand windload criteria as indicated on Structural Drawings in accordance with IBC and ASCE 7 requirements.
1.2.2 Character Proportions and Heights

Letters and numbers on indicated signs for handicapped-accessible buildings shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

   Approved Detail Drawings; G
   Exterior Signage; G

   Provide shop drawings showing fabrication details including elevations, message layouts, sections, side views, plan views, mounting details, and electrical and communication details when applicable. Sign fabricator will include engineering documents that provide sign foundations, connections, wind loads and thermal movement designed to meet local climate requirements without distortions and excessive deflection.

   For all freestanding signs, provide design calculations and the signed seal of a registered structural engineer licensed in the required area of installation.

   For Building Mounted signs provide illustration documents showing all means of mounting and attachment to building structures.

SD-03 Product Data

   Modular Exterior Signage System
   Installation
   Exterior Signage; G

SD-04 Samples

   Exterior Signage; G

SD-05 Design Data

   Performance Requirements Validation; G

   For products and systems indicated to validate compliance with specified wind load performance requirements, provide calculations and design criteria, including engineering analysis data, signed and sealed by the qualified registered Professional Engineer responsible for their preparation.
1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.7 EXTRA STOCK

Provide 20 percent extra interchangeable message panels and extra stock of the following: 5 percent message bars of each color and size for sign types. 5 percent pressure-sensitive letters in each color and size for sign type. 5 percent changeable message strips for sign type.

PART 2 PRODUCTS

2.1 MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage shall consist of a system of coordinated directional, identification, and regulatory type signs located where shown. Dimensions, details, materials, message content, and design of signage shall be as shown. Submit manufacturer's descriptive data and catalog cuts.

2.1.1 Free-Standing Base Mount Pylon/Monolith Type Signs - Building Identification

2.1.1.1 Framing

Interior framing shall consist of aluminum tube columns welded to companion plates. Perimeter framing shall consist of aluminum angle framing welded to the post and plate system as designed. Framing members shall be designed to permit panel removal. Mounting shall be provided as shown. Framing members of steel shall be finished with semi-gloss baked enamel. Openings shall be sealed from moisture and made tamper-proof.

2.1.1.2 Exterior Sheeting Panels

Modular panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 0.090 inch thick aluminum. Top and end panels shall be removable and shall be secured by 3/16 inch socket head jack
nails. Finish for metal panels shall be semi-gloss baked enamel.

2.1.1.3  Mounting

Mount by securing to concrete foundation as indicated.

2.1.1.4  Finishes

Base finish shall be semi-gloss baked enamel or anodized conforming to AA DAF45. Metal panel system finish shall be baked enamel as indicated on the Drawings.

2.1.2  Panel And Post/Panel Type Signs - Directional Signs

2.1.2.1  Posts

One-piece aluminum posts shall be provided with minimum 0.125 inch wall thickness. Posts shall be designed to accept panel framing system described. The post shall be designed to permit attachment of panel framing system without exposed fasteners. Caps shall be provided for each post.

2.1.2.2  Panel Framing System

Panel framing consisting of aluminum sections and interlocking track components shall be designed to interlock with posts with concealed fasteners.

2.1.2.3  Panels

Modular message panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 0.125 inch aluminum. Panels shall be designed to be interchangeable.

2.1.2.4  Finishes

Post finish shall be semi-gloss baked enamel or as indicated on the drawings. Metal panel system finish shall be baked enamel.

2.1.2.5  Mounting

Provide permanent mounting by embedding posts in concrete foundation as indicated.

2.2  GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

2.2.1  Graphics

Signage graphics shall conform to the following:

a. Pressure sensitive precision cut vinyl letters with reflecting surface shall be provided.

b. Message shall be applied to panel using the silkscreen process. Silkscreened images shall be executed with photo screens prepared from original art. Handcut screens will not be accepted. Original art shall be defined as artwork that is a first generation pattern of the original specified art. Edges and corners shall be clean. Rounded corners, cut or ragged edges, edge buildup, bleeding or surfaces
pinholes will not be accepted.

c. Message shall be applied using the frisket method. Photomechanically reproduced graphic masks shall be applied to the sign face which has been coated with the graphics color. A background shall then be applied to the exposed surfaces. Handcut masks will not be accepted. Edges that are nicked, cut, or ragged will not be acceptable. A protective overcoat containing UV-resistant additives shall be applied.

2.2.2 Messages

See drawings and schedule for message content. Typeface: Helvetica medium upper and lowercase. Type size as indicated on Drawings, with a 4 inch lowercase letter and arrow shaft height. Color: White.

2.3 METAL PLAQUES

Design and location of plaques shall be as indicated.

2.3.1 Cast Metal Plaques - Dedication Plaque

2.3.1.1 Fabrication

Cast metal plaques shall have the logo, emblem and artwork cast in the flat relief technique. Plaques shall be fabricated from bronze.

2.3.1.2 Size

Plaque size shall be 20 inch diameter.

2.3.1.3 Border

Border shall be flat band.

2.3.1.4 Background

Background texture shall be fine pebble.

2.3.1.5 Mounting

Mounting shall be concealed.

2.3.1.6 Finish

Finishes shall consist of bronze with dark finish oxidized background. Letters shall be satin polished and entire plaque sprayed with two coats of clear lacquer.

2.3.2 Chemically Etched Zinc Sign

Zinc plate, 1/8 inch thick sign panel with etched characters and graphics with a lightly sandblasted, primed and painted surface. Zinc shall be photo-chemically "deep-etched" to allow graphics to be raised 1/32 inch above background. Graphics shall consist of copy, Grade II Braille and sign border. Plaque design shall be as indicated on drawings. Borders and faces shall have sharp hand tooled edges. The entire plaque shall receive a clear matte top coat for extra protection.
2.3.2.1 Graphic Application

Graphic styles shall be as shown on the Drawings. Graphics shall be roller-coated with a contrasting color. Characters shall be raised 1/32 inch minimum.

2.3.2.2 Color

Color shall be as indicated on the Drawings.

2.4 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B209 for sheet or plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings. Aluminum extrusions shall be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products shall conform to AWS C1.1M/C1.1.

2.5 ORGANIC COATING

Clean, prime and give surfaces a semi-gloss baked enamel or finish in accordance with NAAMM AMP 500, AMP 505, with total dry film thickness not less than 1.2 mils.

2.6 STEEL PRODUCTS

Structural steel products shall conform to ASTM A36/A36M. Sheet and strip steel products shall conform to ASTM A1011/A1011M. Welding for steel products shall conform to AWS D1.2/D1.2M.

2.7 CAST BRONZE

Fabricate components with sharp corners, flat faces, and accurate profiles. Remove and polish burrs and rough spots. Finish faces to a uniform high luster. Cast bronze shall be in accordance with ASTM B62.

2.8 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting shall be 5 to 7 year premium type and shall be in accordance with the flammability requirements of ASTM E84 and shall be a minimum 0.003 inch film thickness. Film shall include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.9 ACRYLIC SHEET

Acrylic sheet shall be in accordance with the flammability requirements of ASTM E84 and shall conform to ANSI Z97.1.

2.10 POLYCARBONATE SHEET

Polycarbonate sheet shall conform to SAE AMS3611.

2.11 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish and shall be non-rusting, non-corroding, and non-staining. Exposed fasteners shall be tamper-proof.
2.12 SHOP FABRICATION AND MANUFACTURE

2.12.1 Factory Workmanship

Work shall be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Welding to or on structural steel shall be in accordance with AWS D1.1/D1.1M. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practical. Items specified to be galvanized shall be by hot-dip process after fabrication if practical. Galvanization shall be in accordance with ASTM A123/A123M and ASTM A653/A653M, as applicable. Other metallic coatings of steel sheet shall be in accordance with ASTM A924/A924M. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

2.12.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

2.12.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete shall not be painted. Upon completion of work, damaged surfaces shall be recoated.

2.13 COLOR, FINISH, AND CONTRAST

Color shall be as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers. For buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs, plaques, or dimensional letters shall be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings; submit drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message shall be included. Circuits installed underground shall conform to the requirements of Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Steel conduits
installed underground and illuminated signage mounted directly on buildings shall be in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed. Submit manufacturer's installation instructions and cleaning instructions.

3.1.1 Anchorage

Anchorage and fastener materials shall be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, cover all project identification, directional, and other signs which may mislead the public. Covering shall be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Submit six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall include simplified diagrams for the equipment as installed. Signs shall be cleaned, as required, at time of cover removal.

3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames shall be field painted in accordance with Section 09 90 00 PAINTS AND COATINGS. Anodized metals, masonry, and glass shall be protected from paint. Finish shall be free of scratches or other blemishes.

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of 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 SOCIETY OF CIVIL ENGINEERS (ASCE)

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

AMERICAN WELDING SOCIETY (AWS)


AWS D1.1/D1.1M (2010; Errata 2011) Structural Welding Code - Steel

AWS D1.2/D1.2M (2014) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)


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


and Aluminum-Alloy Sheet and Plate


1.2 GENERAL REQUIREMENTS

All exterior educational signage shall be provided by a single manufacturer. Exterior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Submit exterior signage schedule in electronic media with spread sheet format. Spread sheet shall include sign location, sign type, and message. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Each sample shall consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Submit three color samples for each material requiring color and 12 inch square sample of sign face color sample.

1.2.1 Performance Requirements

Exterior signage shall be designed to withstand windload criteria as indicated on Structural Drawings in accordance with IBC and ASCE 7 requirements.

1.2.2 Character Proportions and Heights

Letters and numbers on indicated signs shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Approved Detail Drawings; G
Exterior Educational Signage; G

Provide shop drawings showing fabrication details including elevations, graphics and text layouts, sections, side views, plan views, mounting details, and electrical and communication details.
when applicable. Sign fabricator will include engineering
documents that provide sign foundations, connections, wind loads
and thermal movement designed to meet local climate requirements
without distortions and excessive deflection.

For all freestanding signs, provide design calculations and the
signed seal of a registered structural engineer licensed in the
required area of installation.

SD-03 Product Data

Exterior Educational Signage
Installation

SD-04 Samples

Exterior Educational Signage; G

SD-05 Design Data

Performance Requirements Validation; G

For products and systems indicated to validate compliance with
specified wind load performance requirements, provide calculations
and design criteria, including engineering analysis data, signed
and sealed by the qualified registered Professional Engineer
responsible for their preparation.

SD-10 Operation and Maintenance Data

Protection and Cleaning; G

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a
manufacturer regularly engaged in the manufacture of the products. Items
of equipment shall essentially duplicate equipment that has been in
satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the
jobsite in manufacturer's original packaging, and stored in a clean, dry
area in accordance with manufacturer's instructions.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend
beyond a one year period shall be provided.

1.7 EXTRA STOCK

Provide two posts and two sets of typical mounting hardware.

PART 2 PRODUCTS

2.1 EXTERIOR EDUCATIONAL SIGNAGE

Exterior signage shall consist of a system of coordinated educational,
post-mounted type signs located where shown. Dimensions, details, materials, message content, and design of signage shall be as shown on drawings. Submit manufacturer's descriptive data and catalog cuts.

2.1.1 Posts

One-piece aluminum posts shall be provided with minimum 0.125 inch wall thickness. Posts shall be designed to accept sign panel as described. The post shall be designed to permit attachment of panel framing system without exposed fasteners. Posts to be powder-coated with color to be determined by Landscape Architect.

2.1.2 Panel Mounting Plate

Panel framing consisting of aluminum plate of thickness as recommended by sign manufacturer shall be designed to connect to top of post for mounting of sign with concealed fasteners.

2.1.3 Panels

Sign panels to be two, pre-painted sheets of 0.15 mm aluminum bonded to a solid polyethylene core. Exposed back of panel to be painted black.

2.1.4 Vinyl Sheeting for Graphics

See drawings and schedule for graphics and sign content. Sign graphics to be printed on Briteline 3 mm matte white vinyl with Brightline UV overlamine. Vinyl sheeting shall be 5 to 7 year premium type and shall be in accordance with the flammability requirements of ASTM E84 and shall be a minimum 0.003 inch film thickness. Film shall include a pre-coated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.1.5 Finishes

Post finish shall be semi-gloss baked enamel. Metal panel system finish shall be baked enamel.

Color: Black

2.1.6 Mounting

Provide permanent mounting by embedding posts in concrete foundation as indicated in drawings.

2.1.7 Anchors and Fasteners

Exposed anchor and fastener materials shall be compatible with metal to which applied, match in color and finish, and non-rusting, non-corroding, and non-staining. Exposed fasteners shall be tamper-proof.

2.2 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B209 for sheet or plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings. Aluminum extrusions shall be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products shall conform to AWS C1.1M/C1.1.
2.3  STEEL PRODUCTS

Structural steel products shall conform to ASTM A36/A36M. Sheet and strip steel products shall conform to ASTM A1011/A1011M. Welding for steel products shall conform to AWS D1.2/D1.2M.

2.4  VINYL SHEETING FOR GRAPHICS

Vinyl sheeting shall be 5 to 7 year premium type and shall be in accordance with the flammability requirements of ASTM E84 and shall be a minimum 0.003 inch film thickness. Film shall include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.5  ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish and shall be non-rusting, non-corroding, and non-staining. Exposed fasteners shall be tamper-proof.

2.6  SHOP FABRICATION AND MANUFACTURE

2.6.1  Factory Workmanship

Work shall be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Welding to or on structural steel shall be in accordance with AWS D1.1/D1.1M. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practical. Items specified to be galvanized shall be by hot-dip process after fabrication if practical. Galvanization shall be in accordance with ASTM A123/A123M and ASTM A653/A653M, as applicable. Other metallic coatings of steel sheet shall be in accordance with ASTM A924/A924M. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

2.6.2  Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

2.6.3  Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete shall not be painted. Upon completion of work, damaged surfaces shall be recoated.
PART 3 EXECUTION

3.1 INSTALLATION

Signs, shall be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings; submit drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message shall be included. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed. Submit manufacturer's installation instructions and cleaning instructions.

3.1.1 Anchorage

Anchorage and fastener materials shall be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Sign surfaces shall be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, cover all project signs which may mislead the public. Covering shall be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Submit six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall include simplified diagrams for the equipment as installed. Signs shall be cleaned, as required, at time of cover removal.

3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames shall be field painted in accordance with Section 09 90 00 PAINTS AND COATINGS. Anodized metals, masonry, and glass shall be protected from paint. Finish shall be free of scratches or other blemishes.

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA DAF45 (2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AA PK-1 (2009) Pink Sheets: Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings & Ingot

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)


AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M (2014) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2
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; G

Plans and Construction Details/Materials

Message Schedule

SD-03 Product Data

Signage Brochure indicating style and types signs and materials.

Installation; G

Warranty; G

Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4.1); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-04 Samples

Interior Signage; G

Software; G

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions; G

Protection and Cleaning; G
1.3 EXTRA MATERIALS

Provide 20 extra frames and extra stock of the following: blank plates of each color and size for sign types. 10 changeable message strips for sign type. Provide 5 paper inserts and one copy of the software for user produced signs and inserts after project completion and equipment necessary for removal of signage parts and pieces.

1.4 QUALITY ASSURANCE

1.4.1 Samples

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

1.4.2 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.

Sign Fabricator to provide a sequential room number wayfinding plan. The architectural floor plan room numbering layout may not reflect a true sequential wayfinding order and should not be used for wayfinding. The Contractor provided room numbering system will be reviewed and approved by the Contracting Officer during the shop drawing phase. The comprehensive sign documents include a "Door Tag" sign type that will reflect the architectural floor plan room number. These signs are used by Facilites for reference to System Schedules and are not for public wayfinding purpose.

1.5 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.

1.6 WARRANTY

Warrant the interior signage for a period of 2 years from date of final acceptance of the Work 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.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable
design and LEED requirements and definitions.

1.8 OWNER MAINTENANCE AND EDUCATION MANUALS

Contractor to provide templates for sign component for replacing message inserts that are developed in specific hardware types to allow the Facility to produce in-house messages in the future. Education manuals will include instructions for re-ordering modular sign components, perforated paper, and all other replaceable sign pieces. Education Manual content includes, but is not limited to, instructions on how to use and update the digital messages and graphics provided for the Directory / Directional sign types.

PART 2 PRODUCTS

2.1 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

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:

a. Frames shall be aluminum, flat 1/4 inch thick.

b. End caps shall be aluminum style corners.

2.3.2 Changeable Message Strip Signs

Changeable message strip signs shall be of same construction as standard room signs to include a clear sleeve that will accept a paper or plastic insert identifying changeable text. The insert shall be prepared typewritten message. Provide paper and software for creating text and symbols for computers identified by owner for Owner production of paper inserts after project completion. Furnish one suction device to assist in removing face sheet. Sliding inserts or slide knobs that slide horizontally exposing different graphic information shall be provided as identified in the signage placement schedule and drawings.

2.3.3 Type of Mounting For Signs

Provide extruded aluminum brackets for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs shall be by mechanical fasteners. Surface mounted signs shall be mounted with countersunk mounting holes in plaques and mounting screws or 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.

2.3.4 Graphics

Signage graphics for modular signs shall conform to the following:

2.3.4.1 Subsurface Copy

Copy is transferred to the back face of clear acrylic sheeting forming the panel face to produce precisely formed opaque image. This method bonds all sign elements (color, graphics, lettering, Braille and substrate) into a single unit.

2.3.4.2 First Surface Copy Direct Print or Silkscreened (Non-Tactile)

Message may be applied to panel using the silkscreen process. Silkscreened images shall be executed with photo screens prepared from original art. Handcut screens will not be accepted. Original art is defined as artwork that is a first generation reproduction of the specified art. Edges and corners shall be clean.

2.3.4.3 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.

2.3.4.4 Surface Applied Photopolymer-Raised Letters and Braille

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.

2.3.4.5 Engraved Copy - Door Tab Signs Only

Machine engrave letters, numbers, symbols, and other graphics into panel sign on face to produce precisely formed copy and sharp images, incised to uniform depth. Melamine plastic engraving stock used for ADA compliant graphic shall be three-ply lamination contrasting color core meeting ASTM D635.

2.3.5 Character Proportions and Heights

Letters and numbers on signs conform to 36 CFR 1191.

2.3.6 Tactile Letters, Symbols and Braille

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

2.4 BUILDING DIRECTIONAL - DIGITAL MONITORS

Building directional digital monitors shall be lobby directories and shall
be provided with a changeable directory listing consisting of the areas, offices and personnel located within the facility. Dimensions, details, and materials of sign and message content shall be as shown on the drawings.

2.4.1 Electronic Directory System

Provide non-interactive electronic directory. Electronic directory system shall be a complete turnkey system consisting of digital display, hardware, software connected through the local area network (LAN) to a server. Electrical equipment shall be UL listed and shall comply with NFPA 70. Unit shall be wall mounted portrait format with compatible monitor bracket.

2.4.2 Mounting

Fasteners for anchoring directional monitors and brackets to other construction, select fasteners of the type, grade and class required to produce connections that are suitable for anchoring for sign system to other types of construction.

2.5 DOOR TAGS

Provide one door tab plate for each room entry door. Size as indicated on Drawings. Message: Room number to match architectural floor plan room number.

2.6 DIMENSIONAL BUILDING LETTERS

2.6.1 Fabrication

The Directional System shall be provide as an updateable, digitally changeable listing consisting of the department areas located within the facility. Dimensions, details, and materials of sign are as indicated on the Drawings and are provided by the Owner. Digital content for the Directory/Directional messages and graphics are provided 100% by the sign vendor. The message intent is as shown on the Drawings but will be approved by the Owner prior to fabrication during the shop drawing phase.

2.6.2 Size

Letter size shall be as indicated. Provide letter thickness that is manufacturer's standard for the size of letter.

2.6.3 Finish

Provide clear anodized finish.

2.6.4 Mounting

Threaded studs of number and size recommended by manufacturer, shall be supplied for concealed anchorage. Letters which project from the mounting surface shall have stud spacer sleeves. Letters, studs, and sleeves shall be of the same material. Templates for mounting shall be supplied.

2.7 PRESSURE SENSITIVE LETTERS AND GRAPHICS

2.7.1 Fabrication

Ensure that vinyl letter edges and corners of finished letterforms and
graphics are true and clean. Do not use letterforms and graphics with rounded positive or negative corners, nicked, cut, or ragged edges.

2.7.2 Size

Letter size: as indicated.

2.8 ELEVATOR USE SIGN WITH FIRE EVACUATION HOLDER

Elevator use with fire evacuation plan holder signs will be of the same construction as standard room signs and will include a clear plastic sleeve that will accept the paper insert graphic map/paper. Fire evacuation insert will be a computer generated graphic, printed on paper size, as indicated on the Drawings.

2.8.1 Fire Evacuation Map Insert Graphics

Fire evacuation plan holder insert graphics will include a multiple color process floor plan outline that indicates "YOU ARE HERE" text reference and a graphic path leading to the nearest exit, and criteria per the Life Safety Drawings. All graphics and text will be generated from camera ready art and will be first generation. The art work for all graphics, including the floor plan graphic plan will be generated 100% by the fabricator. The floor plan graphic orientation will be coordinated with the sign placement location so that the graphic image coordinates with the actual path of travel to exit the associated area. Original art is defined as artwork that is a first generation reproduction of the specific art.

2.9 MANDATORY / PROHIBITORY SIGNS)

Signs will be of the same construction as standard room signs and will include a clear plastic sleeve that will accept the paper insert graphic map/paper. Message and graphic insert will be a computer generated graphic, printed on paper size, as indicated on the Drawings. Graphic images will be International Pictographs Symbols to match the restrictive / informative sign message intent. i.e. DO NOT ENTER, or RECYCLING.

2.10 AREA OF REFUGE / RESCUE SIGNS

Signs will be "Off-the-Shelf" ready made signs produced by a sign fabricator who regularly produces signage that is used in conjunction with Area of Refuge Call Systems equipment. Signs will include tacktile messages with raised letter and Grade 2 Braille, with the appropriate wording to comply with the current building codes. Refer to AG Interior Signage Drawings for code compliant sign intent.

2.10.1 Location

Locate each sign as indicated on the Drawings and/or as required by the local fire marshall and current building codes.

2.10.2 Color

Storm plastic with black lettering.

2.10.3 Size

Area of Refuge sign; Manufacturer's standard, but not less than 6wx9h
inches. Two-Way Communication sign; Manufacturer's standard, but not less than 6wx8h inches

2.11 ALUMINUM ALLOY PRODUCTS

Aluminum extrusions shall be at least 1/8 inch thick, and aluminum plate or sheet shall be at least 0.0508 inch thick. Extrusions shall conform to ASTM B221; plate and sheet shall conform to ASTM B209. Where anodic coatings are specified, alloy shall conform to AA PK-1 alloy designation 514.0. Exposed anodized aluminum finishes shall be as shown. Welding for aluminum products shall conform to AWS D1.2/D1.2M.

2.12 ANODIC COATING

Anodized finish shall conform to AA DAP45 as follows:

a. Clear (natural) designation AA-M10-C22-A31, Architectural Class II 0.4 mil or thicker.

2.13 ORGANIC COATING

Organic coating shall conform to AAMA 2604, with total dry film thickness not less than 1.2 mils.

2.14 FABRICATION AND MANUFACTURE

2.14.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

2.14.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

2.15 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.

2.16 TYPEFACE

ADA-ABA compliant font for Room Signs Helvetica as indicated on Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed plumb and true and in accordance with approved manufacturer's instructions at locations shown on the detail drawings. Submit six copies of operating instructions outlining the step-by-step procedures required for system operation. The instructions shall include simplified diagrams for the system as installed, the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Each set shall be
permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number. Mounting height and mounting location shall conform to 36 CFR 1191. Required blocking shall be installed. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces shall be installed with matching blank back-up plates in accordance with manufacturer's instructions.

3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish.

a. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance.

b. Mount signs mounted to lay-in ceiling grids with clip connections to ceiling tees.

c. Install signs mounted on metal surfaces with magnetic tape.

d. Install signs mounted on fabric surfaces with hook and loop tape or pin mount.

e. Provide mechanical fastening and tape for heavier signs like directories.

3.1.2 Protection and Cleaning

Protect the work against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned at completion of sign installation in accordance with the manufacturer's approved instructions and the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, Package 1. Submit six copies of maintenance instructions listing routine procedures, repairs, and guides.

3.2 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 10 14 53

TRAFFIC SIGNAGE

02/15

PART 1   GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)


AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA T1 (2016) Use Category System: Processing and Treatment Standard


ASTM INTERNATIONAL (ASTM)


1.2 GENERAL

All signs must be in accordance with the MUTCD. Any signs not detailed on the drawings must be in accordance with the FHWA SHS.

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-03 Product Data

Traffic Sign Posts
Traffic Sign Retroreflective Sheeting
SD-04 Samples
Flexible Posts

PART 2 PRODUCTS

2.1 TRAFFIC SIGN POSTS

2.1.1 Steel Flanged Channel Section (U-Shape)

Fabricate steel posts from steel conforming to ASTM A36/A36M or ASTM A499 and with a minimum yield strength of 30 ksi and a minimum tensile strength of 50 ksi. Punch or drill 5/16 to 3/8 inch diameter holes spaced at 1 or 2 inch centers along the centerline of the web prior to galvanizing for the entire length of the post. Galvanize posts after punching in accordance with ASTM A123/A123M.

2.1.2 Perforated Steel Tube

Fabricate steel posts from steel conforming to either ASTM A653/A653M, structural steel, Grade 50, Class 1, coating designation G90 or ASTM A1011/A1011M, structural steel, Grade 50, hot-dip galvanized after punching in accordance with ASTM A123/A123M. Prepunch holes approximately 7/16 inch in diameter spaced at approximately 1 inch centers along each side of the tube for the entire length of the post.

2.1.3 Steel Tube

Steel tubing must conform to ASTM A500/A500M, Grade B or C, and must be hot-dip galvanized in accordance with ASTM A123/A123M.

2.1.4 Structural Steel H Section

Structural steel posts must conform to ASTM A709/A709M, Grade 50 or 50W. Galvanize posts, fuse plate and splice plate after fabrication in accordance with ASTM A123/A123M.

2.1.4.1 Slip Base, Fuse Plate and Splice Plate

Structural steel base plates and stiffener plates must conform to ASTM A36/A36M, minimum yield strength 50,000 psi.

2.1.4.2 High-Strength Bolts, Nuts and Washers

High strength bolts must conform to ASTM A325. Nuts must conform to ASTM A563. Washers must conform to ASTM F436. High strength bolts, nuts and washers must be zinc coated.

2.1.5 Wood

Wood posts must be dry no. 1 grade Douglas fir, southern or Ponderosa pine, hemlock, spruce, or western larch conforming to AASHTO M 168. Treat the posts with water-borne preservative according to AASHTO M 133, AWPA T1 and AWPA U1.
2.2 FLAT ALUMINUM SIGN PANELS

Aluminum sign panels must conform to ASTM B209, alloy-temper 6061-T6 or 5052-H38. The blanks must be free from laminations, blisters, open seams, pits, holes, other defects that may affect their appearance or use. The thickness must be uniform and the blank commercially flat.

2.3 EXTRUDED ALUMINUM SIGN PANELS

Extruded aluminum panels must conform to ASTM B221, alloy 6063-T6. The maximum allowable deviation from flat on the face is 0.05 inches per foot.

2.4 TRAFFIC SIGN RETROREFLECTIVE SHEETING

All background sheeting applied to flat sheet and extruded panel signs must be in accordance with ASTM D4956, Type III, IV, VII, VIII, IX or XI retroreflective sheeting and must have Class 1, 3, or 4 adhesive backing. Retroreflective sheeting must be high intensity that is an unmetallized micro prismatic reflective material.

Retroreflective sheeting must have sufficient adhesion, strength and flexibility such that the sheeting can be handled, processed and applied according to the manufacturer's recommendations without appreciable stretching, tearing, cracking or other damage.

2.4.1 Legend and Border

Apply retroreflective sheeting as legend and border in accordance with ASTM D4956, Type IX, XI, or AASHTO M 268 Type C or D, Class 1. Retroreflective sheeting must be an unmetallized cube corner microprismatic reflective material. Retroreflective sheeting applied as legend and border for specific signing applications, without a datum mark on the surface of the sheeting, must be evaluated for rotational sensitivity in accordance with AASHTO M 268, Section 3.3.1 and fabricated in accordance with AASHTO M 268, Section 3.3.2.

2.4.2 Screen Printed Transparent Colored Areas

For screen printed transparent colored areas or transparent colored overlay films on white sheeting, the coefficient of retroreflection (RA) must be no less than 70 percent of the original values for the corresponding color.

2.4.3 Adhesive Performance

Adhesive performance for retroreflective sheeting must be in accordance with ASTM D4956. The sheeting surface must be in condition to be readily screen processed and compatible with transparent overlay films, plus recommended transparent and opaque screen process colors. Furnish manufacturer's information as to the type of solvent or solvents that may be used to clean the surface of the sheeting without detrimental loss of performance and durability.

2.5 LETTERS, NUMERALS, ARROWS, SYMBOLS, AND BORDERS

Apply letters, numerals, arrows, symbols, and borders on the retroreflective sheeting or opaque background of the sign using the direct or reverse screen process. Apply messages and borders of a color darker than the background to the paint or the retroreflective sheeting using the
direct process. Messages and borders must be of a color lighter than the sign background and applied using the reverse screen process. Use opaque or transparent colors, inks, and paints of the type and quality recommended by the retroreflective sheeting manufacturer in the screen process. Perform the screening in a manner that results in a uniform color and tone, with sharply defined edges of legends and borders and without blemishes on the sign background that will affect intended use. Air dry or bake the signs after screening according to the manufacturer's recommendations to provide a smooth hard finish. Reject any signs with blister's or other blemishes.

2.6 DELINEATOR POSTS

2.6.1 Steel Posts

Steel posts must be fabricated from steel conforming to ASTM A36/A36M or ASTM A499 and must have a minimum yield strength of 30 ksi and a minimum tensile strength of 50 ksi. Posts must be galvanized after punching in accordance with ASTM A123/A123M.

2.6.2 Flexible Posts

Provide two-piece with driveable steel anchor flexible posts. Posts must be impact-resistant, integrally colored UV stabilized polymer or polycarbonate extrusion or fiberglass reinforced composite material. Other materials are subject to approval by the Contracting Officer's Representative. Include a retroreflective sheeting plate with each post as indicated.

2.7 DELINEATOR RETROREFLECTORS

2.7.1 Circular Prismatic Reflectors

Retroreflectors attached to steel posts must be a 3-inch minimum diameter acrylic plastic lens with prismatic optical elements and a smooth, clear, transparent face. Fabricate the back from similar material and fuse to the lens around the entire perimeter to form a homogeneous unit. Permanently seal the units against the intrusion of dust, water, or air. Mount the retroreflector unit in a housing fabricated from 0.063-inch aluminum alloy or similar, or from cold-rolled, hot dip, galvanized steel, having a thickness of 0.064 inches. Provide the indicated color.

2.7.2 Retroreflective Sheeting

A retroreflective sheeting plate must be applied to each flexible post by the post manufacturer and must be in accordance with ASTM D4956, Type III, IV, V, VII, VIII, IX or XI retroreflective sheeting. Retroreflective sheeting must be high intensity that is an unmetallized cube corner micro prismatic reflective material. Provide the size and color of the retroreflective sheeting plate as indicated.

2.8 HARDWARE

Bolts, nuts, post clips, lock and flat washers must be either aluminum alloy or commercial quality stainless steel, hot-dip galvanized or cadmium plated after fabrication. Bolts/nuts must be an approved tamper resistant design. Provide fiber washers of commercial quality.
2.9 CONCRETE

ASTM C94/C94M, using 3/4 inch maximum aggregate, and having minimum compressive strength of 3000 psi at 28 days.

PART 3 EXECUTION

3.1 SIGN POSTS

3.1.1 Perforated Square Steel Tube

Sign posts consist of a base post and sign post. Drive steel sign base posts with a suitable driving head. Attach sign posts to base posts. Replace any base posts damaged during driving or otherwise at no additional cost to the Government.

3.1.2 Structural Steel H Section Posts

Tighten all breakaway assembly bolts in a systematic manner to the prescribed torque indicated. Loosen each breakaway assembly bolt and re-tighten to the required torque in the same order as the initial tightening. Burr the threads at the nut using a center punch to prevent the nut from loosening. Tighten nuts on hinge plate bolts to the required minimum bolt tension values indicated.

3.1.3 Wood

Drill holes in the post as indicated.

3.2 SIGN PANELS

Clean, degrease and etch the face of metal panels using methods recommended by the retroreflective sheeting manufacturer. After cleaning and degreasing, apply retroreflective sheeting material to the sign panels as recommended by the manufacturer. Perform shearing, cutting and punching prior to preparing the blanks for application of reflective material. Holes must not be field drilled in any part of the panel. Use nylon washers recommended by the sign sheeting manufacturer between the bolt heads and sign faces on flat sheet aluminum signs. Replace any damaged sign panels at no additional cost to the Government.

3.3 DELINEATORS

Drive steel delineator posts into the ground in a manner that will not damage the post. Flexible delineator posts may be driven into the soil in accordance with the manufacturer's instructions or must be attached to a steel anchor. Demonstrate the method of installation for the Contracting Officer's Representative to verify that posts will be installed without being damaged.

3.4 LOCATION AND POSITION OF SIGNS

Locate and erect all signs in accordance with the drawings and MUTCD. Signs should be vertically mounted at right angles to the direction of, and facing, the traffic that they are intended to serve. Where mirror reflection from the sign face is encountered to such a degree as to reduce legibility, turn the sign slightly away from the road. Turn signs that are placed 30 feet or more from the pavement edge toward the road. On curved alignments, determine the angle of placement by the direction of
approaching traffic rather than by the roadway edge at the point where the sign is located. Mounted signs must present a smooth flat surface varying no more than 3/8 inch from a 4-foot straightedge placed in any position on the face of the sign after erection. Mount signs on traffic signal posts with strap or clamp type sign supports. Each installed sign will be inspected by the Contracting Officer's representative prior to acceptance by the Government.

-- End of Section --
PART 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 A336/A336M (2010a) Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts


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


INTERNATIONAL CODE COUNCIL (ICC)

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

Fabrication Drawings
Installation Drawings; G

SD-03 Product Data

Toilet Enclosures
Cleaning and Maintenance Instructions
Colors And Finishes; G
Galvanized Steel Sheet
Sound-Deadening Cores
Anchoring Devices and Fasteners
Hardware and Fittings; G
Brackets; G
Door Hardware; G

Recycled Content (LEED Credit MR 4); G

Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content included in this Section. Include a statement indicating material only costs for each product having recycled content. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-04 Samples

Colors and Finishes; G
Hardware and Fittings
Anchoring Devices and Fasteners

SD-07 Certificates
1.3 REGULATORY REQUIREMENTS

Conform to ICC A117.1 code for access for the handicapped operation of toilet compartment door and hardware.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the manufacturer's original unopened packages with the brand, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated; free from dust, water, other contaminants, and damage during delivery, storage, and construction.

1.5 WARRANTY

Provide certification or warranties that metal toilet partitions will be free of defects in materials, fabrication, finish, and installation and will remain so for a period of not less than 3 years from date of final acceptance of the Work.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2   PRODUCTS

2.1 RECYCLED CONTENT OF PRODUCTS

Provide products with post-consumer recycled content plus one-half of pre-consumer recycled content to the greatest extent possible.

2.2 SYSTEM REQUIREMENTS

Provide a complete and usable toilet partition system, including toilet enclosures, room entrance screens, urinal screens, system of panels, hardware, and support components. Furnish the partition system from a single manufacturer, with a standard product as shown in the most recent catalog data. Submit Fabrication Drawings for metal toilet partitions and urinal screens consisting of fabrication and assembly details to be performed in the factory. Submit manufacturer's Cleaning and Maintenance Instructions.
2.3 MATERIALS

2.3.1 Galvanized Steel Sheet

Provide galvanized steel sheet cold-rolled, stretcher-level, commercial quality material, conforming to ASTM A653/A653M. Conform surface preparation of material for painting to ASTM D6386, Method A.

2.3.2 Sound-Deadening Cores

Provide sound deadening consisting of treated kraft paper honeycomb cores with a cell size of not more than 1 inch. Resin-material content shall weigh not less than 11 percent of the finished core weight. Expanded cores shall be faced on both sides with kraft paper.

2.3.3 Anchoring Devices and Fasteners

Provide steel anchoring devices and fasteners hot-dipped galvanized after fabrication, in conformance with ASTM A385/A385M and ASTM A123/A123M. Conceal all galvanized anchoring devices.

2.3.4 Brackets

Wall brackets shall be two-ear panel brackets, T-style, 1-inch stock. Provide stirrup style panel-to-pilaster brackets.

2.3.5 Hardware and Fittings

2.3.5.1 General Requirements

Conform hardware for the toilet partition system to CID A-A-60003 for the specified type and style of partitions. Provide hardware finish highly resistant to alkalis, urine, and other common toilet room acids. Comply latching devices and hinges for handicap compartments with 36 CFR 1191; provide stainless steel devices and hinges with door latches that operate without either tight grasping or twisting of the wrist of the operator. Submit three samples of each item, including anchoring devices and fasteners. Approved hardware samples may be installed in the work if properly identified.

<table>
<thead>
<tr>
<th>Material</th>
<th>Conformance Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold-rolled sheet steel</td>
<td>ASTM A336/A336M, commercial quality</td>
</tr>
<tr>
<td>Zinc-base alloy</td>
<td>ASTM B86, Alloy AC41-A</td>
</tr>
<tr>
<td>Brass</td>
<td>ASTM B36/B36M, Alloy C26800</td>
</tr>
<tr>
<td>Aluminum</td>
<td>ASTM B221</td>
</tr>
<tr>
<td>Corrosion-resistant steel</td>
<td>ASTM A167, Type 302</td>
</tr>
</tbody>
</table>

2.3.5.2 Finishes

a. Exposed fasteners shall match the hardware and fittings.
2.3.6  Door Hardware

2.3.6.1  Hinges

Hinges shall be adjustable to hold in-swinging doors open at any angle up to 90 degrees and outswinging doors to 10 degrees. Provide self-lubricating hinges with the indicated swing. Hinges shall be the surface-mounted type self closing through bolted with gravity cams.

2.3.6.2  Latch and Pull

Latch and pull shall be a combination rubber-faced door strike and keeper equipped with emergency access.

2.3.6.3  Coat Hooks

Coat hooks shall be combination units with hooks and rubber tipped pins.

2.4  PARTITION PANELS AND DOORS

Fabricate partition panels and doors not less than 1 inch thick with face sheets not less than 0.0396 inch thick.

2.4.1  Toilet Enclosures

Conform toilet enclosures to CID A-A-60003, Type I, Style B, ceiling hung. Furnish width, length, and height of toilet enclosures as shown. Finish surface of panels shall be solid phenolic, Finish 4; water resistant; graffiti resistant; non-absorbent. Reinforce panels indicated to receive toilet paper holders or grab bars for mounting of the items required. Provide grab bars to withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars shall not rotate within their fittings.

2.4.2  Urinal Screens

Conform urinal screens to CID A-A-60003, Type III, Style E, Wall Hung. Provide finish for surface of screens as solid phenolic, Finish 4; water resistant; graffiti resistant; non-absorbent. Furnish width and height of urinal screens as shown. Secure wall hung urinal screens with 42 inch long, continuous flanges. Fabricate screens from the same types of panels as the toilet partitions. Use stainless steel fittings and fasteners.

2.5  CEILING-HUNG PARTITIONS

Pilasters shall be not less than 1-1/4 inch thick with face sheets not less than 0.0635 inch thick. Anchoring device at the top of the pilaster shall be welded to the reinforced face sheets and shall have not less than two 3/8 inch round threaded rods, lock washers, and leveling-adjustment nuts. Anchoring device shall be designed to transmit the strain and loading on the pilaster directly to the structural support above without putting strain or loading on the finished ceiling. Trim piece at the top of the pilaster shall be 3 inch high and fabricated from not less than 0.030 inch thick stainless steel.

2.6  HARDWARE

Provide hardware for the toilet partition system that conforms to CID A-A-60003 for the specified type and style of partitions. Use a
hardware finish that is highly resistant to alkalis, urine, and other common toilet room acids. Provide latching devices and hinges for handicap compartments complying with 36 CFR 1191 and stainless steel door latches that operate without either tight grasping or twisting of the wrist of the operator. Use stainless steel, tamper proof type screws and bolts. Wall mounting brackets must be continuous, full height, stainless steel, in accordance with toilet compartment manufacturer’s instructions.

2.7 COLORS AND FINISHES

2.7.1 Colors

Refer to drawings for color. Submit three samples showing a finished edge on two adjacent sides and core construction, each not less than 12-inch square.

2.7.2 Finishes No.4 and No. 5

Provide solid plastic fabricated of solid phenolic core with melamine facing sheets formed under high pressure rendering a single component section not less than one inch thick. Colors shall extend throughout the panel thickness. Provide exposed finish surfaces: smooth, waterproof, non-absorbent, and resistant to staining and marking with pens, pencils, or other writing devices. Solid plastic partitions shall not show any sign of deterioration when immersed in the following chemicals and maintained at a temperature of 80 degrees F for a minimum of 30 days:

<table>
<thead>
<tr>
<th>Acetic Acid (80 percent)</th>
<th>Hydrochloric Acid (40 percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>Hydrogen Peroxide (30 percent)</td>
</tr>
<tr>
<td>Ammonia (liquid)</td>
<td>Isopropyl Alcohol</td>
</tr>
<tr>
<td>Ammonia Phosphate</td>
<td>Lactic Acid (25 percent)</td>
</tr>
<tr>
<td>Bleach (12 percent)</td>
<td>Lime Sulfur</td>
</tr>
<tr>
<td>Borax</td>
<td>Nicotine</td>
</tr>
<tr>
<td>Brine</td>
<td>Potassium Bromide</td>
</tr>
<tr>
<td>Caustic Soda</td>
<td>Soaps</td>
</tr>
<tr>
<td>Chlorine Water</td>
<td>Sodium Bicarbonate</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>Trisodium Phosphate</td>
</tr>
<tr>
<td>Copper Chloride</td>
<td>Urea; Urine</td>
</tr>
<tr>
<td>Core Oils</td>
<td>Vinegar</td>
</tr>
</tbody>
</table>

PART 3 EXECUTION

3.1 PREPARATION

Take field measurements prior to the preparation of drawing and fabrication to ensure proper fits. Verify that field measurements,
surfaces, substrates and conditions are as required, and ready to receive work. Verify correct spacing of plumbing fixtures. Verify correct location of built in framing, anchorage, and bracing. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the work of this section. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Install partitions rigid, straight, plumb, and level, with the panels centered between the fixtures. Provide a panel clearance of not more than 1/2 inch and secure the panels to walls and pilasters with not less than two wall brackets attached near the top and bottom of the panel. Locate wall brackets so that holes for wall bolts occur in masonry or tile joints. Secure Panels to pilasters with brackets matching the wall brackets. Provide for adjustment due to minor floor variations. Locate head rail joints at pilaster center lines. Install adjacent components for consistency of line and plane. Equip each door with hinges, one door latch, and one coat hook and bumper. Align hardware to uniform clearance at vertical edges of doors.

a. Secure panels to hollow plastered walls with toggle bolts using not less than 1/4-20 screws of the length required for the wall thickness. Toggle bolts shall have a load-carrying strength of not less than 600 pounds per anchor.

b. Secure panels to ceramic tile on hollow plastered walls or hollow concrete-masonry walls with toggle bolts using not less than 1/4-20 screws of the length required for the wall thickness. Toggle bolts shall have a load-carrying strength of not less than 600 pounds per anchor.

c. Secure panels to solid masonry or concrete with lead or brass expansion shields designed for use with not less than 1/4-20 screws, with a shield length of not less than 1-1/2 inch. Expansion shields shall have a load-carrying strength of not less than 600 pounds per anchor.

d. Submit Installation Drawings for toilet partitions and urinal screens showing plans, elevations, details of construction, hardware, reinforcing and blocking, fittings, mountings and escutcheons. Indicate on drawings the type of partition, location, mounting height, cutouts, and reinforcement required for toilet-room accessories.

3.3 CEILING-HUNG PARTITIONS

Secure pilasters to the structural support above with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Level the bottoms of doors with bottoms of pilasters when doors are in a closed position.

3.4 FINAL ADJUSTMENT

After completion of the installation, make final adjustments to the pilaster-leveling devices, door hardware, and other working parts of the partition assembly. Doors shall have a uniform vertical edge clearance of approximately 3/16 inch and shall rest open at approximately 30 degrees when unlatched.
3.5 CLEANING

Clean all surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner compliant with the manufacturer's recommended cleaning and protection from damage procedures until accepted. Remove all equipment, tools, surplus materials, and work debris from the site.

3.6 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA DAF45 (2003; Reaffirmed 2009) Designation System for Aluminum Finishes

ASTM INTERNATIONAL (ASTM)


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
   Cubicle track layout

SD-08 Manufacturer's Instructions
   Cubicle track installation

SD-10 Operation and Maintenance Data
   Cubicle track system, Data Package 1; ; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 DRAWING REQUIREMENTS

Submit cubicle track layout drawings. Include ceiling, surface-mounted installation details, and overlay drawing showing other trades installation within area.
1.4 DELIVERY AND STORAGE

Deliver cubicle tracks to site in unopened containers clearly labeled with manufacturer's name and contents. Store in safe, dry, and clean location. Do not open containers until contents are to be installed.

1.5 QUALITY CONTROL

Allow smooth, rapid, and complete screening with no gaps at corners or ends of track. The track of a standard 8 by 8 foot cubicle shall have no joints. Form corner bends in a single continuous piece on a 12 inch radius to exactly 90 degrees. Other track lengths to 16 feet shall have no joints.

PART 2 PRODUCTS

2.1 CUBICLE TRACK SYSTEM

Heavy-duty type, ceiling surface mounted. Bends shall be minimum 18 inches radius.

2.1.1 Extruded Aluminum Tracks

ASTM B221 and ASTM B456; alloy 6063-TS, channel shape minimum, 1 1/4 inch wide by 1 1/8 inch deep, 0.050 inch minimum wall thickness. Inside raceway to be smooth for interior carriers and must be able to receive a double coated wheel carrier with hook. Finish as designated for aluminum finishes in AA DAF45.

2.2 MATERIALS AND COMPONENTS

2.2.1 Item A5180A, Track, Cubicle, Surface Mounted

Cubical track, surface mounted: Extruded aluminum track, self lubricating carriers, and beaded drop chain hooks; removable end caps. Size and configuration as indicated on drawings.

2.2.2 Cubicle Track and Carrier Unit

Heavy-duty type, ceiling surface mounted. Bends: minimum 18 inches radius.

2.2.3 Curtain

Not a part of this contract.

2.3 CARRIER UNIT

Silent type with double canted wheel carrier. Wheels shall have nylon on stainless steel hooks with swivel to support the curtain. Carriers shall be removable only through access aperture or through end-cap that provides room for insertion or removal of carrier. Provide 2.2 carriers for every foot of track length, plus one additional carrier. Provide a safety loading unit at one end of the channel track consisting of a section of channel track equipped with a hinge and end latch to permit lowering for installation of or removal of curtains from hooks without the use of a step-ladder and without removing carriers from track. Rivet moveable end...
of safety loading unit to be riveted to the hinge. Latching end of safety loading unit with a double locking fail-proof locking device for safety. Safety loading unit to be four feet in length of an 8 foot ceiling installation so latch end lowers to four feet from floor, for installation or removal of curtain without the use of a step-ladder. Increase length of safety loading unit to be increased according to ceiling height. Provide a key wand for every 20 units.

2.4 END STOP AND PULL-OUT

Fabricate from aluminum or nylon with an anodized finish matching the track finish.

2.5 FASTENERS

Stainless steel.

2.6 FINISH

Satin, clear anodized.

PART 3 EXECUTION

3.1 INSTALLATION

Verify dimensions prior to installation. Install cubicle track after painting and finishing operations are complete. Provide labor and all materials indicated, specified or necessary for a complete finished installation. Install track plumb, level and true, and securely anchored to the ceiling to form a neat, rigid installation. Remove damaged or defective components and replace with new components.

3.1.1 Installation Details

Install heavy-duty cubicle tracks ceiling surface mounted. Install cubicle tracks where indicated. Install carrier units at 6 inches on center maximum. Install end cap at each end of the track and pull-out at the end where curtains are stacked to permit insertion and removal of carrier units. Securely fasten end stops to prevent their being forced out by striking weight of carrier units.

3.2 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 E 413 (2010) Rating Sound Insulation


CHEMICAL FABRICS & FILM ASSOCIATION (CFFA)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


U.S. GREEN BUILDING COUNCIL (USGBC)


1.2   SYSTEM DESCRIPTION

a. No less than 30 calendar days prior to the scheduled commencement of installation, submit the following to the Contracting Officer:
Manufacturer's Qualifications
Manufacturer's Sample Warranty
Statement of Code Compliance
Statement of Standards Conformity
Verification of Field Measurements
Fabrication Drawings
Installation Instructions

b. Supply and install manual operation, acoustical folding panel partitions, factory finished, supported from overhead track without floor guides, as shown on the drawings including all hardware, seals, track and rollers as needed to close the specified opening.

1.2.1 Manual Operation

The manual operation shall be a force no greater than 20 lbf to start movement at the rate of 3.33 ft/s. Use a removable handle to extend and retract the bottom operable seals; vertical movement of seals shall be 2 inches. Closure to the lead wall shall be by use of a flexible bulb; accomplish final closing by means of a lever exerting pressure against the wall.

1.2.2 Performance Requirements

1.2.2.1 Fire Endurance

For partitions more than 60 square feet in area, provide covering and lining with flame spread rating of 25 or less, fuel contribution rating of 15 or less, smoke generation of 50 or less in accordance with NFPA 101 when tested in accordance with ASTM E 84. Submit flame and smoke development tests reports. Provide door and partition finishes with a Class A rating when tested in accordance with ASTM E 84.

1.2.2.2 Laboratory Acoustical Requirements

Provide partitions tested in accordance with ASTM E 90, by a laboratory accredited by the U.S. Bureau of Standards, that have attained a sound transmission class (STC) of not less than 47 in a fully extended position. Partition tested shall be of the same construction, materials, and model number as the partition to be provided and be fully operable. Panel weight shall be a minimum of 8.0 psf. Design panel thickness (3 inch nominal) and composition to provide the required STC rating in accordance with ASTM E 90 and ASTM E 413.

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

Manufacturer's Qualifications; G
Manufacturer's Sample Warranty
Statement of Code Compliance; G
Statement of Standards Conformity; G
Verification of Field Measurements; G

SD-02 Shop Drawings

Installation; G
Layouts; G
Fabrication Drawings; G

Drawings containing complete schematic diagrams and details required to demonstrate that the system has been coordinated and will properly function as a unit. Show location, dimensions and weight of folded partition; layout of the work, track and jamb fastening methods; seal details and installation details; proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Folding Panel Partitions; G
Installation Instructions; G

Recycled Content (LEED Credit MR 4); G

Product data indicating percentage by weight of post-consumer and pre-consumer recycled content for products having recycled content included in this Section. Include a statement indicating material only costs for each product having recycled content. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4.1); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter less water and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-04 Samples

Folding Panel Partitions; G

SD-06 Test Reports

Acoustical Test; G
Flame and Smoke Development Tests; G

Reports on laboratory acoustical requirements and acoustical test. Reports on flame and smoke development tests.

SD-07 Certificates
Materials; G
Folding Panel Partitions; G

Certificate attesting that the materials meet the requirements specified and that partitions have specified acoustical and flame retardant properties, as determined by test.

SD-10 Operation and Maintenance Data

Folding Panel Partitions

Data Package 1 for folding panel partitions, in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Include in the instructions the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and operating features. Include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Six complete copies of maintenance instructions explaining routine maintenance procedures including inspection, adjustments, lubrication, and cleaning. List possible breakdown, methods of repair, and a troubleshooting guide. Include instructions for equipment layout and simplified wiring and control diagrams of the system as installed.

SD-11 Closeout

All approved LEED Submittals specified under SD-03 Product Data; S

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the jobsite in the manufacturer's original, unopened, and undamaged packages with labels legible and intact. Provide labels to indicate the manufacturer, brand name, size, finish, and placement location. Store partitions and accessories in unopened packages in a manner that will prevent damage. Handle partition materials in accordance with manufacturer's instructions. Protect materials from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.5 WARRANTY

Provide Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period. In addition, provide warranty of the pantographs, trolleys and tracks for 10 years from date of final acceptance of the Work.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT OF PRODUCTS

Provide products with post-consumer recycled content plus one-half of pre-consumer recycled content to the greatest extent possible.
2.2 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.3 MATERIALS

Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and essentially duplicate items that have been in satisfactory use for at least 2 year prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Provide heavy-duty type hardware standard with the manufacturer. Provide pulls and latches for all partitions. Provide partitions with magnetic contact latches. Provide anodized aluminum clear finish hardware.

2.4 FOLDING PANEL PARTITIONS

Provide folding panel partitions using top hung ball bearing carriers which support modular panels.

a. Provide partitions made up of a series of rigid panels, each panel being a one-piece assembly. Unless otherwise specified, use the least number of panels. The mechanical seal of the panel shall actuate with a single operating action.

2.4.1 Panels

Provide panels of steel skin, tackable base, laminated to appropriate structural acoustical backing, mounted in full perimeter protective frame. Steel for the panel frames shall be a minimum of 16 gauge thick steel with minimum 22 gauge thick face panels spot welded to the frame. Frame shall enclose and protect all edges of the surface material. Nominal thickness 3 inches. Panels shall be not more than 4 feet wide, except for end closure panels, and be full height to track. Panels shall lock in place to form a stable, rigid partition; low profile hinges may not project more than 1/4 inch maximum from panel edge. Panel surfacing shall wrap around the vertical panel edges without vertical trim.

2.4.2 Finish Covering

Finish material shall be minimum 66 inches wide, acoustical material of 100 percent synthetic fiber in accordance with CFPA-W-101-D, and conforming to ASTM D 751 and NFPA 286. Provide non-allergenic stain and mildew resistant fabric which will not rot or support growth of bacteria. Class A fire rating. Color and pattern shall be as indicated on drawings.

2.4.3 Track

Provide recess extruded aluminum track as shown. Conform aluminum to ASTM B 221. Provide track that is the manufacturer's standard product designed for the weight of the finished partition, including door. Provide track sections in the maximum lengths practicable, and not less than 6 feet long except for narrow doors and at ends of runs where short length is required. Provide suitable joint devices such as interlocking keys at each joint to provide permanent alignment of track.
2.4.4 Suspension System

Provide a suspension system consisting of heavy duty extruded aluminum track connected to the structural support by threaded rods, and trolleys designed to support the weight of the partition. Provide extruded aluminum track with minimum thickness of 1/8 inch. Provide 2 trolleys per panel with 2 ball bearing polymer or steel tired wheels.

2.5 ACCESSORIES

2.5.1 Ceiling Guards

Furnish partitions with ceiling guards or integral track and ceiling guards as recommended by the manufacturer.

2.5.2 Metal Soffit

Provide soffit when steel track is recessed. Provide metal soffit of adequate thickness to protect the ceiling from damage by door operation and with the door manufacturer's standard neutral-color applied finish. Soffit on aluminum track shall be an integral part of the track.

2.6 SEALS AND SWEEPSTRIPS

Provide perimeter seals or sound insulation, of manufacturer's standard product, to achieve the sound transmission class specified and to pass the visual field test specified, without crack or craze when subjected to severe usage. Provide mechanical seal top and bottom of the fire rated panel. Provide mechanical bottom seal that can be raised or lowered for positive control. Provide manufacturer's vertical seals between panels to ensure acoustical rating. Bottom seals shall consist of a vinyl sweep mechanical seal which will expand in place, or provide panels which can be lowered by a removable operating device. Provide vertical seal between panels which is anodized, architectural grade, aluminum extrusion with vinyl sound seal. Sweep strips shall be vinyl or other material that will not crack or craze with severe usage. Provide sweep strip STC to the specified rating.

2.7 COLOR

Color: as indicated on the drawings. Color listed is not intended to limit selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 INSTALLATION

Install in accordance with the manufacturer's approved instructions.

3.1.1 Preparation Work

Verify dimensions and condition of openings scheduled to receive folding panel partitions. Install partitions in accordance with the approved partition layouts, manufacturer's directions, and ASTM E 557. Provide structural support for the track support elements as indicated.

3.1.2 Adjustment

Adjust manually operated partitions to open and close from any position.
with a maximum horizontal force as specified in paragraph Manual Operation applied to pendant pull, box or handle.

3.2 FIELD TESTS

3.2.1 Operational Test

In the presence of the Contracting Officer, operate partition at least three times to demonstrate that partition is capable of being moved from the stored position to the fully extended position smoothly and quietly. Activate mechanical seals top and bottom. Adjust partitions which do not operate properly and retest.

3.2.2 Visual Test

Conduct visual field tests for light leakage with all room lights turned on in the space on one side of the partition. Darken space on the other side of the partition. Light leakage from the lighted space to the darkened space is not acceptable. If light leakage does occur, adjust the partition to correct the problem and retest.

3.3 CLEANING

Clean any soiled parts of the partition in accordance with manufacturer's printed instructions.

3.4 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA DAF45 (2003; Reaffirmed 2009) Designation System for Aluminum Finishes

ASTM INTERNATIONAL (ASTM)


SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)


U.S. GREEN BUILDING COUNCIL (USGBC)

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

Corner Guards; G
Wall Guards (Bumper Guards); G
Chair Rail; G
Wall Covering/Panel; G

SD-03 Product Data

Corner Guards; G
Wall Guards (Bumper Guards); G
Chair Rail; G
Wall Covering/Panel; G

Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4.1); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-04 Samples

Finish Material; G

SD-06 Test Reports

Corner Guards
Wall Guards (Bumper Guards)
Chair Rail; G
Wall Covering/Panel

SD-07 Certificates

Corner Guards
Wall Guards (Bumper Guards)
Chair Rail; G
Wall Covering/Panel

SD-11 Closeout

All approved LEED Submittals specified under SD-03 Product Data; S

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Keep materials dry, protected from weather and damage, and stored under cover.
Materials shall be stored at approximately 70 degrees F for at least 48 hours prior to installation.

1.4 WARRANTY

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

1.5 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.2 STANDARD PRODUCTS

To the maximum extent possible, corner guards, wall guards (bumper guards), wall panels and wall covering shall be the standard products of a single manufacturer and shall be furnished as detailed. Drawings show general configuration of products required, and items differing in minor details from those shown will be acceptable.

2.2.1 Resilient Material

Provide resilient material consisting of high impact resistant extruded acrylic vinyl, polyvinyl chloride, or injection molded thermal plastic conforming to the following:

2.2.1.1 Minimum Impact Resistance

Minimum impact resistance shall be 18 ft-lbs/sq. inch when tested in accordance with ASTM D256, (Izod impact, ft-lbs per sq inch notched).

2.2.1.2 Fire Rating

Fire rating shall be Class 1 when tested in accordance with ASTM E84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less. Material shall be rated self extinguishing when tested in accordance with ASTM D635. Material shall be labeled and tested by an approved nationally known testing laboratory.

2.2.1.3 Integral Color

Colored components shall have integral color and shall be matched in accordance with SAE J1545 to within plus or minus 1.0 on the CIE-LCH scales.

2.2.1.4 Chemical and Stain Resistance

Materials shall be resistant to chemicals and stains reagents in accordance with ASTM D543.
2.2.1.5 Fungal and Bacterial Resistance

Materials shall be resistant to fungi and bacteria in accordance with ASTM G21, as applicable.

2.3 CORNER GUARDS

2.3.1 Resilient Corner Guards

Corner guard units shall be surface mounted type, radius formed to profile shown. Corner guards shall extend from basetop to ceiling. Mounting hardware, cushions, and base plates shall be furnished. Assembly shall consist of a snap-on corner guard formed from high impact resistant resilient material, mounted on a continuous aluminum retainer. Extruded aluminum retainer shall conform to ASTM B221, alloy 6063, temper T5 or T6. Factory fabricated end closure caps shall be furnished for top and bottom of surface mounted corner guards. Insulating materials that are an integral part of the corner guard system shall be provided by the manufacturer of the corner guard system. Exposed metal portions of fire rated assemblies shall have a paintable surface.

2.4 WALL GUARDS (BUMPER GUARDS)

2.4.1 Wall Guards

Wall guards shall be provided with prefabricated end closure caps, inside and outside corners, concealed splices, cushions, mounting hardware and other accessories standard with the manufacturer. Extruded aluminum retainers shall conform to ASTM B221, alloy 6063, temper T5 or T6. End caps and corners shall be field adjustable to assure close alignment with handrails and wall guards. Wall guards shall have profile as shown. Wall guards shall consist of snap-on covers of high impact resistant resilient material, minimum 0.078 inch thick, mounted over 2 inch wide aluminum, minimum 0.062 inch thick retainer, anchored to wall at maximum 24 inches on center.

2.5 WALL COVERING/PANELS

Provide wall covering/panels consisting of high impact rigid acrylic vinyl or polyvinyl chloride resilient material. Panel sizes shall be 4 x 8 feet. Submit fire rating and extinguishing test results for resilient material. Also submit statements attesting that the items comply with specified fire and safety code requirements.

2.5.1 Rigid Vinyl Acrylic Wall Covering

Wall covering thickness shall be 0.040 inch.

a. Wood Chair Rail with Plastic cover, CR-1: Standard-duty assembly consisting of continuous sculpted, solid-wood.

   1. Wood Rail: 3-1/2 inches high by 5/8 inch. Size and profile indicated on Drawings.

      a. Wood Species: Certified Ash.
      b. Cover: Extruded rigid plastic, minimum 0.070-inch wall thickness.
      c. Profile: As indicated on drawings.
      d. Color: As indicated on drawings.
2.6 TRIM, FASTENERS AND ANCHORS

Provide vinyl trim, fasteners and anchors for each specific installation as shown.

2.7 FINISH

Submit three samples indicating color and texture of materials requiring color and finish.

2.7.1 Aluminum Finish

Finish for aluminum shall be in accordance with AA DAF45. Exposed aluminum shall be designation chemically etched medium matte, with clear anodic coating class II architectural coating 0.4 mil thick. Concealed aluminum shall be mill finish as fabricated, uniform in natural color and free from surface blemishes.

2.7.2 Resilient Material Finish

Finish for resilient material shall be manufacturers standard texture with colors in accordance with SAE J1545.

2.8 ADHESIVES

Adhesive for resilient material shall be in accordance with manufacturers recommendations.

2.9 COLOR

Color shall be as indicated. Color listed is not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Corner Guards and Wall Guards (Bumper Guards) and Chair Rail

Material shall be mounted at location indicated in accordance with manufacturer's recommendations.

3.1.2 Wall Covering

Surfaces to receive protection shall be clean, smooth, and free of obstructions. Adhesives shall be applied in controlled environment in accordance with manufacturer's recommendations.

3.2 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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
  Finishes; G
  Accessory Items; G
SD-04 Samples
  Finishes; G
  Accessory Items
SD-07 Certificates
  Accessory Items
SD-10 Operation and Maintenance Data
  Electric Hand Dryer; G

1.2 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then deliver to the jobsite in manufacturer's original packaging, and store in a clean, dry area protected from construction damage and vandalism.

1.3 WARRANTY

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

PART 2   PRODUCTS

2.1 MANUFACTURED UNITS

Provide toilet accessories where indicated in Drawings. Provide each accessory item complete with the necessary mounting plates of sturdy construction with corrosion resistant surface.

2.1.1 Anchors and Fasteners

Provide anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited
for use with the supporting construction. Provide tamperproof design exposed fasteners with finish to match the accessory.

2.1.2 Finishes

Except where noted otherwise, provide the following finishes on metal:

<table>
<thead>
<tr>
<th>Metal</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless steel</td>
<td>No. 4 satin finish</td>
</tr>
<tr>
<td>Carbon steel, copper alloy, and brass</td>
<td>Chromium plated, bright</td>
</tr>
</tbody>
</table>

2.2 ACCESSORY ITEMS

Conform to the requirements for accessory items specified below. Submit fasteners proposed for use for each type of wall construction, mounting, operation, and cleaning instructions and one sample of each other accessory proposed for use. Incorporate approved samples into the finished work, provided they are identified and their locations noted. Submit certificate for each type of accessory specified, attesting that the items meet the specified requirements.

2.2.1 Item A1066, Mirror, Mirror, Float Glass, with SS Frame

Wall mounted, frameless; 1/4-inch float glass with 1 inch beveled front edges and special waterproof back. Hanging hardware shall be included. Size: 18 inches wide by 36 inches high.

2.2.2 Item A1080, Mirror

Wall mounted, Stainless Steel frame; 1/4-inch float glass with special waterproof back. One-piece stainless steel angle frame with continuous integral stiffener on all sides and beveled front. Galvanized steel back shall have integral horizontal hanging brackets near the top and near the bottom. Size: 28 inches wide by 72 inches high.

2.2.3 Item A4995, Diaper Changing Station, Horizontal

Diaper changing station shall be wall mounted and shall be fabricated of high impact plastic with no sharp edges, steel on steel hinges and 10 gauge steel mounting supports. Unit fold down platform shall be concave to the child's shape, and shall be horizontal to the wall. Equipped with nylon and velcro safety straps and engineered to withstand a minimum static load of 250 pounds. Shall have an integral dispenser for sanitary liners. Mounting hardware shall be included. Size: 35 inches wide by 20 inches high by 4 inches deep.

2.2.4 Item A5030, Built-in, Fold-up, Shower Stall Bench

Bench shall be constructed of 5/16 inch thick, solidly fused plastic laminate with matte-finish melamine surfaces and black phenolic-resin core that are integrally bonded. Seat shall be secured to the frame with stainless steel carriage bolts and acorn nuts. The frame shall be 18-8 S, Type 304, stainless steel with satin finish with 16 gauge, 1 1/4 inches square tubing and 18 gauge, 1 inch diameter tubing. The mounting flanges shall be 18-8 S, Type 304, 3/16 inch thick stainless steel with satin
finish. The flanges shall be 3 inches diameter with 3 mounting screw holes. The base plate shall be 18-8 S, Type 304, heavy-gauge stainless steel. The spring shall be 17-7, Type 301, 24 gauge stainless steel spot welded to the base plate. The guide bracket shall be 18-8 S, Type 304, 16 gauge stainless steel with satin finish. Approximate size: 18 inches wide by 14 7/16 inch deep. Refer to finish identification drawing for plastic laminate color selection.

2.2.5 Item A5080, Wall mounted Paper Towel Dispenser

Surface mounted roll paper towel dispenser. Automatic manual feed feature. 8 inch roll with 3.5 inch diameter stub roll (approximately 150 feet). High Impact plastic, translucent smoked plastic. Metal key operated lock. Mounting hardware shall be included. Size: 13.3 wide by 13.5 high by 9.8 inches deep. Must meet ADA standards for Accessible Design.

2.2.6 Item A5090, Sanitary Napkin Disposal Unit, Wall Mounted

Surface mounted corrosion resistance Type 304, stainless steel, all-welded, satin finish. Cover shall be one piece, seamless construction with full-length piano hinge. Container shall have an integral finger depression for opening. Approximate size: 10 inches high by 7-1/2 inches wide by 3-13/16 inch deep.

2.2.7 Item A5109A, Grab Bars, at Water Closets

Grab bar shall be 18 gauge, 1-1/4 inches OD Type 304 stainless steel. Grab bar shall be 36 inches in length as indicated. Concealed mounting flange shall have set screw mounting holes concealed on the lip of the flange. Grab bar shall have satin finish. Installed bars shall be capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation. Space between wall and grab bar shall be 1-1/2 inches. Refer to drawings for exact length and configurations.

2.2.8 Item A5109B, Grab Bars, at Water Closets

Grab bar shall be 18 gauge, 1-1/4 inches OD Type 304 stainless steel. Grab bar shall be 42 inches in length as indicated. Concealed mounting flange shall have set screw mounting holes concealed on the lip of the flange. Grab bar shall have satin finish. Installed bars shall be capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation. Space between wall and grab bar shall be 1-1/2 inches. Refer to drawings for exact length and configurations.

2.2.9 Item A5110, Grab Bars, at Showers

Grab bar shall be 18 gauge, 1-1/4 inches OD Type 304 stainless steel. Grab bar shall be form and length as indicated. Concealed mounting flange shall have set screw mounting holes concealed on the lip of the flange. Grab bar shall have satin finish. Provide peened non-slip surface. Installed bars shall be capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation. Space between wall and grab bar shall be 1-1/2 inches. Refer to drawings for exact length and configurations.
2.2.10 Item A5135, Combination Mop/Broom Rack with Shelf

Unit shall consist of an 8 inch deep shelf with supporting brackets, drying rod, rag hooks and mop/broom holders. All metal components shall be fabricated of Type 304 stainless steel with satin finish. Shelf shall be minimum 18 gauge with 2 inch return edges; front edge hemmed. Mounting brackets: minimum 16 gauge, welded to shelf. Drying rod: stainless steel minimum 1/4 inch diameter. Item shall be provided with three spring-loaded rubber cam mop/broom holders and three 16 gauge rag hooks. Dimensions: approximately 36 inches long by 6 inches high.

2.2.11 Item A5160, Shelf, 8" Depth, SS, Surface Mounted

Shelf shall be constructed of type-304 stainless steel with satin finish. Stainless steel mounting brackets shall be welded to shelf. Dimensions approximately 24 inches long by 8 inches wide with 3/4 inch return edges.

2.2.12 Item A5170, Metal Shower Rod

Unit shall consist of shower curtain rod, shower curtain and hanging hooks. Shower curtain rods shall be Type 304, stainless steel with satin finish and 1 inch outside diameter by 20 gauge one-piece die formed stainless steel with satin finish. Length of rod as indicated on contract documents. Shower curtain shall be opaque matte white vinyl, 0.008 inch thick with nickel-plated grommets along top every 6 inches. Provide stainless steel shower curtain hooks.

2.2.13 Item A5200, Dispenser, Toilet Tissue, SS, 2 Roll, Surface Mounted

Double roll stainless steel toilet paper dispenser shall be constructed of type 304 stainless steel with satin finish. Unit shall accommodate two standard core toilet paper rolls up to 5-1/2 inch diameter. Flanges shall be equipped with concealed, 16 gauge stainless steel mounting brackets that are secured to concealed stainless steel wall plates with stainless steel locking set-screws. Spindles shall be equipped with a heavy-duty internal spring.

2.2.14 Item A5205, Bar, Towel, Surface Mounted

Surface mounted towel bar fabricated of Type 304 stainless steel with satin finish. Flanges and support arms shall be 22 gauge, equipped with concealed 16 gauge mounting brackets, and concealed 16 gauge wall plates with locking set screws. Bar shall be a minimum of 3/4 inch diameter tubing by 24 inches in length.

PART 3 EXECUTION

3.1 INSTALLATION

Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Provide oval exposed screw heads. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Use sealants for brackets, plates, anchoring devices and similar items in showers (a silicone or polysulfide sealant) as they are set to provide a watertight installation. After installation, thoroughly
clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Conceal fasteners on accessories without backplates. Install accessories with sheet metal screws or wood screws in lead-lined braided jute, PTFE or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do not use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   REFERENCES

The publication listed below forms a part of this specification to the extent referenced. The publication is referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


1.2   SUBMITTALS

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

SD-02 Shop Drawings

- Fire extinguisher cabinets; G
- Mounting brackets; G

Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, wall bracket mounted measurements, and location as coordinated with Government supplied fire extinguishers.

SD-03 Product Data

- Fire extinguisher cabinets; G
- Mounting brackets; G
- Fire Extinguisher location sign; G

Provide required operational features, color and finish, and anchorage details, as coordinated with Government provided...
material.

SD-08 Manufacturer's Instructions

Fire extinguisher cabinets
Indicate special criteria and wall opening coordination requirements.

SD-10 Operation and Maintenance Data

Fire Extinguishers; Data Package 1
Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 QUALITY ASSURANCE

1.3.1 Fire-Rated, Fire Protection Cabinets:
Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

1.3.2 NFPA Compliance
Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

1.4 DELIVERY, HANDLING, AND STORAGE

1.4.1 Handling and Storage
Materials shall be protected from weather, soil, and damage during delivery, storage, and construction.

1.4.2 Delivery
Materials shall be delivered in their original packages, containers, or bundles bearing the brand name and the name of the material.

PART 2 PRODUCTS

2.1 FIRE EXTINGUISHERS
The Government will furnish fire extinguishers for the facility.

2.2 MOUNTING BRACKETS
Designed to prevent accidentally dislodging extinguisher, of size required for up to 10-pound capacity fire extinguisher, in plated finish. Provide brackets for extinguishers not located in cabinets.

2.2.1 Elevator Machine Room
Unless otherwise indicated, provide mounting brackets inside the elevator machine room installed on the wall on the strike-jam side of the machine room.
2.3 FIRE EXTINGUISHER CABINETS

Manufacturer's standard semi-recessed box, size as required to suit up to 10 pound capacity fire extinguisher, complete with trim, frame, door, and hardware. Weld joints and grind smooth. Miter and weld perimeter door frames.

2.3.1 Finish

Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.3.1.1 Cabinet and Door

Stainless steel with No. 4, directional satin finish.

2.3.2 Trim Style

ASTM A 167, AISI Type 302/304 alloy stainless steel. Exposed one-piece combination trim and perimeter door frame overlapping surrounding wall surfacing with exposed trim face and wall return at outer edge (backbend). Fabricate with minimum 1 1/4 inch backbend rolled-edge corners mitered, welded, and ground smooth. Provide depth backbend as required to suit actual wall conditions.

2.3.3 Door

ASTM A 167, AISI Type 302/304 alloy stainless steel with 1/8 inch thick ASTM C 1036 clear tempered glass. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

2.3.4 Identification

Identify fire extinguishers in cabinets with "FIRE EXTINGUISHER" lettering applied to door. Provide silk screen lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Identify bracket-mounted extinguishers with "FIRE EXTINGUISHER" in 2 inch red letter decals applied to a "ready made" flat sign mounted perpendicular to the wall.

2.4 FIRE EXTINGUISHER LOCATION SIGN

Projection mounted sign printed on both sides. Core material shall be aluminum, minimum 0.040 inches thick, and formed with an integral flange or provided with metal bracket to secure sign perpendicular to the substrate. Visual area shall be approximately 9 inches wide (projection) by 7 inches high. Background color shall be red and the words FIRE EXTINGUISHER with graphic of extinguisher in white. Provide screws of the type appropriate for the substrate to secure the sign; adhesive pads are not acceptable.

PART 3 EXECUTION

3.1 INSTALLATION

Install cabinets and fire extinguishers in locations and at mounting heights indicated or, if not indicated, at heights to comply with
applicable regulations of governing authorities. Prepare recesses in walls for cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions. Fasten mounting brackets and cabinets to structure, square and plumb.

a. The installation of extinguishers shall comply with the manufacturer's recommendations.

b. Extinguishers shall be fully charged and ready for operation upon installation.

3.1.1 Fire Extinguisher Location Sign

Install signs where fire extinguishers are placed, with or without cabinets. Subject to direction of governing authority, align the center of the sign with the center of the cabinet vertically, and the top of the sign no greater than 80 inches above the finish floor. Secure sign to substrate with screws.

3.2 ACCEPTANCE PROVISIONS

3.2.1 Repairing

Damaged and unacceptable portions of completed work shall be removed and replaced with new work at no additional cost to the Government.

3.2.2 Cleaning

Surfaces of the work, and adjacent surfaces soiled as a result of the work, shall be cleaned in an approved manner. Equipment, surplus materials, and rubbish from the work shall be removed from the site.

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   SUBMITTALS

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

SD-02 Shop Drawings

Item A5145, Hook, Robe, 2 Prong; G
Item A5150, Hook, Garment, Triple, Surface Mounted; G
Item X3150 Rack, Apron/Gloves, Wall Mounted; G

SD-03 Product Data

Item A5145, Hook, Robe, 2 Prong; G
Item A5150, Hook, Garment, Triple, Surface Mounted; G
Item X3150 Rack, Apron/Gloves, Wall Mounted; G

SD-07 Certificates

Item A5145, Hook, Robe, 2 Prong; G
Item A5150, Hook, Garment, Triple, Surface Mounted; G
Item X3150 Rack, Apron/Gloves, Wall Mounted; G

1.2   DELIVERY, HANDLING, AND STORAGE

1.2.1   Handling and Storage

Material shall be protected from the weather, soil, and damage during delivery, storage, and construction.

1.2.2   Delivery

Materials shall be delivered in original packages or containers bearing the brand name and the name of the material.

1.3   FIELD MEASUREMENTS

Field measurements shall be taken prior to the preparation of drawings and fabrication to ensure proper fits.
PART 2   PRODUCTS

2.1   Item A5145, Hook, Robe, 2 Prong

Provide two prong robe hook as indicated. Hook size 2 inches high by 4 inches wide by 2-5/16 inch. Projection of hook shall be not less than 1 5/8 inches. Refer to Finish Identification Drawings for additional information

2.2   Item A5150, Hook, Garment, Triple, Surface Mounted

Provide coat rack with 3 individual hooks on bar. Bar shall be natural anodized aluminum finish. Bar shall be 16 inch wide by 4 1/2 inches high by 3 3/4 inches deep. Projection of hook shall be not less than 1 5/8 inches. Refer to Finish Identification Drawings for additional information

2.3   Item X3150 Rack, Apron/Gloves, Wall Mounted

Wall mounted tri-rack shall hold one apron and two gloves. Approximate size: 16 inches high by 28 wide by 8 inches deep, tubular steel. Holds apron and pair of gloves.

PART 3   EXECUTION

3.1   GENERAL INSTALLATION

Install miscellaneous specialties true to line, level and plumb, as applicable and in accordance with each manufacturer's instructions. Fasten items securely in place and adjust.

3.1.1   Anchorage

Provide anchors and fasteners to secure items in place. Coordinate backing locations with other sections of this specification. Use inserts, expansion shields, power driven anchors, toggle bolts, machine bolts, or lag bolts, as required for a particular condition. Walls shall be reinforced as required to support wall mounted items.

3.2   DEMONSTRATION

Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls.

3.3   CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 11 53 00
LABORATORY EQUIPMENT AND FUMEHOODS
05/11

PART 1   GENERAL

1.1 RELATED REQUIREMENTS

See Section 01 20 00.00 20 PRICE AND PAYMENT PROCEDURES for Government's procurement policy for all CAT A medical and dental equipment.

1.2 REFERENCES

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

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)


ASTM INTERNATIONAL (ASTM)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code
1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Conform to provisions of Section 12 35 70 MEDICAL AND DENTAL CASEWORK. Provide final utility connections and utility service to equipment including waste, under Sections 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS; 22 00 70 PLUMBING SYSTEMS; 22 60 70 GAS AND VACUUM SYSTEMS FOR HEALTHCARE FACILITIES; 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS; and 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.4 SUBMITTALS

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

SD-02 Shop Drawings
- Item L2255, Canopy, Hood, Exhaust Stack, Individual
- Item M2020, Cabinet, Storage, Safety

SD-03 Product Data
- Item L2255, Canopy, Hood, Exhaust Stack, Individual
- Item M2020, Cabinet, Storage, Safety
  - Include descriptive literature, technical data sheets, and diagrams.

SD-04 Samples
- Exterior hood paint; G

SD-06 Test Reports
- Fumehood test; G
- Base cabinet test; G

SD-10 Operation and Maintenance Data
- Item L2255, Canopy, Hood, Exhaust Stack, Individual
- Item M2020, Cabinet, Storage, Safety
  - Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.
1.5 SUBMITTAL REQUIREMENTS

1.5.1 Hood Paint

Submit color chips of exterior hood paint. Submit at least five colors which are standard with the manufacturer.

1.5.2 Drawing Requirements

Show pertinent installation layout. Indicate details of construction and rough-in requirements.

1.5.3 Schedule

Include each type of equipment and hood and submit in accordance with Section 11 74 00 DENTAL EQUIPMENT.

1.5.4 Tests

Submit fume hood test and cabinet test reports required by ACGIH-2092S.

PART 2 PRODUCTS

2.1 MATERIALS, COMPONENTS, AND SPECIAL DESIGN REQUIREMENTS

2.1.1 Aluminum Alloy

ASTM B221 equivalent in ultimate tensile, yield, and shear strengths to Alloy 6063-T5 or 6063-T6.

2.1.2 Carbon Steel

ASTM A1008/A1008M, cold rolled sheets, commercial bright finish.

2.1.3 Stainless Steel

ASTM A167; No 4 satin finish including welds and fabricated surfaces. Provide Type 302, 304, or 316 alloy unless otherwise specified. Provide minimum thickness of U.S. Standard 16 gage, except 14 gage for working surface.

2.1.4 Safety Glass

ASTM C1048, fully tempered "FT," clear.

2.1.5 Casework Components

Conform with Section 12 35 70 MEDICAL AND DENTAL CASEWORK for base cabinets, counter tops, service fittings and finishes.

2.1.6 High Efficiency Particulate Air (HEPA) Filter

Meet requirements of UL 586.

2.1.7 Fumehood Design

Design, calculate face velocities, and test fume hoods in accordance with ACGIH-2092S, Laboratory fume hoods, auxiliary systems, and associated equipment shall meet the requirements of NFPA 70 and NFPA 45.
2.1.8 Hood Static Pressure Loss

With the sash in full-open position the static pressure loss through the fumehood shall not exceed 1/2 inch water gage when operating at 75 feet per minute (fpm), 7/8 inch water gage at 100 fpm, 1.125 inch water gage at 125 fpm. For hoods equipped with bypass, the static pressure loss and exhaust volume shall remain relatively constant (within 5 percent) regardless of sash position.

2.1.9 Electrical Devices

Prewired at the factory to a common, integral junction box to provide easy exterior connection and disconnection.

2.2 UNITS

2.2.1 Item L2255, Canopy, Hood, Exhaust Stack, Individual

Canopy hood for use with large apparatus, designed for wall installation with remote exhaust fan. Fabricate with integral baffle to increase slot velocities.


b. Size: 30 inches deep by 18 inches high by 60 inches long.

2.2.2 Item M2020, Cabinet, Storage, Safety

Cabinet shall conform to NFPA standards and OSHA regulations. Cabinet shall have two manual-closing doors, three point locking handle and double-wall steel construction with 1-1/2 inch air space. Provide four leveler feet; three-point lock and a 2 inch leak proof sill. Cabinet finish shall be epoxy-coated steel. Provide rear vent outlets with flame arresters and closure plugs, epoxy coated steel shelf and leveling legs. 2 inch diameter pipe taps, one on each side for venting to the exterior of the cabinet. Approximate size: 48 inches wide by 22 inches deep by 35 inches high

PART 3 EXECUTION

3.1 INSTALLATION

Install units at locations indicated. Conform to installation provisions of Section 33 11 23 NATURAL-GAS / LIQUID PETROLEUM GAS DISTRIBUTION; Section 22 00 70 PLUMBING SYSTEMS; Section 22 60 70 GAS AND VACUUM SYSTEMS FOR HEALTHCARE FACILITIES and the ACGIH-2092S including provision for an adequate supply of tempered make-up air to meet the air flow requirements of fume hood(s). Provide interlocks for controls and alarms to maintain the required air balance between hood interiors and the room.

3.2 POSTED OPERATING INSTRUCTIONS

Provide in accordance with the requirements in Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS.
3.3 FIELD QUALITY CONTROL

3.3.1 Inspection

Examine each unit for visual defects, operation and conformance to specifications.

3.3.2 Tests

Test each unit to ensure that the equipment is operational and conforms to specification requirements. Field tests for fume hood operation and performance shall meet the requirements of ACGIH-2092S.

3.4 3.6 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 11 71 00
WARMING CABINETS, STERILIZERS, AND ASSOCIATED EQUIPMENT
02/09

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

See Section 01 20 00.00 20 PRICE AND PAYMENT PROCEDURES for Government's procurement policy for all CAT A medical and dental equipment.

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.

ASME INTERNATIONAL (ASME)

ASME B16.18 (2012) Cast Copper Alloy Solder Joint Pressure Fittings


ASME BPVC SEC VIII D1 (2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)


<table>
<thead>
<tr>
<th>Standard Number</th>
<th>Standard Title</th>
</tr>
</thead>
</table>
1.3 SUBMITTALS

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

SD-02 Shop Drawings

Item S0237, Sterilizer, ELEC, VAC, 2DO, RCSD 1WLL, 20x20x38 Chamber; G
Item S0290, Rack, 2SH, 20x20x38 CHMBR; G
Item S0295, Loading Car & Transfer Carriage, 20x20x38 Cham; G
Item S0965, Washer/ Disinfector, Dental; G
Item S1900, Pass Thru Window; G
Item S2635, Cleaner, Ultrasonic, SNGL Cham, CAB, F/S; G

SD-03 Product Data

Item S0237, Sterilizer, ELEC, VAC, 2DO, RCSD 1WLL, 20x20x38 Chamber; G
Item S0290, Rack, 2SH, 20x20x38 CHMBR; G
Item S0295, Loading Car & Transfer Carriage, 20x20x38 Cham; G
Item S0965, Washer/ Disinfector, Dental; G
Item S1900, Pass Thru Window; G
Item S2635, Cleaner, Ultrasonic, SNGL Cham, CAB, F/S; G

SD-06 Test Reports

Item S0237, Sterilizer, ELEC, VAC, 2DO, RCSD 1WLL, 20x20x38 Chamber; G
Item S0290, Rack, 2SH, 20x20x38 CHMBR; G
Item S0295, Loading Car & Transfer Carriage, 20x20x38 Cham; G
Item S0965, Washer/ Disinfector, Dental; G
Item S1900, Pass Thru Window; G
Item S2635, Cleaner, Ultrasonic, SNGL Cham, CAB, F/S; G

SD-10 Operation and Maintenance Data

Item S0237, Sterilizer, ELEC, VAC, 2DO, RCSD 1WLL, 20x20x38 Chamber; G
Item S0290, Rack, 2SH, 20x20x38 CHMBR; G
Item S0295, Loading Car & Transfer Carriage, 20x20x38 Cham; G
Item S0965, Washer/ Disinfector, Dental; G
Item S1900, Pass Thru Window; G
Item S2635, Cleaner, Ultrasonic, SNGL Cham, CAB, F/S; G

1.4 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity and temperature variation, dirt and dust, or other contaminants.
1.5 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified, not later than 3 months before the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are the standard product of manufacturers regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. With the exception of distillation equipment, all equipment described within this specification shall conform to UL 60601-1. The label or listing of the Underwriters Laboratories, will be accepted as evidence that the equipment conforms to the standard. In lieu of this label or listing, the manufacturer may submit a statement from a nationally recognized, equally equipped testing agency indicating that items have been tested in accordance with specification requirements. For Navy projects refer to 11 74 00 DENTAL EQUIPMENT in lieu of this paragraph. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Submit a complete list of equipment and material, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions.

a. Each major item of equipment shall have the manufacturer's name, address, and catalog or serial number permanently affixed to a plate securely attached to the equipment. In addition, each pressure vessel shall bear the ASME stamp and pressure rating, indicating compliance with applicable code requirements.

b. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or properly guarded.

c. Materials, unless otherwise specified, shall conform to the following:

2.1.1 Carbon Steel


2.1.2 Nickel

ASTM B39. Nickel-copper alloy or stainless steel or white metal.

2.1.3 Nickel and Nickel-Alloy Clad Steel

ASTM A265. Nickel or nickel-copper alloy and steel for pressure vessels, mill-rolled under heat and pressure until integrally bonded over entire interface.

2.1.4 Nickel-Copper Alloy (Monel Metal)

2.1.5 Stainless Steel

ASTM A167, Type 301 or 316L; Class 304L for welded construction and Class 302 or 304 for construction formed without welding. Exposed surfaces of stainless steel to have satin finish.

2.1.6 Stainless Steel Bars and Rods

ASTM B166.

2.1.7 Stainless Steel for Pressure Vessels

ASTM A240/A240M.

2.1.8 Stainless Steel Clad

ASTM A264 for pressure vessels.

2.1.9 Tin

ASTM B339.

2.1.10 Titanium

For construction of products used in contact with distilled water, ASTM B348, Grade 2.

2.1.11 Fasteners

Use corrosion-resistant materials for all rivets, bolts, nuts, studs, spacers, and welding metal.

2.2 PIPING AND TUBING

Seamless, annealed, and ground smooth. Welded tubing to be thoroughly heat treated and properly quenched to eliminate carbide precipitation, drawn true to size and roundness. Piping and tubing shall conform to the following:

2.2.1 Steam Supply and Return Condensate Lines

Copper pipe shall conform to ASTM B42; brass pipe shall conform to ASTM B43; brass tube shall conform to ASTM B135, Alloy 230. Include strainer, shut-off valve and pressure gage suitable for steam pressure up to 80 psig. In return line include steam trap, check valve, and hand shut-off valves.

2.2.2 Water and Waste Lines

Copper tube shall conform to ASTM B88 Type K, hard-drawn or annealed for bending; brass tube shall conform to ASTM B135, Alloy 230 or C23000.

2.2.3 Pipe Fittings

Wrought copper or wrought bronze, brazing or solder joint type in accordance with ASME B16.18 and ASME B16.22. Use ASTM B32, Alloy Sb5 tin-antimony solder to make joints for copper tubing.
2.3 **EQUIPMENT SUPPORTS**

Furnish supports for stands, brackets, hangers, and similar equipment, and accessories including pipe, duct, and conduit. Floor stands shall be field adjustable for leveling.

2.4 **ELECTRICAL WORK**

Provide electric motor-driven equipment complete with motors, motor starters, and controls. Electrical equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical characteristics shall be as specified herein or indicated. Provide motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Provide manual or automatic control, protective or signal devices required for the operation specified, and any control wiring required for controls and devices specified.

2.5 **STERILIZER COMPONENTS**

2.5.1 **Pressure Vessels**

Design, construction, materials, and testing of each pressure vessel, including doors, shall comply with applicable provisions of ASME BPVC SEC VIII D1. Submit a signed copy of ASME Form U-1 or U-1A, as shown in ASME BPVC SEC VIII D1 Appendix W, with each sterilizer, as applicable.

2.5.2 **Welding Materials**

Welding Materials shall comply with ASME BPVC SEC II-C. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

2.5.3 **Doors**

Sterilizer doors shall be vertical power operated sliding type. Doors shall be interlocked to prevent chambers from being charged until seal is established.

2.5.3.1 **Sliding Doors**

Provide vertical power sliding doors for sterilizers in lieu of hinge mounted doors, if necessary. Temperature of handles, during operation, shall not exceed 122 degrees F if metal, or 140 degrees F if nonmetal. Doors shall require no more than a 5-pound force for opening.

2.5.4 **Controls**

Where a unit is scheduled or specified to have automatic microprocessor type controls, provide the controls consisting of a selectively programmable microcomputer that monitors and controls the system operations and functions. It shall be possible to energize the entire system by a single switch. If chamber temperature should fail to reach or fall 2 degrees F below the set value, timer will reset. Automatic controls shall include the following associated instrumentation:
2.5.4.1 Data Collection

Automatic data collection system, digital type, consisting of a printer-recorder, able to print at least 20 characters per line on a recording tape, and recording tape storage unit. During processing, printer-recorder shall document that all parameters of the cycle were met, or provide a record of the microcomputer's fault indicators and self diagnostics. The record shall be removable from the machine at the end of the cycle and shall provide space for the operator's signature and notation of sterilizer identification number. System shall include alarms and a programmable clock that displays time and date (day, month, year). The sterilizer shall be supplied with at least three rolls of printer paper and two ink supplies (either cartridges or ribbons, as appropriate).

2.5.4.2 Status

Status indicator to indicate each cycle phase. Indicator shall visually alert if door is unlocked and shall visually and/or audibly alert if sterilizer does not reach set temperature or drops below set temperature during sterilizing phase. On two-door-model sterilizers, the remote door end shall include phase indicators, information for previous cycle parameters and cycle start/stop control.

2.5.4.3 Processing Time

Processing time indicator in the form of a digital display that shows sterilizing time.

2.5.4.4 Cycle Selector

Cycle selector to program and actuate each cycle individually. Selected cycle shall be visually displayed and all others shall be locked out.

2.5.4.5 Time Setting

Time setting switches to accurately set individual cycle times. Once cycle has started, times cannot be changed unless reset/abort switches are actuated and completed, or regular cycle is completed. Provide visual display of time setting.

2.5.4.6 Cycle Monitor

Cycle monitor device, nonresetable, to count each cycle.

2.5.4.7 Main Switch

Main power and control switch to energize and de-energize main power and controls.

2.5.4.8 Reset/Abort

Reset/abort switch to stop cycle.

2.5.5 Chamber Evacuation System

Sterilizers may utilize a vacuum system consisting of a condenser water ejector in lieu of a vacuum pump.
2.5.6 Connections to Equipment

Prewire and prepipe each unit of equipment complete with trim and fittings. Equipment shall include fittings to prevent backflow of polluted water or waste into water supply system or equipment in accordance with ICC IPC. Provide reduced pressure or atmospheric type backflow preventer.

2.6 Item S0237, Sterilizer, ELEC, VAC, 2DO, RCSD 1WLL, 20x20x38 Chamber

Recessed one wall, double door model, steam operated with integral steam generator, cabinet instrument gravity and vacuum steam sterilizer. Chamber size: 20 inches wide by 20 inches high by 38 inches deep. Powered vertical sliding door operation.

Control system shall have touch screen, ink on paper impact printer, help screens with alarm conditions, auto check of control program and cycle data, and service reprogrammable flash ROM memory.

a. Electrical characteristics: 120 volt, 9.5A, 60 Hz, single phase for controls. 480V, 36A, 60Hz, three phase for integral steam generator, 480V, 37A, 60Hz, three phase for vacuum pump.

b. Cold water: 1 inch NPT, 30 to 60 psig.

c. Steam supply: Integral steam generator. Pure water 1/2 inch NPT, 20 to 50 psig.

d. Drain: 1-1/2 inch ODT drain terminal.

2.7 Item S0290, Rack, 2SH, 20x20x38 CHMBR

Loading rack and two shelves to fit a sterilizer with chamber size: 20 inches wide by 20 inches high by 38 inches deep. Must be from same manufacturer of and fit sterilizer S0237. Constructed of Stainless steel.

2.8 Item S0295, Loading Car & Transfer Carriage, 20x20x38 Cham

Loading car and Transfer Carriage k and two shelves to fit a sterilizer with chamber size: 20 inches wide by 20 inches high by 38 inches deep. Must be from same manufacturer of and fit sterilizer S0237. Constructed of Stainless steel.

2.9 Item S0965, Washer/ Disinfector, Dental

Thermal disinfector, automatic dispenser module with time relay, suitable for the thermal disinfection and cleaning of dental instruments and accessories. Approximately 33-1/2 inches high, 20-1/2 inches wide and 24 inches deep. Include the following:

a. Automatic controls.

b. Fold down manual controlled door.


d. Electrical characteristics: 208 volts, 30 amps, single phase.

e. Material handling accessories shall include two mesh trays and injector baskets.

f. Cold and pure water: 3/4 inch GHT.
2.10 Item S1900, Pass Thru Window

Pass-through window: Double hung window with counter balance sash, constructed with removable stainless steel frame and 1/4 inch thick tempered safety glass window pane.

Wall frame: The frame shall be constructed of No. 16-gauge stainless steel with welded corners, ground and polished smooth. The frame shall be telescoping for easy installation into wall.

Construction: The pass-through window assembly shall be constructed entirely of type 304 stainless steel polished to a No. 4 finish.

Size: 36 inches wide by 36 inches high.

2.11 Item S2635, Cleaner, Ultrasonic, SNGL Cham, CAB, F/S

Freestanding single chamber cleaner cabinet used to clean instruments with sonic energy in a heated water detergent solution. Power lid with automatic tray elevator. Adjustable supports in base.

Overall cabinet size: 43-1/2 inches wide by 42-1/2 inches high by 36 inches long.

Chamber size: 27 inches long by 15 inches width by 13 inches depth.

Maximum load 20 gallon, 35 pounds of instruments

Exterior surfaces to be 304 type stainless steel with a No. 4 finish.

Electrical: 208V, 3 phase, 26A, five wire including neutral and ground.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

Install equipment at locations indicated in accordance with manufacturer's printed installation instructions, Section 11 74 00 DENTAL EQUIPMENT, and approved detail drawings. Submit detail drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that cabinets and sterilizer systems have been coordinated and will function as a unit. Drawings shall show proposed layouts and anchorage of equipment and appurtenances, and equipment relationship to other work including clearances for maintenance and operation. Drawings shall include installation details and settings, drain piping connections, and complete electrical wiring and control diagrams. Necessary items such as framing, mounting hardware and trim shall be furnished and installed as required for the type of equipment furnished. For equipment designed for product pass-thru walls and/or partitions, provide gasketing, safing and baffle plates at unit perimeter to prevent air flow between the communicating spaces when doors are in closed position.
3.3 ADJUSTING

Following installation, flows, timers, levelers, and similar components and operation devices shall be adjusted as appropriate. After testing, and before acceptance, equipment shall be examined to ensure that adjustments are correct and that any additional adjustments deemed necessary during product testing or because of timing, have been incorporated.

3.4 UTILITIES

3.4.1 Service Runs

Connect service runs from equipment to building services as indicated.

3.4.2 Dissimilar Metal Connectors

Connections between ferrous and nonferrous metallic pipe shall be made with dielectric waterways and flanges. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

3.4.3 Waste Steam

Distillate coolers or other protective devices shall be installed as necessary to eliminate discharge water temperatures to waste in excess of 140 degrees F.

3.5 MANUFACTURER'S FIELD SERVICES

Provide the services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

3.6 FIELD TESTS AND INSPECTIONS

3.6.1 Before Testing

Pipes, equipment and components shall be cleaned of grease, dirt, stains, and other foreign materials.

3.6.2 Testing

Testing shall be performed in accordance with referenced specifications and/or requirements specified. One item or similar model, as necessary or appropriate, shall be tested to ensure that it is operational and installation conforms to specification requirements. Hydrostatically test piping system at pressure of 1.5 times system operating pressure with water at temperature not exceeding 100 degrees F. Before test, remove or isolate gage traps and apparatus that may be damaged by that pressure. Install calibrated test gage in system to observe any loss of pressure. Close off system and maintain test pressure not less the one hour. Inspect joints and equipment connections for leaks. Retest and make repair until no further leaks are observed. Manufacturer's standard
equipment warranty shall not begin until the manufacturer certifies equipment conformance to all required testing specified and until beneficial occupancy of the portion of the facility where the equipment is installed. Submit certified copies of results of factory tests of equipment tested. Test reports in booklet form showing field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed equipment. Each test report shall indicate the final position of controls.

3.6.3 Inspection

Each item shall be examined for visual defects and conformance to specifications.

3.7 CLEANING

3.7.1 For Final Acceptance

Remove labels, fingerprints, and clean all surfaces both inside and out. Tightly cover and protect fixtures and equipment against rust, dirt, water, and chemical or mechanical injury. Marred surfaces shall be repaired, patched, and touched-up as suitable for conditions.

3.7.2 Marred Surfaces Exposed-to-View

Marred exposed surfaces that affect appearance, such as both interior and exterior cabinet finishes, shall be finished to match the adjacent finishes, like new. Parts that cannot be refinished in this manner shall be replaced.

3.7.3 Concealed Marred Surfaces

Marred surfaces exposed to atmosphere, where such surfaces do not affect product's appearance but do affect resistance to elements, such as galvanized pipes and insulation shall be finished to equal resistance performance as the unmarred surfaces.

3.8 TRAINING

3.8.1 Training Course

Conduct training course for operation staff as designated by the Contracting Officer. The training period, for a total of 16 hours of normal working time, shall start after systems are functionally complete but prior to final acceptance. The field instructions shall cover all of the items contained in the operations and maintenance instructions, as well as demonstrations of routine maintenance operations. Notify Contracting Officer at least 14 days prior to date of proposed conduction of training course. The manuals shall be approved prior to the training course.

3.8.2 Operating Manual

Submit six complete copies of operation manual outlining the step-by-step procedures required for system startup, operation, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features.
3.8.3 Maintenance Manual

Submit six complete copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and trouble shooting guide. The manuals shall include simplified schematic diagrams for the equipment as installed. Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

3.9 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 11 74 00
DENTAL EQUIPMENT
04/06

PART 1   GENERAL

1.1 RELATED REQUIREMENTS

See Section 01 20 00.00 20 PRICE AND PAYMENT PROCEDURES for Government's procurement policy for all CAT A medical and dental equipment.

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)


1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Conform to the provisions of Section 11 74 00 DENTAL EQUIPMENT. Provide final utility connections and utility service to equipment under Sections 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, 22 00 70 PLUMBING SYSTEMS, 22 60 70 GAS AND VACUUM SYSTEMS FOR HEALTHCARE FACILITIES, 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, and 26 20 00 INTERIOR DISTRIBUTION SYSTEM."

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:

Conform to the submittal provisions of Section 11 74 00 DENTAL EQUIPMENT.

SD-02 Shop Drawings

Item D0755, Assembly, Boilout/Curing, Double
Item D0904, Workstation, Tech, Dental, Lab, Single Station
Item D0925, Hood, Fume, Dental Acrylic, Floor Standing

SECTION 11 74 00 Page 1
PART 2   PRODUCTS

2.1  MATERIALS

2.1.1  Stainless Steel

Class 301, 302, or 304. Exposed surfaces shall have a No. 4 finish.

2.1.2  Aluminum Alloy

ASTM B221; provide alloy equivalent in ultimate tensile, yield, and shear strengths to Alloy 6063-T5 or 6063-T6, as applicable.

2.1.3  Carbon Steel

ASTM A568/A568M; cold-rolled, stretcher level sheets 16 gage and lighter with a commercial bright finish.
2.2 ITEMS

2.2.1 Item D0755, Assembly, Boilout/Curing, Double

Electric powered double tank boilout/curing unit. Two 18 gauge stainless steel tanks: 10 inches by 14 inches by 12 inches deep and 10 inches by 14 inches by 10 inches deep with inside handles. Electrical requirements are 120V, 1 phase for water pump and spout solenoid with hard wired connection, and 208 volts, 1 phase 60 hz, 2.5kW each for curing tank and boilout tank with a single point 208V 1 phase hard wired connection. Cabinet shall be included that unit fits into. Cabinet and countertop shall be constructed of stainless steel and be integral to the boilout unit. Shall include a backshelf and fifth spout. This should be provided together as one product. Cabinet shall not be constructed separately by millwork manufacturer. Approximate Cabinet size 36 inches wide by 31 inches deep 37 inches high

2.2.2 Item D0904, Workstation, Tech, Dental, Lab, Single Station

Single, self-contained, modular technician workstation with utility connections for air, gas, and electric. Approximate size: 48 inches wide by 24 inches deep by 34 inches high without light structure.

1. Load bearing steel frame on adjustable legs with end panels and supports.
2. Overhead color corrected task lighting,
4. Dust extraction unit with support frame for waste drawer, filter drawer with Motor, Suction Hood.
5. Bench top shall include 1 storage cabinets with 4 drawers and instrument inserts, one stainless steel debris drawer and a cast cement / fiberglass countertop; Case pan shelf system with shelf and supports.
6. Gas pipeline connection with stop valves; compressed air connection with stop valves; and pressure reducing valve.

2.2.3 Item D0925, Hood, Fume, Dental Acrylic, Floor Standing

Floor-standing fume hood workstation for processing acrylic dental resins. Shall be constructed of PVC plastic/fiberglass liner. Shall feature built-in lighting, and extraction fan. Counter-balanced vertically sliding front protective window. Approximate dimensions: 47 inches wide by 25 inches deep by 53 inches high. Provide compatible stand by same manufacturer as a component of D0925. Stand will add approximately 29 inches more to height.

2.2.4 Item D0930, Workstation, Dental Lab, Casting

Casting Dental Lab Workstation, 73 inches wide by 26 inches deep by 34 inches high

a. Full Length load bearing steel support frame on adjustable legs with end panels and supports
b. Stainless steel wall shelf with brackets. 48 inches wide by 16 inches deep

c. Built in soldering unit

d. Gas pipeline connection

e. Compressed air connection

f. Pull out casting ring cooling drawer with steel grid

g. Soap Stone counter top

h. Exhaust to atmosphere extraction Hood. 72 inches wide by 24 inches deep.

2.2.5 Item D0942, Workstation, Dental Lab, Microblasting

Microblasting Dental Lab Workstation with dust collector, 30 inches wide by 34 inches deep by 46 inches high

a. Load bearing steel support frame with end panels and supports

b. Interior space: 2.2 cubic feet, 24 inches wide by 10 inches high by 14 inches deep

c. Window: tempered glass opening (hinged) 23 inches by 11 inches

d. Lighting: 40 watt cool white fluorescent lamp.

2.2.6 Item D0960, Workstation, Dental Lab, Plaster

Dental lab plaster workstation, 120 inches wide by 24 inches deep by 37 inches high, includes:

a. Stainless steel counter top

b. Stainless steel sink

c. Counter mounted plaster waste disposal with knife scraper

d. Trimmer console for rinser bath

e. Two mixing faucets for cold and warm water

f. Two plaster traps, one at each sink, plaster trap shall be 19-inch diameter by 20-1/2 inch tall

g. Panel with air gun module

h. Pressure reducing valve

i. Connection kits for sink and rinsing bath

j. Two Floor mounted base cabinets with 4 drawers

k. One floor mounted sink base cabinet, half of cabinet has 1 single door and the other half has 2 drawers for housing the...
rinsing bath

1. One floor mounted sink base cabinet with door, for housing the sink

m. One floor mounted waste disposal base cabinet with waste container.

n. Four ground fault receptacles, 15 amp

o. Upright water valve

2.2.7 Item D0980, Workstation, Dental Lab, Polishing, Single

Single polishing station with lathe

a. Suction Motor: ¾ HP, 115 Volts/60 Hz

b. Polishing Motor: No 26 Red wing, two speed lathe

c. Suction Capacity: 600 CFM

d. Filter Area: 62 Square feet, 24 shakable cloth filter bags

e. Cleaning: External foot shaker, internal cabinet dust tray, self contained dust collector with lathe

f. Approximate unit dimensions: 56 inches high by 36 inches wide by 24 inches deep. Work surface approximately 40 inches to table top, adjustable table frame.

g. Finish: baked coating

2.2.8 Item D6155, Light, Dental, Operating, Ceiling, Column

Ceiling mounted LED dental operating light used to illuminate the field of work for the dentist.

Shall provide 3 inch by 6 inch light pattern with uniform intensity. Long depth of field generated within 18 to 36 inch range.

Vibration and shock resistant. Dual membrane touch pads.

Third axis rotation. Flex arm range of movement shall be capable of movement travel up to 40 degrees above and below horizontal and up to 27 degrees vertically.

5000 degree and 4200 degree Kelvin selections with high/medium/low intensity settings.

No-cure setting.

2.2.9 Item D8650, Chute, Waste, Plaster, Counter Mounted

Counter mounted plaster waste chute. The chute shall be constructed of stainless steel and is available in either a round or square configuration. The chute is mounted over a waste receptacle and is used to dispose of waste material through the countertop. The chute can be ordered as part of the countertop unit rather than as a separate item.
2.2.10 Item D9059, Coupler, Quick Disconnect

1/4 inch control air valve with 1/2 inch x 1/8 inch brass bushing, chrome plated escutcheon, chrome plated quick disconnect adaptor, 1/8 inch x 1/4 inch quick disconnect, 1/8 inch x 1/4 inch poly quick disconnect without shut off. Chapman-Huffman Company Models meets this specification.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to the installation provisions of Section 11 74 00 DENTAL EQUIPMENT, for the items specified herein. Install the items specified herein at the locations indicated on the drawings.

3.2 FIELD QUALITY CONTROL

3.2.1 Inspection

Examine each item for visual defects and conformance to specifications.

3.2.2 Tests

Test each item to ensure that the equipment is operational and conforms to specifications.

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 Construction Waste Management and Disposal, for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1 GENERAL REQUIREMENTS

Provide roller window shades, complete with necessary brackets, fittings, and hardware. 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)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


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
  Installation; G
SD-03 Product Data
  Window Shades; G
SD-04 Samples
  Window Shades; G
SD-06 Test Reports
  Window Shades
SD-08 Manufacturer's Instructions
  Window Shades
SD-10 Operation and Maintenance Data
  Window Shades

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 Manufacturer's Qualifications

Obtain motor-controlled roller shades through one source from a single manufacturer with a minimum of twenty years experience and minimum of three projects of similar scope and size in manufacturing products comparable to those specified in this section.

1.4.1.2 Installer's Qualifications

Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.

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 with temperature maintained above 50 degrees F. Do not open containers until needed for installation unless verification inspection is required.

1.6 WARRANTY

Provide manufacturer's 10 year minimum limited warranty from date of final acceptance of the Work.

PART 2 PRODUCTS

2.1 WINDOW SHADES, WT-1

Roller tube shall operate smoothly and be of sufficient diameter and thickness to prevent excessive deflection. Provide brackets that are appropriate for inside outside and ceiling mount. The shade cloth shall meet the performance described in NFPA 701, small scale test. Treat steel features for corrosion resistance.

2.1.1 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. Provide hardware system that allows for operation of multiple shade bands by a single operator. Connectors shall be offset to assure alignment from the first to the last shade band. Provide shade hardware constructed of minimum 1/8 inch thick plated steel or heavier as required to support 150 percent of the full weight of each shade.

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.
2.2 COLOR

Provide color, pattern and texture for metal and shade fabric as indicated on Drawings. 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.

3.2 ROLLER WINDOW SHADE PLACEMENT SCHEDULE

All exterior windows include WT-1 except at main lobby.

3.3 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.

3.4 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.

3.5 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1 REFERENCES

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

AMERICAN FOREST FOUNDATION (AFF)


ASTM INTERNATIONAL (ASTM)


CALIFORNIA AIR RESOURCES BOARD (CARB)

CARB 93120  (2007) Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)


CSA GROUP (CSA)

CSA Z809-08  (R2013) Sustainable Forest Management

FOREST STEWARDSHIP COUNCIL (FSC)

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

PROGRAMME FOR ENDORSEMENT OF FOREST CERTIFICATION (PEFC)


SUSTAINABLE FOREST INITIATIVE (SFI)

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-1691 (1994; Rev F) Construction and Material Schedule for Military Medical and Dental Facilities

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; G Elevations, plans and cross sections showing service runs; locations of blocking, rough-ins requirements and sink centerlines

SD-03 Product Data

Casework, Materials and Hardware

SD-04 Samples

Casework;
Wall Hung Cabinets; G
Floor Mounted Cabinets; G
Countertops; G
Laminated Plastic Sheets; G

SD-07 Certificates

Certified Sustainably Harvested Wood; G

SD-08 Manufacturer's Instructions

Installation

SD-11 Closeout Submittals

Recycled Content for Baked Enamel Carbon Steel Medical Casework; S
Recycled Content for Corrosion Resisting Steel Medical Casework; S
Recycled Content for Wood Core Medical Casework; S
Recycled Content for Carbon Steel Medical Casework; S
Recycled Content for Wood Core Dental Casework; S
Recycled Content for Carbon Steel Dental Casework; S
Recycled Content for Baked Enamel Carbon Steel Dental Prosthetics Casework; S
Recycled Content for Corrosion Resisting Steel Dental Prosthetics Casework; S
Recycled Content for Corrosion Resisting Steel Countertops; S
Recycled Wood Content for Plastic Laminate Countertops; S
Certified Sustainably Harvested Wood for Medical Casework; S
Certified Sustainably Harvested Wood for Countertops; S
Indoor Air Quality for Composite Wood and Agrifiber Products Used In Countertops; S

1.3 CERTIFICATIONS

1.3.1 Certified Sustainably Harvested Wood

Provide wood certified as sustainably harvested by FSC STD 01 001, ATFS STANDARDS, CSA Z809-08, SFI 2015-2019, or other third party program certified by PEFC ST 2002:2013. Provide a letter of Certification of Sustainably Harvested Wood signed by the wood supplier. Identify certifying organization and their third party program name and indicate compliance with chain-of-custody program requirements. Submit sustainable wood certification data; identify each certified product on a line item basis. Submit copies of invoices bearing certification numbers.

1.3.2 Indoor Air Quality Certification

For purposes of this specification, composite wood and agrifiber products include particleboard, medium density fiberboard (MDF), wheatboard, strawboard, panel substrates, and door cores. Products must contain no added urea-formaldehyde resins. Provide products certified to meet emissions requirements of either CARB 93120 or CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type). Provide current product certification documentation from certification body.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver casework to the jobsite in the original individual containers, complete with screws, keys, and instructions. Mark each container with the manufacturer's name and catalog number. Store casework in an adequately ventilated, dry location that is free of dust, water, or other contaminate and in a manner to permit access for inspection and handling. Handle casework carefully to prevent damage to the surfaces. Replace damaged items that cannot be restored to like-new condition.

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 Recycled Content for Healthcare Casework Materials

Recycled content is identified for some products in this section; provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph RECYCLED CONTENT. Other products listed in this section may be available with recycled content; identify those products that meet project requirements for recycled content, and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph RECYCLED CONTENT.

2.1.2 Certified Sustainably Harvested Wood

Certified sustainably harvested wood is identified for some products in this section; provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph BIOBASED PRODUCTS. Other products listed in this section may be available as certified sustainably harvested wood; identify those products that meet project requirements for certified sustainably harvested wood, and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph BIOBASED PRODUCTS.

2.1.3 Reduce Volatile Organic Compounds (VOC) (LOW-EMITTING MATERIALS) for Products

Reduced VOC content is identified for some products in this section; provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS (VOC) (LOW-EMITTING MATERIALS). Other products listed in this section may be available with reduced VOC content; identify those products that meet project requirements for reduced VOC content, and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS (VOC) (LOW-EMITTING MATERIALS).

2.2 CASEWORK

Submit for approval Drawings showing layout of casework at 3/4 inch equals one foot scale. Indicate details of construction and rough-in requirements. Indicate cabinets and countertop materials and hardware. All wood products must be formaldehyde free. Verify job condition affecting the work and obtain accurate field measurements for incorporation into drawings. Locate structural members, required utilities and services provided by other sections of this specification. Submit details and information fabrication and installation, manufacturer's printed data, catalog cuts, and instructions for installation and cleaning. Provide prefabricated casework as scheduled on the detail drawings. Factory fabricate of manufacturer's standard sizes and finishes and conform to MIL-STD-1691, and the requirements specified below. Casework items are identified on drawings with numbers preceded by the letters "C" and "D". These numbers are Joint Schedule Numbers in MIL-STD-1691. Material finish and color shall be As indicated on the drawings

<table>
<thead>
<tr>
<th>JSN Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C01D0A</td>
<td>Cabinet, U/C/B, 4 Drawer, 34x18x22</td>
</tr>
<tr>
<td>C02C0A</td>
<td>Cabinet, Undercounter Base Unit with one adjustable shelf, one door and one full width drawer. Provide left or right hand door as indicated on the drawings. 34 inches high (overall with countertop) by 24 inches wide by 23 inches deep.</td>
</tr>
</tbody>
</table>
C02D0A  Cabinet, Undercounter Base Unit, with four equal height
drawers, 34 inches high (overall with countertop) by 24 inches
wide by 23 inches deep.

C02D0C  Cabinet, Undercounter Base Unit, with three equal height
drawers, 34 inches high (overall with countertop) by 24 inches
wide by 23 inches deep.

C03E0A  Cabinet, Undercounter Base Unit, one shelf, one drawer,
two hinged doors, 34 inches high (overall with countertop) by 30
inches wide by 23 inches deep.

C03F0A  Cabinet, Undercounter Base Unit, One shelf, two Half
Drawers, two hinged doors, 34 inches high by 30 inches wide by 23
inches deep.

C03G0A  Cabinet, U/C/B, 2 Shelf, 2 Door, 34x30x22

C03H0A  Cabinet, Undercounter Base Unit, Two half Drawers, three
full width drawers, 34 inches high by 30 inches wide by 22 inches
deep.

C03J0A  Cabinet, U/C/B, 8 Half Drawers, 34x30x22

C03P0A  Cabinet, Undercounter Sink Knee space sink panel, 30
inches wide by 23 inches deep.

C04E0A  Cabinet, Undercounter Base Unit, one shelf, one drawer,
two hinged doors, 34 inches high (overall with countertop) by 36
inches wide by 23 inches deep.

C04F0A  Cabinet, Undercounter Base Unit, One shelf, two Half
Drawers, two hinged doors, 34 inches high by 36 inches wide by 23
inches deep.

C04P0A  Cabinet, Undercounter Sink Knee space sink panel, 36
inches wide by 23 inches deep.

C05P0A  Cabinet, Undercounter Sink Knee space sink panel, 48
inches wide by 23 inches deep.

CA040   Cabinet, Wall Hung, Open front with two adjustable
shelves, 30 inches high without sloped top by 36 inches wide by
13 inches deep. Sloped top where indicated on drawing.

CB010A  Cabinet, W/H, 2 Shelf, 1 DO, Sloping Top, 38x18x13

CB020   Cabinet, Wall Hung with two adjustable shelves and one
hinged door, 30 inches high without sloped top by 24 inches wide
by 13 inches deep. Provide left or right hand door as indicated on
drawings. Sloped top where indicated on drawing.

CB020A  Cabinet, W/H, 2 Shelf, GDO, Sloping Top, 38x24x13

CD030   Cabinet, Wall Hung with two adjustable shelves and two
hinged doors, 30 inches high without sloped top by 30 inches wide
by 13 inches deep. Sloped top where indicated on drawing.

CD030A  Cabinet, W/H, 1 Shelf, 2 DO, 25-3/16 H X 30 W X 13 D
CD040    Cabinet, Wall Hung with two adjustable shelves and two hinged doors. 30 inches high without sloped top by 36 inches wide by 13 inches deep. Sloped top where indicated on drawing.

CD040A   Cabinet, W/H, 1 Shelf, 2 DO, 25 H X 36 W X 13 D

CE030    Cabinet, Wall Hung with two hinged glazed doors, two adjustable shelves and a single pane in each door. 30 inches high without sloped top by 30 inches wide by 13 inches deep. Sloped top where indicated on drawing.

CE040    Cabinet, Wall Hung with two hinged glazed doors, two adjustable shelves and a single pane in each door. 30 inches high without sloped top by 36 inches wide by 13 inches deep. Sloped top where indicated on drawing.

CW030   Cabinet, Floor Standing, 5 SH, 2 GDO, ST, 92x30x13

CW100   Cabinet, Floor Standing, 5 shelves, 2 glass hinged doors, 84 inches high without sloped top by 48 inches wide by 16 inches deep. Sloped top where indicated on drawing.

CT020   Countertop, Solid Surface

CT020A  Countertop, Solid Surface

CT050   Countertop, Stainless Steel

2.2.1 Medical and Dental Casework

Provide medical casework of baked enamel carbon steel, corrosion resisting steel and wood core covered with laminated plastic sheets. Color of finish in accordance with color schedule as indicated. Locations are indicated on the drawings.

2.2.1.1 Recycled Content

Baked enamel carbon steel must contain a minimum of 40 percent recycled content, as calculated by the sum of the percentage of pre-consumer and 1/2 the percentage of post-industrial recycled steel content. Provide data identifying percentage of recycled content for baked enamel carbon steel medical casework. Wood core must contain a minimum of 50 percent recycled content, as calculated by the sum of the percentage of pre-consumer and 1/2 the percentage of post-industrial recycled wood content. Provide data identifying percentage of recycled content for wood core medical casework.

2.2.1.2 Sustainably Harvested Wood

Wood materials must contain a minimum of 50 percent wood that is certified sustainably harvested. Provide documentation that certified sustainably harvested wood for medical casework is used and identify percentage.

2.2.2 Wood Cabinet Body Substrate/Door and Drawer Substrate Locations as indicated on Drawings.

    a. Particleboard
All particleboard shall be industrial grade M3, 19 mm 3/4 inch thick. Particleboard shall meet the minimum standards listed in ASTM D1037 and CPA A208.1. No urea added formaldehyde.

b. Door and Door Fronts to be HPDL, High Pressure Decorative Laminate

All plastic laminates shall meet the requirements of ANSI/NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on the drawings. Submit two samples of each plastic laminate pattern and color. Samples shall be a minimum of 120 by 170 mm 5 by 7 inches in size. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

Horizontal General Purpose Standard (HGS) Grade
Horizontal general purpose standard grade plastic laminate shall be 1.22 mm (plus or minus 0.127 mm) in thickness. This laminate grade is intended for horizontal surfaces.

Vertical General Purpose Standard (VGS) Grade
Vertical general purpose standard grade plastic laminate shall be 0.71 mm (plus or minus 0.012 mm) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components.

c. Countertops

Solid Polymer, ½ inch thick, colors and patterns as indicated on drawings.

d. Thermally Fused Melamine

Thermally Fused Melamine (melamine panels) shall be used for unexposed and concealed ends

e. Edge Banding

Edge banding for casework doors and drawer fronts shall be shall be 3 mm 0.125 inch PVC edge banding. Color and pattern shall match exposed door and drawer front laminate pattern and color. PVC to be color through.

f. Glass for Glazed Doors

Tempered, 3mm thick for unframed doors and 5mm thick for framed doors.

g. Cabinet Hardware

All hardware shall conform to ANSI/BHMA A156.9, unless otherwise noted, and shall consist of the following components:

Door Hinges
Full overlay, concealed, 170 degree opening incorporating a self-closing feature. Mounting plate shall provide three-way adjustment in door alignment.

Door Hinges - Lab
Institutional grade, three knuckle steel hinge with 270 degree opening, zinc finished and complete with cover cap.

Cabinet Pulls
4 inch wire pull, stainless steel

Drawer Slide for Drawers
Full extension, ball bearing, zinc, 150 lb

Door Catches
Magnetic catch

Adjustable Shelf Support System
Angled steel pin

Locks
5 pin tumbler cam lock with offset cam and non-removable core. Exposed face chrome plated. Keyed alike per room.

Grommets
Grommets shall be metal material in manufacturer's standard size. Locations shall be as indicated on the drawings.

h. Fabrication

Cabinet style as indicated on the drawings.

Base and Wall Cabinet Case Body
Full stretcher frame. Intermediate rail between drawers and between drawers over doors

Base Cabinet Backs
Semi-exposed and unexposed to be ¼" white hardboard. Exposed cabinet backs to be ½" thick with laminate to match front laminate.

Wall and Tall Cabinet Backs
Semi-exposed 1/2 inch thermally fused melamine.

Drawer Bottoms
Fully dovetailed, 9 ply Baltic Birch with 1/4 inch white thermally fused melamine on MDF core bottom.

Shelves
Full depth.

2.2.3 Metal Cabinet Body Substrate/Door and Drawer Substate-Locations as indicated on the drawings.

a. Galvanized Sheet Steel

Commercial quality galvanized sheet steel to ASTM 653, Z275 designation. Required for all cabinets for extra corrosion resistance.

b. Stainless Steel

ASTM A240, type 304 alloy with AISI No. 4 brushed finish

Materials and Thickness
11 gauge leveling bolt gusset plates.
14 gauge drawer slides and side suspension channels
16 gauge rails, legs, gusset plates, cabinet top and horizontal rails
18 gauge for door and drawer fronts, cabinet floor, cabinet sides, vertical front members, cabinet toe kick, service cover panels, table and kneehole frames, front rails, gable legs and dust caps, false panels, furring and filler panels
20 gauge for drawer backs, door backs, vertical closure channel, removable back panels, shelves, drawer bodies and drawer divider

c. Glass for Glazed Doors
Tempered, 3mm thick.

d. Countertops
Solid Polymer, ½" thick, colors and patterns as indicated on drawings.

Stainless Steel
18 gauge 304 stainless steel with number 4 brushed finish.

e. Cabinet Hardware

Door Hinges
Five knuckle-type barrel door hinges of 14 gauge stainless steel

Cabinet Pulls
4 inch wire pull, stainless steel

Drawer Slide for Drawers
Full extension, ball bearing, 100 lb capacity

Door Catches
Adjustable type, spring actuated nylon roller friction catches

Adjustable Shelf Support System
Die formed steel, zinc plated to engage in shelf adjustment holes.

Locks
Removable core, 5 disc tumbler

Grommets
Grommets shall be metal material in manufacturer's standard size. Locations shall be as indicated on the drawings.

f. Fabrication

Base Cabinet
Removable back panels.

Shelving edges shall be turned down on all four sides 1 inch, and returned under on front and back 1 inch. Shelves 36 inches and longer shall have channel reinforcement at front edge.

Doors and drawers shall be ¾ inch thick with sound deadening material extending continuously full-width, and top to bottom. Doors, drawers, tracks and back panels shall be field replaceable.
Drawer shall be one-piece construction including bottom, two sides, back and inner front flange end welded to the drawer front.

2.2.4 Countertops

Provide countertops as indicated. In lieu of individual samples, complete minimum size casework may be submitted as samples. Mock-up units are not acceptable. Samples shall be of sufficient size to show color, pattern, and method of assembly. Some requirements are:

<table>
<thead>
<tr>
<th>Countertop and backsplash</th>
<th>One section, containing both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door and drawer front</td>
<td>One of each, with hardware mounted</td>
</tr>
<tr>
<td>Laminate plastic color samples</td>
<td>approx 2 X 3 inch size</td>
</tr>
</tbody>
</table>

2.3 Stainless Steel Casework

2.3.1 JSN Numbers

Conform to JSN number configurations indicated in paragraph entitled "CASEWORK", except that all components, including cabinet hardware, shall be stainless steel.

2.3.2 Stainless Steel Sheet

Conforming to ASTM A 240, Type 304, stretcher-leveled standard of flatness.

2.3.3 Nominal Stainless-Steel Thicknesses for Stainless Steel Medical Casework

a. Sides, Ends, Fixed Backs, Bottoms, Cabinet Tops, Soffits, and Items Not Otherwise Indicated. Bottoms may be 0.038 inch if reinforced.

b. Back Panels, Doors, Drawer Fronts and Bodies, and Shelves: 0.038 inch except 0.050 inch for unreinforced shelves more than 36 inches.

c. Intermediate Horizontal Rails, Center Posts, Tubular Legs, and Top Gussets: 0.062 inch.

d. Drawer Runners and Hinge Reinforcements: 0.078 inch.

e. Leveling and Corner Gussets: 0.109 inch.

2.3.4 Stainless Steel Cabinet Fabrication

a. General: Assemble and finish units at point of manufacture. Use precision dies for interchangeability of like-size drawers, doors, and similar parts. Perform assembly on precision jigs to provide units that are square. Reinforce units with angles, gussets, and channels. Integrally frame and weld to form a dirt and
vermin-resistant enclosure. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch

b. Metal Flush Doors: Outer and inner pans that nest into box formation, with full-height channel reinforcements at center of door. Fill doors with noncombustible, sound-deadening material.

c. Hinged Doors: Mortise for hinges and reinforce with angles welded inside inner pans or hollow metal stiles at hinge edge.

d. Metal Drawers: Fronts made from outer and inner pans that nest into box formation, with no raw metal edges at top. Sides, back, and bottom fabricated in one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal.

e. Metal Shelves: Front, back, and ends formed down, with edges returned horizontally at front and back to form reinforcing channels. Provide clips, brackets, pilasters or other means to support shelves from cabinet ends and allow height of shelves to be adjusted in increments of not more than 2 inches

f. Toe Space: Provide metal toe space, fully enclosed, 4 inches high by 3 inches deep, with no open gaps or pockets.

2.3.5 Stainless Steel Countertops

a. Provide units with smooth surfaces in uniform plane free of defects. Ease exposed edges and corners. Provide front and end overhang of 1 inch over base cabinets.

b. Reinforce underside of countertop with channels or use thicker metal sheet where necessary to insure rigidity without deflection.

c. Form backsplash coved to and integral with top surface.

d. Provide rolled edge. Weld shop-made joints.

e. Provide raised (marine) edge around perimeter of countertops containing sinks; pitch two ways to sink to provide drainage without channeling or grooving.

f. Reinforce underside of countertop with channels or use thicker metal sheet where necessary to insure rigidity without deflection.

g. Weld shop-made joints.

h. Fabricate units for field assembly, where necessary, using tight-fitting butt-joints mechanically bolted through continuous channels welded to underside at edges of joined ends. Grind and polish surfaces to produce uniform, directional satin finish
matching No. 4 finish with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

2.3.6 Hardware

Provide healthcare manufacturer's standard, commercial quality, heavy duty stainless steel hardware.

2.3.7 Finish

a. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece.

b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

2.4 PLUMBING FIXTURES

Provide faucet, trap and drain fittings, gas, air and vacuum cocks as required. Provide connection conforming to the requirements specified in Section 22 00 70 PLUMBING, HEALTHCARE FACILITIES.

PART 3 EXECUTION

3.1 INSTALLATION

Install casework in a manner that does not damage the work of other trades. Secure the casework in place in true alignment, level, and plumb. Secure units with screws through backs to cleats that have been anchored to building structure with toggle or expansion bolts.

Do not install building construction materials that show visual evidence of biological growth.

3.1.1 Wall Hung Cabinets

Install wall-hung cabinets to support the weight of the cabinets plus the normally expected weight of the contents of the cabinets. Space fasteners 12 inch on center using at least three bolts in each 3 or 4 foot unit width. Join adjacent cabinets in an assembly together at top and bottom with inconspicuous bolts or clips. Seal joints between the casework and wall surfaces which are not larger than the joints between casework sections with sealant conforming to ASTM C920, Type M, Grade NS, Class 25, Use NT. Close larger joints with filler strips of the same material and finish as adjacent casework. Cut filler strips to the contour of the wall surface and secure to the casework with concealed nails or screws. Use filler strips no wider than 6 inch.

3.1.2 Floor Mounted Cabinets

Set floor-mounted metal cabinets on a common metal base or integral base, in assemblies up to 6 feet in length in rooms having concrete or resilient flooring. Bolt cabinets to bases at cabinet corners. Face metal bases with resilient material to match wall base in space where the cabinets are located. Fasten together adjoining cabinets at top and bottom of front and back with bolts placed inconspicuously inside cabinets. Set metal
cabinets in rooms having terrazzo or ceramic-tile floors on concrete or masonry bases with exposed faces finished the same as other bases in the room. Seal flush openings between cabinet and wall surfaces, due to irregularity of surfaces, with Type S or M, Grade NS, Class 12.5, use NT, conforming to ASTM C920. Close exposed-to-view openings larger than joints in tile work with filler or scribing strip of the same material and finish as adjacent casework. Cut filler to contour of wall surface and secure to casework with concealed sheet-metal screws. Use minimum width and number of fillers consistent with need and in no case shall filler exceed 6 inch in width.

3.1.3 Countertops

Height of counter tops as indicated. Where required, toe space at front of cabinets shall be provided by installing front face of cabinets 3 inch in front of face of base. Where toe space is not required, face of base and cabinets shall be flush. Bases must have a height of approximately 4 inch. Install all items as required for proper operation in accordance with the manufacturer's directions.

3.2 INSPECTION AND CLEANING

Inspect placed items for proper location, fastening, connection to utilities, operation, and for damage which may have occurred during installation. Put each item into service to prove proper operation. Correct defects disclosed during inspection. Clean cabinets and countertops in accordance with manufacturer's instructions.

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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. GREEN BUILDING COUNCIL (USGBC)


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

Vanities; G

Show configuration, materials, thicknesses, hardware, finishes, and colors of vanities for the project.

SD-03 Product Data

Low-Emitting Adhesives and Sealants (LEED Credit IEQ 4.1); G

Manufacturers' product data for sealants, sealant primers, and adhesives used on the interior of the building (defined as inside of the weatherproofing system and applied on-site), including printed statement of VOC content in gram per liter and material safety data sheets. Submit in format provided in Section 01 33 29 SUSTAINABILITY REPORTING.

SD-11 Closeout

All approved LEED Submittals specified under SD-03 Product Data; S

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver vanities undamaged and store in a safe, dry, and clean location. Handle so as to prevent damage.

1.4 SUSTAINABLE DESIGN REQUIREMENTS

See Section 01 33 29 SUSTAINABILITY REPORTING for additional sustainable
design and LEED requirements and definitions.

PART 2 PRODUCTS

2.1 LOW-EMITTING ADHESIVES AND SEALANTS

For field applications that are used on the interior of the building, adhesives and sealants shall comply with the VOC content limits specified in Section 01 33 29 SUSTAINABILITY REPORTING.

2.2 VANITIES L-2 and L-3

Provide, single lavatory type and double lavatory type. Size shall be as indicated on Drawings, and except as specified herein.

2.3 FINISHES

2.3.1 Bowl

Rimless single piece molded design of quartz surface made from a blend of resin, natural quartz, granite and other minerals. ABA compliant. Color as indicated on Drawings. Refer to Section 22 00 70, PLUMBING HEALTHCARE FACILITIES, for faucet information.

2.3.2 Access Panel

Water supplies, waste assembly are concealed within the frame. 300 series stainless steel. Refer to Section 22 00 70, PLUMBING HEALTHCARE FACILITIES, for plumbing connections.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Final Assembly

Distribute vanities to rooms as indicated. Uncrate, assemble, adjust as necessary, and place as specified or indicated, complete with accessories and hardware. Position vanities as indicated.

3.1.2 Fastening

Fasten vanities as recommended by vanity manufacturer. Fasteners shall be appropriate for use with the wall construction.

3.2 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- 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 D2047 (2011) Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine


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

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

SD-02 Shop Drawings

Installation Drawings; G
Detail Drawings; G

SD-03 Product Data

Entrance Floor Mats and Frames; G
Adhesives and Concrete Primers; G

SD-04 Samples

Entrance Floor Mats and Frames; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions; G

SD-10 Operation and Maintenance Data
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 and frames are slip resistant in accordance with ASTM D2047, Coefficient of Friction, minimum 0.60 for accessible routes and be structurally capable of withstanding a Uniform floor load of 300 lbf/sq. ft.. Ensure flammability is in accordance with ASTM E648, Class 1, Critical Radiant Flux, minimum 0.45 watts/m2.

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 Entrance Floor Mats and Frames

Submit manufacturer's catalog data. Submit sample of assembled sections of floor mat showing corners, intersections, and other details of construction. Submit samples of exposed floor mat, frame finish and accessories, and custom graphics.

2.1.1 Mechanically Fabricated Aluminum Floor Tile Assembly, WM-1 and WM-2

Mechanically fabricated from aluminum plate with a 1/4 inch thickness. Slots provide free area for fall of dirt and debris. WM-1 carpet inserts in pattern as indicated on Drawings. WM-2 slip resistant rubber tile inserts in pattern as indicated on Drawings. Clear anodized finish. Frameless installation. 1000lb per wheel rolling load.

2.2 ADHESIVES AND CONCRETE PRIMERS

Provide adhesives and concrete primers, where required, according to manufacturer's recommendations.

2.3 COLOR AND SIZE

Ensure color is in accordance with the drawings. Module size maximum 34 inch x 119 inch.

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 and frames 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.

Submit detail drawings, and custom graphics drawings as required. Provide installation drawings. Provide manufacturer's protection, maintenance, and repair information.

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   REFERENCES

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

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4  (1995; R 2004) Basic Hardboard

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A208.1  (1999) Particleboard

ANSI A208.2  (2002) Medium Density Fiberboard (MDF) For Interior Applications

ASTM INTERNATIONAL (ASTM)

ASTM A 1008  (2004b) Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

ASTM A 240  (2004ae1) Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications


ASTM A 36  (1992) Structural Steel

ASTM A 500  (2003a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 53  (1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 666  (2010) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar


1.2 SYSTEM DESCRIPTION

1.2.1 Modular Laboratory Furniture

Detailed description and configuration of each component per scheduled JSN item attached to this Section.

<table>
<thead>
<tr>
<th>JSN</th>
<th>Nomenclature</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. EO579A</td>
<td>Workstation, Chemistry Lab, Small</td>
</tr>
<tr>
<td>b. EO581A</td>
<td>Workstation, Hematology Lab, Small</td>
</tr>
<tr>
<td>c. EO581B</td>
<td>Workstation, Hematology Lab, Small</td>
</tr>
<tr>
<td>d. EO581C</td>
<td>Workstation, Hematology Lab, Small</td>
</tr>
<tr>
<td>e. EO581D</td>
<td>Workstation, Hematology Lab, Small</td>
</tr>
<tr>
<td>f. EO582A</td>
<td>Workstation, Shipping/Receiving Lab, Small</td>
</tr>
<tr>
<td>g. EO583B</td>
<td>Workstation, Microbiology Lab, Small</td>
</tr>
<tr>
<td>h. EO583C</td>
<td>Workstation, Microbiology Lab, Small</td>
</tr>
<tr>
<td>i. EO584A</td>
<td>Workstation, Blood Bank/Serology Lab, Small</td>
</tr>
<tr>
<td>j. EO585</td>
<td>Workstation, Cytology Lab, Small</td>
</tr>
<tr>
<td>k. EO589A</td>
<td>Workstation, Chemistry Lab, Medium</td>
</tr>
<tr>
<td>l. EO589B</td>
<td>Workstation, Chemistry Lab, Medium</td>
</tr>
<tr>
<td>m. EO591B</td>
<td>Workstation, Hematology Lab, Medium</td>
</tr>
<tr>
<td>n. EO593A</td>
<td>Workstation, Histopathology Lab, Medium</td>
</tr>
<tr>
<td>o. EO593B</td>
<td>Workstation, Histopathology Lab, Medium</td>
</tr>
</tbody>
</table>
1.2.2 Design Criteria

This specification establishes the minimum requirements for the acquisition and installation of a complete modular laboratory furniture system.

a. The system shall respect this intent in addition to providing maximum product integration and flexibility to accommodate changing medical technology.

b. The system shall permit maximum internal flexibility which will facilitate cost efficient reconfiguration of space and traffic patterns.

c. System shall be space efficient by making maximum use of vertical space and by providing a highly organized and versatile method(s) of storing and transporting materials.

1.3 RELATED WORK

Coordinate with the work of this Section with the work of Divisions 22 and 26 for installation of service fittings, connection of service utilities, and incidental items required for a complete modular laboratory furniture system, including but not limited to, wiring, receptacles, plumbing fixtures and related materials required, but not specified herein.

1.4 SAFETY

1.4.1 Fire Safety

Components shall meet requirements for flame spread and smoke development as specified by NFPA 101 except as follows. Testing shall have been conducted in accordance with either ASTM E 84, UL 723, or NFPA 255 on the entire assembled panel and each different combination of fabric and interior construction. In addition, fabric shall meet the requirements of NFPA 265. Panel flame spread shall not exceed 25 for Class A and panel smoke development shall not exceed 450 for Class A, B and C.

1.4.2 General Safety

Modular laboratory furniture system shall be free of rough or sharp edges.

1.4.3 Electrical System

Task lights shall be UL approved and shall meet the requirements of NFPA 70. The electrical system shall meet the requirements of UL 1286.
1.5 QUALITY CONTROL

1.5.1 Manufacturer Qualifications

Manufacturer shall have minimum five years' continuous experience in manufacturing of system components and accessories.

Manufacturer furnish proof of successful completion of at least three projects of similar scope within the indicated time; furnish names of projects, scope, and name and telephone number of individual at facility to contact.

Furnish proof of financial and technical resources to assure prompt performance in production and delivery.

Furnish proof manufacturer produces products specifically designed for functional disciplines of pharmacy, laboratory, ICU, surgery, materials handling, paper and data processing, emergency, receiving, nurses station, recovery, and administration.

1.5.2 Installer Qualifications

Installer shall have minimum three years' experience on projects similar in scope and shall be certified, or otherwise trained / approved, by the manufacturer to install specified modular laboratory furniture system.

Provide list of at least three previous projects, within the indicated time; furnish names of projects, scope, and name and telephone number of individual at facility to contact.

Furnish proof of financial and technical resources to assure prompt performance in delivery and installation and in-service training of personnel.

1.6 SUBMITTALS

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

SD-02 Shop Drawings

Installation Drawings; G

Provide complete installation drawings, including all dimensioning, details of construction, and accessory items. Indicate electrical, plumbing, mechanical, and telecommunication entry locations. Indicate wall reinforcement and anchorages.

Warranties; G

SD-03 Product Data

Modular Furniture Components; G

Provide catalog and model numbers for all components.

SD-04 Samples
Modular Furniture Components; G

Provide samples of all finishes and colors for compliance with finishes and colors indicated.

SD-07 Certificates

Modular Laboratory Furniture System; G

Two complete sets of certificates attesting that the proposed system meets specified requirements. The certificate shall be dated after the award of contract, shall name the project, and shall list specific requirements being certified.

Manufacturer Qualifications; G

Provide specified qualification data.

Installer Qualifications; G

Provide specified qualification data.

SD-10 Operation and Maintenance Data

Operating and maintenance data; G

Provide technical and operational instructions and user's manuals for all components. Minimum of two copies of manufacturer's complete catalogs and price lists. Location and phone number of nearest service organization.

SD-11 Closeout Submittals

Final Drawings; G

As built drawings of all spaces where the modular laboratory furniture system has been installed.

Warranties; G

1.7 DELIVERY, STORAGE AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked thereon. Remove modular furniture components from packaging and store in an unoccupied, dry location that is ventilated. Storage shall be free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

1.8 WARRANTY

All warranties run from date of final acceptance of the work by the Contracting Officer. Warranties shall be signed by the authorized representative of the manufacturer. System warranty shall also be signed by the authorized representative of the installer.

   a. Written warranty on entire system, signed jointly by installer and
the system manufacturer, for period of one year.

b. Written warranty on all system components from manufacturer for a period of 5 years.

c. Written warranty on items incorporated into system, but not manufactured by the system manufacturer, for a period of one year.

PART 2 PRODUCTS

2.1 MODULAR LABORATORY FURNITURE SYSTEM

2.1.1 Modular Furniture Components

All components shall be provided by one manufacturer. All components, except as indicated otherwise on drawings, shall be modular, on 6-inch increments starting at 24 inches, and shall be interchangeable to form a flexible system which will accommodate change.

a. If products of several manufacturers are used to satisfy this Section, then all items shall meet the specified flexibility and interchangeability requirements.

2.1.2 Hanging Components

All hanging components shall be modular on the same increments.

a. Provide units which are selectively removable and replaceable without disturbing adjacent components.

b. Modular drawers of various sizes.

2.2 MATERIALS

2.2.1 Metal Products

Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes. Finishes as specified.

a. Steel Tubing: ASTM A 500, cold-formed steel tubing.

b. Steel Pipe: ASTM A 53, standard weight (Schedule 40) unless otherwise indicated.

c. Steel Plates, Shapes, and Bars: ASTM A 36.

d. Stainless Steel Sheet, Strip, and Plate: ASTM A 240 or ASTM A 666, Type 304.

e. Stainless Steel Bars and Shapes: ASTM A 276, Type 304.

f. Cold-Rolled Steel: ASTM A 1008, commercial steel, Type B or structural steel, Grade 33 as required unfinished thickness.

g. Aluminum Plate and Sheet: ASTM B 209; Alloy 6061-T6, or as required.
h. Aluminum Extrusions: ASTM B 221; Alloy 6063-T6, or as required.

i. Aluminum Castings: ASTM B 26; Alloy 443.0-F, or as required.

2.2.2 Solid Surfacing

Cast, 100 percent acrylic polymer solid surfacing material.

2.2.3 Rigid Vinyl Extrusions

Manufacturer's standard.

2.2.4 Plastic Laminate

a. Chemical-Resistant Plastic Laminate: NEMA LD 3, Grade HGP.

Laminate shall have the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.9.5:

1. Nitric Acid (30 Percent): Moderate effect.
2. Sulfuric Acid (77 Percent): Moderate effect.
3. Hydrochloric Acid (37 Percent): Moderate effect.
4. Phosphoric Acid (75 Percent): No effect.
5. Acetic Acid (98 Percent): No effect.
6. Formaldehyde: No effect.
7. Ethyl Acetate: No effect.
8. Ethyl Ether: No effect.
10. Benzene: No effect.
11. Xylene: No effect.
12. Butyl Alcohol: No effect.
13. Furfural: No effect.
14. Methyl Ethyl Ketone: No effect.
17. Ammonium Hydroxide (28 Percent): No effect.
18. Zinc Chloride: No effect.
19. Gentian Violet: No effect.
20. Methyl Red: No effect.

b. Solid surfacing countertops at sink locations.

2.2.5 Wood Products

a. Hardboard: AHA A135.4; manufacturer's standard thickness.

b. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde; in manufacturer's standard thickness.

c. Particleboard: ANSI A208.1, Grade M-2; manufacturer's standard thickness.

2.2.6 PVC Edge Banding

PVC edge banding shall be 0.12 inch thick, matching color, pattern and finish of adjacent surfaces, unless otherwise indicated on the drawings.
2.3 FABRICATION

All colors and textures shall be as indicated on drawings, except as otherwise specified herein.

2.3.1 Electrical

a. Distribution system:

   (1) Furnish with J-boxes and empty conduit at top of panel.
   (2) Furnish with empty conduit and J-boxes for telephone and computer services.
   (3) Locate J-boxes for switches and wall plugs where indicated on drawings.
   (4) Entire system shall be UL listed.

b. Wire management:

   (1) Provide field wiring of low-voltage and data telecommunications cabling, accessible at nominal 15 inches above floor and at height indicated on drawings or as required.

2.3.2 Support Components

2.3.2.1 Horizontal Support Elements

a. Adapter Rail:

   (1) Shall provide horizontal interface capability to suspend horizontally hung components on vertical support elements.
   (2) Shall be available in a minimum of four nominal widths of 24 inches, 30 inches, 48 inches and 60 inches.
   (3) Shall adjust vertically in 1 inch or less increments.
   (4) Shall have a leveling mechanism to level hanging components.
   (5) Material shall be steel or extruded aluminum with manufacturer's standard coating.

b. Frame Support:

   (1) Shall be available in a minimum of four modular widths from 30 inches to 96 inches. Please refer to the equipment drawings for specific finishes and sizes.
   (2) Shall provide horizontal interface capability to suspend under the work surface storage units.
   (3) Material shall be steel or extruded aluminum with manufacturer's standard coating.

c. Electrical Wiring Chases:

   (1) Manufacturer's standard modular, surface-mounted aluminum raceway system shall be used to provide power and/or low-voltage services. The raceway shall be provided and installed under this Section.
   (2) The double channel wire chase shall be a rectangular section 1-3/4 inch deep x 5-1/4 inches high while the single channel wire chase section shall be a rectangular section 1-3/4 inches deep x 2-5/8 inches high; fabricated out of 0.080 inch aluminum. The wire chase channels shall be attached with hanger clips of minimum 13 gauge cold rolled steel. The wire chase channels shall be
available in modular widths, from 24 to 96 inches long. The wire chase channels shall attach to supporting structures without defacing the structures and shall be adjustable up or down on 1-inch increments. The aluminum raceway system shall be UL listed as a Multioutlet Assembly and Surface Metal Raceway conforming to the National Electrical Code Article 380.

(3) The double channel wire chase shall be subdivided into two equal but separate wiring compartments to facilitate the installation of both power and low-voltage wiring and provide a 2 inch bend radius for Fiber Optic/UTP installations. The single channel Wirechase shall facilitate the installation of both power and low-voltage wiring and provide a 2 inch bend radius for Fiber Optic/UTP installations. Each channel shall accept industry standard devices to provide a seamless interface for voice, data, audio, and video applications at the point of use.

(4) The wire capacity of each double/single channel wire chase shall be 15 type TW or type THW #12 AWG wires with devices or 7, 25-pair low voltage cables. Each double/single channel wire chase shall accommodate site specific requirements from internal and external elbows to flat tees.

(5) Wire chase covers shall be fabricated of 0.080 inch aluminum in 12 inch increments providing easy access to wiring and maximum flexibility for adding or relocating outlets and circuits. Covers shall accommodate single outlets, duplex outlets, NEMA-Locking outlets, GFCI outlets, and surge protected outlets.

2.3.2.2 Vertical Support Elements

a. Wall Strips:

(1) Wall strips shall be fabricated of extruded aluminum with manufacturer’s standard frame inserts. Wall strips shall provide for modular laboratory furniture system's components to be suspended from architectural walls where functional or operational procedures, medical equipment, technological changes, or staff requirements may require 1 inch vertical height adjustments.

(2) Wall strips shall be able to accept adapter rails to convert vertical support to horizontal support, and dispensing rails to provide for material dispensing stations.

(3) Wall strips shall be capable of supporting at least 600 pounds of supplies in addition to the empty weight of the work surfaces, storage cabinets, and shelves and light fixtures.

(4) Wall strips shall be available in lengths from 5 feet to 7 feet as required.

2.3.3 Laboratory Module Assembly

2.3.3.1 Pass-through Module

a. General Performance Requirements:

(1) Pass-through modules shall be used to form laboratory work area configurations that are easily rearranged to meet changing functional needs.

(2) An interior shelf and work surface shall be aligned to provide a continuous surface area at any height.

(3) The shelf assembly shall be installed in at least three heights ranging from 29 inches to 48 inches.

(4) Modules shall support modular storage components and work
surfaces, enclose plumbing and electrical lines, and fixtures.
(5) An interior shelf and top shelf shall be available. The tops
and sides of the shelves shall have chemical resistant plastic
laminate on all exposed surfaces.

b. Description:

(1) Shall be available in nominal heights of 48 and 80 inches and
in widths of 2 feet, 2 feet 6 inches, and 4 feet as required.
(2) Shall be constructed of a minimum of 16 gauge, cold rolled
steel tube and shall have minimum four 1-3/4 inch adjustable
glides in the corners.
(3) Shall be shipped completely finished from the manufacturer,
pre-assembled, ready for installation.
(4) The pre-assembled unit shall consist of steel hanger frames
with slots at 1 inch or less intervals for suspension of hanging
components, and a minimum of four adjustable floor glides.
(5) All components of the pass-through modules shall be coated
with manufacturer's standard corrosion and stain resistant finish.

2.3.3.2 Support Panels

a. General Performance Requirements:

(1) Panels shall be used to form laboratory work area
configurations that are easily rearranged to meet changing
functional needs.
(2) Shall have pre-assembled steel hangers with slots at a
maximum of 1 inch intervals for suspension of work surfaces, shelf
storage, adapter rails, frame supports and dispensing rails.
Panel types to support a maximum weight of 1,150 pounds per panel,
per side.
(3) Shall have adjustable floor glides and the capability of
easily relocating an entire run of dividers by sliding over the
floor without disassembly of dividers and suspended modular
counters and shelf storage units.
(4) Shall be of sufficient width to permit one person to easily
carry, skid, transport or relocate with minimum risk of bodily
strain or harm.
(5) Shall be capable of being installed on top of finished
flooring without the penetration of the finished floor or the use
of floor fasteners; shall have complete flexibility for future
changes without having to patch floor material.

b. Description:

(1) Panels shall be available in nominal heights of 48 inches and
80 inches and in widths of 2 feet, 2 feet 6 inches, and 4 feet.
(2) Panels shall be constructed of a minimum of 16 gauge, cold
rolled steel tube, and shall have at least two 1-3/4 inch
adjustable floor glides in the corners.
(3) Panels shall be shipped completely finished from the
manufacturer, pre-assembled, ready for installation.
(4) The pre-assembled unit shall consist of steel hanger frames
with slots at 1 inch intervals for suspension of hanging
components, and two adjustable floor glides.
(5) Panels shall be coated with manufacturer's standard corrosion
and stain resistant finish.
(6) Power entry support panels shall allow the routing of both
electrical and telecommunications wires to the worksurface level from either the floor or the ceiling.

2.3.3.3 Access Panels

a. General Performance Requirements:

(1) Access panels shall close off the interior chase of the module, and shall be available in manufacturer's standard sizes to allow maximum accommodation of laboratory needs. Access panels shall be capable of easy removal to permit access to utility systems enclosed within the chase.

(2) Access panels shall be made of a minimum of 20 gauge cold rolled steel, with steel upper and lower clips for attaching to modules. Access panels shall have manufacturer's standard corrosion and stain resistant finish.

2.3.3.4 Storage Units

a. General Performance Requirements:

(1) Storage units shall attach to and be interchangeable with the basic module and support panels.

(2) Exposed edges shall be finished with PVC edge banding.

b. Undercounter Storage Units:

(1) Units shall have a minimum of four cubic feet of storage and a load capacity of approximately 200 pounds.

(2) Units shall have space for drawers and an interior adjustable shelf.

c. Overhead Storage Units

(1) Units shall be mounted above the work surface.

(2) Units shall be in nominal sizes and material as indicated on drawings.

d. Specialty Storage Units

(1) Units shall be mounted below the work surface.

(3) Units shall be nominal sizes and materials as indicated on drawings.

(4) Units shall support a maximum load capacity of 200 pounds.

(5) Units shall be manufacturer's standard high temperature-cleanable molded plastic.

e. Sink Storage Unit

(1) The unit shall be free cantilevered.

(2) The unit shall be in nominal widths of 24 inches, 30 inches, 40 inches and 60 inches with nominal depths of 24 inches and 30 inches.

(3) The unit shall be solid surfacing with integral backsplash.

(4) Unit shall be ADA compliant.
2.3.4 Counter Surfaces

2.3.4.1 Heavy Duty Storage Work Surface

a. Shall be a cantilevered work surface with additional top loading capability as well as under-the-counter storage.
b. Shall include manufacturer's standard frame adapter to support under the work surface containers.
c. Shall be in nominal sizes of 24 inches and 30 inches deep, and 24 inches through 96 inches wide, made of plywood or particleboard with chemical-resistant plastic laminate finish.

2.3.5 Miscellaneous Modular Components

2.3.5.1 Lighting

a. General Performance Requirements

(1) UL listed unit shall have task lighting manufacturer's standard.
(2) Unit shall have cord outlet that can be utilized on either right or left side.
(3) Unit shall be relocatable with the use of tools as needed.
(4) Unit shall have light switch at manufacturer's standard location(s).

b. Types Required

(1) Task lighting shall mount on the underside of shelving and shall be available in widths from 24 inches to 60 inches, provided with manufacturer's standard acrylic diffusing lens.

PART 3 EXECUTION

3.1 INSTALLATION

The modular laboratory furniture shall be installed by certified installers in accordance with manufacturer's printed installation instructions and installation drawings. Components shall be installed level, plumb, square, and with proper alignment with adjoining furniture. The components shall be securely interconnected. Three sets of special tools, as applicable, and equipment necessary for the relocation of panels and other components shall be furnished. Verify that equipment is properly installed, connected, and adjusted.

3.2 CLEANING

Upon completion of installation, all products shall be cleaned and polished and the area shall be left in a clean and neat condition. Any defects in material and installation shall be repaired, and damaged products that cannot be satisfactorily repaired shall be replaced. The Contractor shall submit Operating and Maintenance Data and Final Drawings as specified.
3.3 WASTE MANAGEMENT

Separate corrugated cardboard and packing materials in accordance with the Waste Management Plan and reuse or recycle.

-- End of Section --
PART 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)


AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.3 (2013) Operations - Safety Requirements for Powder Actuated Fastening Systems

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2010; Errata 2011) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

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


ASTM INTERNATIONAL (ASTM)


1.2 SUBMITTALS

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

SD-02 Shop Drawings

Bicycle Racks; G
Pipe Bollards; G
Decorative Removable Pipe Bollards; G
Assembly Instruction Drawings

SD-03 Product Data

Bicycle Racks
Pipe Bollards
Decorative Removable Pipe Bollards, including all components and accessories; G

SD-04 Samples

Finish; G

SD-06 Test Reports
Testing

SD-07 Certificates

Primer Certificate
Powder Coatings Certificate

1.3 QUALITY ASSURANCE

Qualify welders in accordance with AWS D1.1/D1.1M using procedures, materials, and equipment of the type required for the work.

1.3.1 Fabrication Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

1.3.2 Installation Drawings

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation.

1.3.3 Assembly Instruction Drawings

Submit assembly instruction drawings showing layout(s), connections, bolting and anchoring details in accordance with manufacturer's standards. Submit drawings showing scaled details of proposed site furnishings, elevations for each type of site furnishing; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction.

1.3.4 Primer Certificate

Submit a certificate from the manufacturer stating that the primer conforms to requirements of SSPC Paint 25.

1.3.5 Powder Coatings Certificate

Submit a certificate from the manufacturer stating that the powder coat conforms to ASTM D3451.

1.4 DELIVERY, STORAGE, AND HANDLING

Ship items knocked-down (KD) ready for site assembly. Packaged components shall be complete including all accessories and hardware. Materials shall be delivered, handled, and stored in accordance with the manufacturer's recommendations. Site furnishings shall be inspected upon arrival at the job site for conformity to specifications and quality in accordance with paragraph MATERIALS. Protect from corrosion, staining, and other types of damage. Store items in designated area free from contact with soil and weather. Remove and replace damaged items with new items.
PART 2   PRODUCTS

2.1   MATERIALS

Provide materials which are the standard products of a manufacturer regularly engaged in the manufacture of such products. The materials provided shall be of a type with proven satisfactory usage for at least 2 years.

2.1.1   Metals

Metallic materials and products shall conform to Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS. Furnish metal components with factory drilled holes and free of excess weld and spatter. Metal components with holes that will not be filled by hardware or hidden by other components will be rejected. Structural steel products shall conform to ASTM A36/A36M, ASTM A500/A500M and ASTM A501/A501M.

2.1.2   Structural Tubing

ASTM A500/A500M

2.1.3   Steel Pipe and Fittings

Steel pipe shall conform to ASTM A53/A53M, Type E or S, Grade B; standard malleable iron fittings shall conform to ASTM A47/A47M.

2.1.4   Anchors and Hardware

Provide anchors, where necessary, for fastening site furnishings securely in place and in accordance with approved manufacturer's instructions. Anchoring devices that may be used, when no anchors are otherwise specified or indicated, include anchor bolts, slotted inserts, expansion shields for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; and lag bolts and screws for wood. Anchor bolts shall conform to ASTM A307. Hardware shall be stainless steel in accordance with ASTM A153/A153M and compatible with the material to which applied. All exposed hardware shall match in color and finish. Mounting hardware shall be concealed, recessed, and plugged.

2.1.4.1   Threaded Inserts and Expansion Anchors

Provide inserts as shown in details. Expansion shields shall conform to CID A-A-1925, group II, type 4, class 1. Provide embedment required by manufacturer.

2.1.4.2   Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose.

2.1.4.3   Toggle Bolts

ASME B18.2.1.

2.1.4.4   Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A307.
2.1.4.5 Power Driven Fasteners

Follow safety provisions of ASSE/SAFE A10.3.

2.1.4.6 Screws

ASME B18.2.1, ASME B18.6.2, and ASME B18.6.3.

2.1.4.7 Washers

Provide plain washers to conform to ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

2.1.5 Concrete

Cast-in-place concrete materials and products shall conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.2 COATINGS AND FINISHES

2.2.1 Finish

Finish shall be as specified by the manufacturer or as indicated. Exposed surfaces and edges shall be rounded, polished, or sanded. Finish shall be non-toxic, non-glare, and resistant to corrosion. Exposed surfaces shall be smooth and splinter-free exposed surfaces. Submit two sets of color data for each furnishing displaying manufacturer's color selections and finishes, and identifying those colors and finishes proposed for use.

2.3 SITE STANDARDS

Site furnishings shall be furnished with the dimensions and requirements indicated.

2.4 BICYCLE RACKS

Design bicycle racks in accordance with manufacturer's standards and to meet design conditions indicated. Locate as shown on the drawings. Provide finish as selected from manufacturer's standards. Racks shall accommodate locking devices and secure, as a minimum, one wheel and part of the frame simultaneously. The spacing between racks shall be a minimum of 24 inches.

2.4.1 Metal Bicycle Racks

Provide stainless steel bicycle racks as shown in details. Type of mounting, bicycle rack capacity and height above the ground as shown on the drawings.

2.5 PIPE BOLLARDS

Provide 8-inch diameter schedule 40 (extra strong) steel, Grade B pipe filled with concrete and painted safety yellow. Provide concrete footings as indicated.
2.5.1 Concrete

Cast-in-place concrete materials and products shall conform to Section 03 30 00 CAST-IN-PLACE CONCRETE

2.6 DECORATIVE REMOVABLE PIPE BOLLARDS

Provide minimum 5-inch diameter aluminum bollard with cylindrical and fluted body, tapered bottom and ball top, with minimum 10-inch diameter base, as indicated. Provide two retractable mounts per bollard to allow moving the bollards as indicated on the plan. Retractable mounts shall be steel, hot dip galvanized, installed in concrete with drainage as indicated. Bollards shall be provided with lock pin and padlock to secure the bollards in place. Retractable mounts shall be suitable for vehicular traffic when in the down position. Bollards shall be provided with Black textured semi gloss Polyester powder coat over epoxy primer.

2.6.1 Decorative Removable Bollard Material

Aluminum: ASTM B26

2.6.2 Concrete

Cast-in-place concrete materials and products shall conform to Section 03 30 00 CAST-IN-PLACE CONCRETE

PART 3 EXECUTION

3.1 INSTALLATION

Verify that finished grades and other operations affecting mounting surfaces have been completed prior to the installation of site furnishings. Site furnishings shall be installed plumb and true, at locations indicated, in accordance with the approved manufacturer's instructions.

3.1.1 Assembly and Erection of Components

New parts shall be acquired from the manufacturer; substitute parts will not be accepted unless approved by the manufacturer. When the inspection of parts has been completed, the site furnishings shall be assembled and anchored according to manufacturer's instructions or as indicated. When site furnishings are assembled at the site, assembly shall not interfere with other operations or pedestrian and vehicular circulation.

3.1.2 Anchorage, Fastenings, and Connections

Furnish metal work, mounting bolts or hardware in ample time for securing into concrete or masonry as the work progresses. Provide anchorage where necessary for fastening furniture or furnishings securely in place. Provide, for anchorage not otherwise specified or indicated, slotted inserts, expansion shields, and power-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish the fastenings to which they are applied. Conceal fastenings where practicable.
3.2 TESTING

Test each site furnishing to ascertain a secure and correct installation. A correct installation shall be according to the manufacturer's recommendations and by the following procedure: Measure the physical dimensions and clearance of each installed site furnishing for compliance with manufacturer's recommendations and as indicated. Site furnishings which do not comply shall be reinstalled. Fasteners and anchors determined to be non-compliant shall be replaced. Submit a written report describing the results of the testing and a report of post-installation test results.

3.3 BOLLARDS

Install as indicated on the plans and in accordance with the manufacturer's recommendations.

3.4 BICYCLE RACKS

Affix to base structure by flanges anchored to concrete or other existing masonry by expansion shields. Provide Series 300 stainless steel bolts to anchor flanges, of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or concrete, treat as per manufacturer's recommendations.

3.5 RESTORATION AND CLEAN UP

When the installation has been completed, clean up and protect the site. Existing areas that have been damaged from the installation operation shall be restored to original condition at Contractor's expense.

3.5.1 Clean Up

The site shall be cleaned of all materials associated with the installation. Site furnishing surfaces shall be cleaned of dirt, stains, filings, and other blemishes occurring from shipment and installation. Cleaning methods and agents shall be according to manufacturer's instructions or as indicated.

3.5.2 Protection

The area shall be protected as required or directed by providing barricades and signage.

3.5.3 Disposal of Materials

Excess and waste material and packaging shall be removed and disposed off Government property.

3.6 RE-INSTALLATION

Where re-installation is required, the following shall be accomplished:

a. Re-install the product as specified. Material acquisition of replacement parts is the responsibility of the Contractor. Provide replacement materials that are new and supplied by the original manufacturer to match.
b. Damage caused by the failed installation shall be repaired.

3.7 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 36/C 36M (2003e1) Gypsum Wallboard

NATIONAL COUNCIL ON RADIATION PROTECTION AND MEASUREMENTS (NCRP)


NCRP Rpt 49 (1976) Structural Shielding Design and Evaluation for Medical Use of X-Rays and Gamma Rays of Energies up to 10 MeV

NCRP Rpt 51 (1977) Radiation Protection Design Guidelines for 0.1-100 MeV Particle Accelerator Facilities

STEEL DOOR INSTITUTE (SDI)


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

29 CFR 1910.1025 Lead

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)


1.2   SYSTEM DESCRIPTION

X-ray shielding shall be constructed unimpaired by joints, openings for ducts, pipes, or other openings through shielding, or conduits, service boxes, and other items embedded in the shielding. The shielding shall appear to be continuous. Lead patches, lead sleeves, and/or mazes shall be installed as required to provide continuity of the shielding. Thicknesses indicated on drawings for shielding are minimum acceptable thickness.
1.3 SUBMITTALS

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

SD-02 Shop Drawings

Materials; G

Drawings indicating thickness of shielding materials at all locations; construction at floor, walls, ceiling, and columns; details of shielding materials laps and lap securing methods; fastenings, profiles, details of items and accessories penetrating the shielding materials; and any special method of construction.

SD-03 Product Data

Shielding Materials; G

Manufacturer's catalog cuts, descriptive data, and installation instructions.

SD-04 Samples

Leaded glass; G

8 x 10 inch sample of each specified panel.

SD-06 Test Reports

Testing and Certification

Copies of surveyor's reports.

SD-07 Certificates

Materials

Certification indicating the shielding materials supplied comply with specified quality and thicknesses.

1.4 QUALIFICATIONS

Work shall be performed by a company which specializes in the type of shielding work required by the Contract documents. Company shall have a minimum of 5 years of documented successful experience.

1.5 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered in the original containers bearing the name of the manufacturer and brand name. Shielding materials shall be stored off the ground under watertight cover. Handle materials preventing damage to edges, ends or surfaces in conformance with 29 CFR 1910.1025. Damaged materials shall be removed from the premises.
1.6 WARRANTY

Lead sheet shielding materials shall be warranted against sagging and curling for 10 years from date of final acceptance of the Work.

PART 2 PRODUCTS

2.1 SHIELDING MATERIALS

2.1.1 Lead Sheet

Lead sheet shall conform to ASTM B 749, Grade C, thickness as indicated on drawings.

2.1.2 Lead-Lined Gypsum Wallboard

Lead-lined gypsum wallboard shall be a single thickness of unpierced lead laminated to 5/8 inch thick gypsum board conforming to ASTM C 36/C 36M, Type III, Grade R, Class 1, Form a, Style 1.

2.1.3 Lead Glass

Leaded glass shall be clear X-ray protective quality glass in single or multiple thicknesses. Lead-barium, polished plate glass containing more than 60 percent heavy metal oxide, including 55 percent lead oxide by weight. Leaded glass shall have lead equivalence required for the shield wall, door, or partition in which the leaded glass is installed.

2.1.4 Lead-Lined Wood Doors

Lead-lined wood doors shall be premium grade, book matched hardwood veneer, solid core, in accordance with WDMA I.S. 1-A. Lead sheet shall extend to door edges and provide x-ray absorption equal to the partition in which the door is installed. Face veneer for lead-lined doors shall be maple finished with an approved natural finish. Doors shall have filler strips, crossbanding face veneers and hardwood edge strips glued under heavy pressure with contact adhesive.

2.1.4.1 Shielding

Cores shall be secured together with steel bolts, using washers under heads and nuts. Bolts shall be spaced not more than 1-1/2 inches from edges around door perimeter and not more than 8 inches on centers in both directions. Bolts shall be countersunk and have poured lead or lead dowels covering heads and nuts flush with face of core. Door thickness shall be manufacturer's standard for lead thickness used, unless shown otherwise.

2.1.4.2 Painting and Sealing Doors

Doors shall receive two shop coats of water-resistant sealer before shipment to jobsite. See Section 09 90 00 PAINTS AND COATINGS for finish painting; color as indicated on the drawings.

2.1.4.3 Door Hardware

Door hardware shall be as specified in Section 08 71 00 DOOR HARDWARE. Mortises for floor hinge arms and top pivots with sheet lead and necessary lead plugs, sheet lead, stainless steel pans, bolts and screws shall be
Thresholds

Thresholds are specified in Section 08 71 00 DOOR HARDWARE. Line thresholds with a single sheet of lead to provide required shielding.

Lead-Lined Window Frames

Lead-lined window frames for viewing windows mounted in lead-lined doors shall be constructed from extruded aluminum alloy with concealed lead lining, splayed on four sides for wide-angle viewing. Frames shall form a minimum overlap of 3/8 inch at the perimeter of the lead glass or twice the thickness of the shielding, whichever is greater. Thickness of lead shall be the same as the lead in the barrier in which they occur. Frames can be either solid or telescoping type. Lead stops shall be provided for glass installation.

Lead-Lined Steel Doors and Frames

Doors shall conform to Section 08 11 13 STEEL DOORS AND FRAMES, in accordance with SDI A250.8, Grade II, heavy duty, Model 1, minimum 18 gage faces with steel stiffeners throughout. Apply unpierced lead sheet, of thickness equal to that used in the adjoining wall, in the center of the doorknob between the two faces, continuously from top to bottom and edge to edge. Shield cutouts for locksets with sheet lead of the same thickness as used in the door; lap lead lining of locksets and the door lining. Prepare doors to receive viewing windows and louvers as indicated. Provide removable stops for glazed openings. Use Section 08 71 00 DOOR HARDWARE for protective hardware requirements. Line thresholds with a single sheet of lead to provide required shielding.

Frames

Steel frames shall be as specified in Section 08 11 13 STEEL DOORS AND FRAMES. The inside of frames shall be lined with a single thickness of sheet lead. The thickness of the lead lining shall be the same as the lead lining of the system in which the frames are used. Linings shall be installed at the factory, and shall be continuous. Lining shall be formed to contour of frame. Lead shields shall be formed around areas prepared to receive hardware. Each lining shall be wide enough to provide and maintain an effective lead lap with the lead of the adjoining shielding units.

DESIGNATING PLAQUES

Required Information

Designating plaques shall be furnished and installed as specified below in rooms and as indicated on the drawings. Locations where shielding thickness changes, or is not continuous, shall be indicated on the plaque. Plaque shall be of aluminum, plastic, bakelite, or other approved materials and shall be four inches high by ten inches long to contain the required information as specified below.

a. Rooms Where Level of Protection Is Uniform Throughout: Provide one sign for each room indicating lead equivalence of partitions,
ceilings, floors, doors, and other portions of radiation protection enclosure. Indicate height of radiation protection above floor.

b. Rooms Where the Level of Protection Is Not Uniform Throughout: Provide one sign for each room with different lead equivalences in different locations. Indicate, in tabular form, lead equivalence of each wall, partition, floor, ceiling, door, and window. Indicate height of radiation protection above floor or indicate that partitions are radiation protected to full height. Indicate where lead equivalence changes or is not continuous.

c. For Concrete Shielded Rooms: Provide one sign for each different wall thickness required, indicating the thickness of concrete and thickness of borated polyethylene-lined doors.

2.3 CONCRETE

Concrete shielding material shall be uniform density of 147 pcf. See Section 03 30 00 CAST-IN-PLACE CONCRETE.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of materials shall be performed in accordance with drawings and approved manufacturer's recommendations and NCRP Rpt 35 NCRP Rpt 49 NCRP Rpt 102 or NCRP Rpt 51.

3.1.1 Workmanship

Sheet lead shall be installed free of waves, lumps, and wrinkles and with a minimum of joints. Joints in sheet lead shall provide protection equivalent to the protection provided by the adjacent sheet lead. Joints shall be finished smooth and neat.

3.1.2 Protection

Lead shields shall be used to maintain continuity of protection where unshielded built-in items penetrate lead linings. Where outlet boxes, junction boxes, ducts, conduits, and similar items prevent the use of shields, lead sleeves or lead lining shall be used. Fasteners shall not disrupt the continuity of shielding.

3.2 LEAD-LINED GYPSUM WALLBOARD

Lead-lined gypsum wallboard shall be applied over supports specified in Section 09 22 00 METAL SUPPORT ASSEMBLIES. Method of predrilling or drilling pilot holes shall not cause deformation of the fastener and shall not cause distortion of wallboard. Wallboard shall be applied vertically, with long edges parallel to supports, and with lead linings placed next to supports. Blocking shall be provided at end joints.

3.2.1 Joints

Sheet-lead strips not less than the lead thickness used for wallboard and not less than 1-1/2 inches wide shall be installed on blocking and supports at all joints.
3.2.2 Corner Joints

Corner joints shall consist of 1-3/4 x 1-3/4 inch lead angle.

3.2.3 Wood Supports

The sheet-lead strips shall be secured to blocking and supports at outer edges with wire nails. Edges of wallboard shall then be butt-jointed and fastened to supports with lead-headed nails at approximately 8 inches on centers at joints and 12 inches on center at intermediate supports with nail heads driven slightly below the surface of wallboard.

3.2.4 Metal Supports

Edges of gypsum wallboard at metal studs shall be fastened with 1 inch long lead-headed screws.

3.3 Thresholds

Thresholds shall be installed in accordance with approved detail drawings. Prior to installation, lead threshold surfaces in contact with concrete shall be painted with a coat of asphalt paint or latex material.

3.4 Lead-Lined Doors

Doors shall be fit, hung, and trimmed as required. Doors shall be installed with a clearance of 1/16 inch at sides and top and minimum adequate clearance at bottom. Warp or twist of doors after doors have been hung and finished shall not exceed 1/4 inch in any face dimension of door including full diagonal.

3.5 Hardware

Bolts and screws which penetrate lead lining shall be recessed on the side of the door opposite hardware and shall be plugged with lead plugs to match face of door. Nuts for securing surface-applied hardware such as hinges, door closers and automatic door operators shall be countersunk and covered with lead-lined 16 gauge stainless steel pans. Stainless steel pans shall be secured with round-head screws with dull chromium-plated finish. Cutouts for lock sets and latch cases shall be patched with sheet lead. Lead lining of the lock set and lead lining of the door shall be lapped to provide x-ray absorption equal to the door.

3.6 View Windows

View windows shall be installed in doors with hardwood stops to match face veneer. Stops shall be glued to door on corridor side and shall be fastened with countersunk oval head screws or finishing nails.

3.7 Testing and Certification

Before and after x-ray equipment has been installed and placed in operating condition, the x-ray installation shall be surveyed by a qualified expert as defined in NCRP Rpt 49 NCRP Rpt 102 or NCRP Rpt 51. Survey shall be performed in accordance with NCRP Rpt 49 NCRP Rpt 102 or NCRP Rpt 51. Four copies of surveyor's report shall be furnished to the Contracting Officer. Any part of x-ray shielding work found to be defective shall be corrected or replaced, including all other work affected thereby.
3.8 PROTECTION

3.8.1 Limit Access

Lock radiation-protected rooms once doors and locks are installed and limit access to those persons performing work in the rooms.

3.8.2 Plaques

Install in location designated by the Contracting Officer in all rooms where lead lined partitions occur. Install plaques in designated locations, in all rooms where concrete is used for radiation protection.

   a. Unless otherwise indicated, secure each plaque to partition 5 feet above floor in such a manner as not to impair protective characteristics of partition.

3.9 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1   RELATED REQUIREMENTS

Requirements stipulated in document entitled "Interim Technical Guidance ITG 2013-01, NAVFAC Elevator Design Guide" (hereinafter referenced as "ITG 2013-01") apply to this Section. This document is available from the NAVFAC facilitator http://www.wbdg.org/ccb/browse under Interim Technical Guidance.

1.2   REFERENCES

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

**AMERICAN WELDING SOCIETY (AWS)**


**ASME INTERNATIONAL (ASME)**


ASME B16.11 (2011) Forged Fittings, Socket-Welding and Threaded


**ASTM INTERNATIONAL (ASTM)**


1.3 SYSTEM DESCRIPTION

Provide a pre-engineered elevator system, by manufacturer regularly engaged in the manufacture of elevator systems, that complies with ASME A17.1/CSA B44 and ASME A17.2 in their entirety, and additional requirements specified herein.

1.3.1 Miscellaneous Requirements

Submit one set of wiring diagrams, in plastic or glass cover, framed and mounted in elevator machine room for revised building electrical system, if needed, to make supplied elevator system function as specified. Deliver other sets to Contracting Officer. Coded diagrams are not acceptable unless adequately identified. Submit calculations for the Reaction Loads imposed on the building by and Heat Loads generated by the elevator system.

1.3.2 Provisions for Earthquake Protection

The facility shall comply with Seismic Design Criteria indicated on Structural drawings, and shall comply with all ASME A17.1/CSA B44, Part 8.4 requirements for short period spectral response acceleration (Ss) as indicated.

1.4 SUBMITTALS

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

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data
Passenger Elevators; G

Information on motor, pump, gages, cylinder/plunger assemblies, piping and valves, hall station, and buffer on elevators and accessories. For elevator supporting systems, include information on car control and emergency power systems. On data sheets, provide document identification number or bulletin number, published or copyrighted prior to the date of contract bid opening.

Elevator Microprocessor Controller; G
Field Quality Control Plan; G

SD-04 Samples

Cab Enclosures and Hoistway Entrance Assemblies; G

SD-05 Design Data

Reaction Loads; G

Calculations of reaction loads imposed on building by elevator system that comply with ASME A17.1/CSA B44. Calculations shall be certified by a Registered Professional Engineer. Do not fabricate materials nor perform construction until approved.

Heat Loads; G

Calculations for total anticipated heat loads generated by all the elevator machine room equipment. A Registered Professional Engineer shall provide certified calculations. Do not fabricate materials nor perform construction until approved.

Emergency Power Systems; G

SD-06 Test Reports

Field Tests Reports; G

SD-07 Certificates

Elevator Controller Certification; G

Qualifications; G

A letter of endorsement from the elevator manufacturer certifying that the Elevator Specialist is acceptable to manufacturer no later than 14 days after the Notice to Proceed providing the name and Statement of Qualifications of the individual who will perform the duties specified herein for the Elevator Specialist. Copies of certified welders' qualifications, demonstrating compliance with AWS D1.1/D1.1M, Section 4; list welders' names with corresponding code marks.

SD-09 Manufacturer's Field Repors

Cybersecurity Hygiene Checklist

SD-10 Operation and Maintenance Data
Data package in accordance with Section 01 78 23 OPERATION AMD MAINTENANCE DATA. Three Operation and Maintenance Manuals, 28 days prior to the Operation and Maintenance Training. Include a list of phone numbers, personnel contacts, and all tools required for operation and maintenance.

Operation and Maintenance Training; G

Proposed Onsite Training schedule, submitted concurrently with the Operation and Maintenance Manuals.

1.5 QUALITY ASSURANCE

1.5.1 Elevator Specialist

Perform work specified in this Section under the direct guidance of the Elevator Specialist who is regularly engaged in the installation and maintenance of the type and complexity of elevator system specified in the contract documents, and who served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 24 months. Provide endorsement letter from the elevator manufacturer certifying that the Elevator Specialist is acceptable to manufacturer. The Elevator Specialist oversees the acceptance inspections and tests, signs and certifies the successful results. Provide the Elevator Specialist's written certification that the installation is in accordance with the contract requirements, after completion of the acceptance inspections and tests. Bring any discrepancy to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered. See additional requirements in Section 01 45 00.00 20 QUALITY CONTROL.

1.5.2 Elevator Inspector

a. Elevator Inspector will be provided by the Government to inspect the installation of the elevator(s) to ensure that the installation conforms to all contract requirements. The Elevator Inspector will witness the acceptance inspections and tests, approve all results, and shall sign and certify the successful results. The Elevator Inspector, after completion of the acceptance inspections and tests, will provide written certification that the installation is in accordance with the contract requirements.

1.5.3 Welders' Qualifications

Comply with AWS D1.1/D1.1M, Section 4 Qualification. Provide certified copies of welders' qualifications. List welders' names with corresponding code marks to identify each welder's work.

1.5.4 Product Data Requirements

Provide manufacturers' product data for all elevator components, including but not limited to the following: elevator controller, hydraulic pump unit, hydraulic pump and motor, hydraulic cylinder, hydraulic piping and
fittings, car and hall fixture buttons and switches, cab and machine room communication devices, door operator, door protection system, car roller guides, and buffers. For data sheets, provide document identification number or bulletin number, published or copyrighted prior to the date of contract bid opening. Provide controller manufacturer's published procedures for performance of each and all testing required by ASME A17.1/CSA B44.

1.5.5 Emergency Power Systems

Where the facility does have an emergency power system, confirm the elevators that will be connected to the emergency power system. Confirm the complete emergency power system and sequence of operation for all elevators, including operation of the elevator lobby manual selection switch. Provide wiring diagrams for building emergency power interface with elevator controls. For elevators not supplied by an emergency power system, provide manufacturers' product data for auxiliary power systems.

1.5.6 Detail Drawings

Submit detail drawings, including dimensioned layouts in plan and elevation showing the arrangement of elevator equipment, accessories, supporting systems, anchorage of equipment, clearances for maintenance and operation; and details on hoistway, doors and frames, operation and signal stations, controllers, motors, guide rails and brackets, cylinder and plunge unit, and points of interface with normal power fire alarm system HVAC or exhaust systems and interface with emergency power systems. Provide drawings to show any revised building electrical system required to make supplied elevator system function as specified. Prepare drawings with complete wiring diagrams showing electrical connections and other details required to demonstrate sequence of operations and functions of system devices. Include the appropriate sizing of electrical protective devices on the drawings, which are frequently different from National Electrical Code standard sizes.

1.5.7 Maintenance Control Program (MCP)

For each elevator, prepare and provide a written Maintenance Control Program (MCP) that complies with ASME A17.1/CSA B44 Section 8.6, including written documentation that details the test procedures for each and every test that is required to be performed by ASME A17.1/CSA B44. Assemble all MCP documentation, and supporting technical attachments, in a single MCP package and provide in both electronic and hard copy. Assemble entire hard copy MCP in 3-ring binders. For each elevator provided, the MCP must include only documentation and instruction that apply to the elevator specified.

For each elevator, provide an additional, separate binder that includes all maintenance, repair, replacement, call back, and other records required by ASME A17.1/CSA B44. The records binder must be kept in the elevator mechanical room, maintained by elevator maintenance and service personnel, and be available at all times to authorized personnel.

Provide detailed information regarding emergency service procedures and elevator installation company personnel contact information. Provide a listing of all tools to be provided to the Contracting Officer as components of the elevator system.
1.6 SCHEDULING

Every six months, test systems for Emergency Power Operation, and Firefighters' Service. Schedule to not interfere with building operations. For Firefighters' Service, test monthly in accordance with ASME A17.1/CSA B44, Section 8.6.10.1. Provide written results of each test operation to the Contracting Officer. Document all inspection and testing. Maintain copy of documentation in machine room.

1.7 WARRANTY

Provide routine warranty service in accord with manufacturer's warranty requirements, for a period of 12 months after the date of final acceptance of the work. Perform work during regular working hours. During the warranty service period, include 24-hour emergency service, with 1 hour response time, without additional cost to the Government. Include adjustments, greasing, oiling, and cleaning. Provide routine inspection and tests of elevators in accordance with ASME A17.1/CSA B44 Section 8.11.3 and ASME A17.2. Provide supplies and parts to keep elevator system in operation. Perform service only by factory trained personnel. Maintain a maintenance log of all service orders performed during the warranty period and submit it to the Contracting Officer 21 days prior to the end of the warranty period.

1.8 MAINTENANCE AND REPAIR ACTION PLAN

Provide plan of action prepared by the Elevator Specialist for emergency and routine maintenance in accordance with paragraph titled WARRANTY. Provide a list of phone numbers, personnel contacts, and all maintenance and diagnostic tools provided by paragraph "Maintenance and Diagnostic Tools", to the Contracting Officer.

1.8.1 Operation and Maintenance Data

Assemble all shop drawing and product data material into O&M Data Packages in accordance with Article SUBMITTALS. Provide two complete O&M Data Packages in hard copy and two complete electronic O&M data packages on separate CDs, in PDF format. Provide all O&M Data Packages to Contracting Officer. Include controller diagnostic documentation and software.

1.8.2 Machine Room Cabinet

For storage of O&M Data Packages and Wiring Diagrams, provide locking metal cabinet with a minimum size of 20 inch W by 12 inch D by 30 inch H. Cabinet must be sized large enough to accommodate all O&M Data and hardware required. Secure cabinet to machine room wall.

PART 2 PRODUCTS

2.1 PASSENGER ELEVATORS

2.1.1 Basic Requirements; No. 1 and No. 2 Passenger

a. Rated Load: No. 1, 4,000 lbs; No. 2, 5,000 lbs.

b. Rated Speed: No. 1, 125 fpm; No. 2, 150 fpm.

c. Travel Length: As indicated.
d. Number of Stops: As indicated.

e. Number of Hoist Way Openings: As indicated.

f. Car Inside Dimensions: As indicated, and required to suit conditions.

h. Car Door Types: No. 1, center opening, 48 inches wide; No. 2, two-speed door, center opening, 54 inches wide.

i. Gurney Accommodation: No. 1, yes; No. 2, no.

j. Electrical Power: 480v, 3-phase, 50 hp maximum.

2.1.1.1 Cab Enclosures and Hoistway Entrance Assemblies

Premanufactured elevator interiors system. System shall include floor and base, rear and side wall panels with vertical accent panels that run from floor to ceiling, panel frames and reveals, handrails, ceiling and lighting. System shall be "ready to install" with fasteners, adhesives, and other materials required for a complete assembly. Fasteners shall be concealed type.

a. Floor and Base: As indicated on the Drawings.

b. Wall Panels, Panel Frames and Reveals: As indicated on the Drawings.

c. Interior face of door(s); stainless steel.

d. Ceilings; Stainless Steel. Ceiling frame; anodized aluminum.

e. Lighting; LED perimeter and recessed low-voltage LED down lights.

f. Handrails: As indicated on the Drawings.

g. Hoistway Doors and Frame Finishes by Elevator manufacturer; provide finishes on exterior of hoistway as follows:

   (1) Frame; stainless steel.
   (2) Exterior face of door; stainless steel.

2.2 SPECIAL OPERATION AND CONTROL

Provide all special operations and control systems in accordance with ASME A17.1/CSA B44. Provide special operation key switches with 6 pin cylinder locks with removable cores and a key control lock for each operation system.

2.2.1 Firefighters' Service

Provide equipment and signaling devices. The designated level for Firefighters' key operated switch is the ground floor.

2.2.1.1 Firefighters' (FEO) Key Box

Provide flush mounted, locked with lock that uses the FEO K1 key, minimum
size 5 inches W x 9 inches H x 1.5 inches D. Install at 6 feet above the floor directly above the FEO phase 1 key switch.

2.2.2 Smoke Detectors

Provide connections directly to fire alarm system which will, when smoke is detected by any smoke detector, actuate Firefighters' Service and send each elevator to the correct floor as required by ASME A17.1/CSA B44. Provide smoke detectors located in the elevator lobbies and the elevator machine room. Use an addressable fire alarm system with listed smoke detectors in the above stated locations. Ensure that all smoke detectors are mounted on finished ceiling.

2.2.3 Fire Sprinklers

Provide fire sprinklers in accordance with all applicable safety codes and with Section 21 13 13.00 20 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION. Provide shutoff valve, check valve, and non-adjustable, zero time-delay flow switch, in each sprinkler line immediately outside of each machine room and hoistway, if applicable. Provide inspectors' test valve for periodic testing of flow switch and shunt trip disconnect.

Pipe sprinkler piping serving these spaces in a series manner with no laterals. Locate inspectors' test connection at the end of pipe runs such that operation of the test connection will purge air from system piping.

2.2.3.1 Shunt Trip Disconnect

Provide flow switches specified in paragraph FIRE SPRINKLERS to comply with ASME A17.1/CSA B44 and NFPA 72 for shunt trip of the main line power supply. For each elevator, provide control wiring connecting the flow switch to a shunt trip equipped circuit breaker located in the elevator machine room. Upon flow of water, flow switch will instantaneously cause opening of the shunt-trip circuit breaker and remove power from the elevator. Flow switch must also send a signal to fire alarm control panel to indicate water flow condition.

2.2.4 Top-of-Car Operating Device

Provide operating device mounted on or from car crosshead, to permit operation of car at 150 fpm maximum for adjustment, maintenance, testing, and repair. Include integral or remote safety device, continuous pressure "UP" and "DOWN" switches or buttons, emergency stop switch, and inspection switch.

2.2.5 Hoistway Access Switches

Provide key-operated hoistway access switch to permit limited movement of car at terminal floors for car positioning, operative only when "INSPECTION" switch in car operating panel is in the "INSPECTION" position. Locate switch 6 feet above floor level, within 12 inches of hoistway entrance frame or with only ferrule exposed when located in entrance frame.

2.2.6 Independent Service

Provide exposed key-operated switch in car operating panel to enable
independent service and simultaneously disable in-car signals and landing-call responses. Provide indicator lights that automatically illuminate during independent service. For Elevators #1 and #2, if one car is removed from group, provide other car(s) responding to its hall call.

2.2.7 Elevator Operation

2.2.7.1 Selective Collective Automatic Operation


2.2.7.2 Duplex Selective Collective Automatic Operations

Provide Duplex Selective Collective Automatic Operation. Provide a single push button for terminal landings and dual push buttons, up and down, at intermediate landings. In each car operating panel, provide push buttons numbered to correspond to each landing. If a car is taken out of service, or fails to respond to a landing call within a predetermined adjustable time limit of approximately 40 to 180 seconds, transfer calls to the other elevator functioning as a Selective Collective elevator until the out-of-service car is returned to the system. Provide a push-button riser adjacent to each elevator.

2.2.7.3 Group Automatic Operation

Provide Group Automatic Operation. Provide a single push button for terminal landings and dual push buttons, up and down, at intermediate landings. In each car operating panel, provide push buttons numbered to correspond to each landing. If a car is taken out of service, or fails to respond to a landing call within a predetermined adjustable time limit of approximately 40 to 180 seconds, transfer calls to another car until the out-of-service car is returned to the system. Provide a push-button riser adjacent to each elevator.

2.2.8 Parking Switch

Provide two-position parking switch in car station service cabinet. One position causes car to remain parked at floor landing where last used; other position causes car to park at main floor.

2.3 ELEVATOR DRIVE SYSTEM

Provide hydraulic elevator drive system, including pump unit, piping, cylinder/plunger assembly, and associated equipment, which will operate at a maximum working pressure of 500 psi or less. Provide complete elevator system that meets or exceeds the NEII-1.

2.3.1 Hydraulic Pump Unit

Provide self-contained pump unit, including oil-hydraulic elevator pump, electric motor, suction-line oil strainer, oil-tight drip pan, and structural steel outer base with tank supports and isolation pads. Provide oil tank capacity for full plunger displacement plus at least 10 gallons. Provide means to maintain oil temperature between 80 and 120 degrees F regardless of ambient temperature. Limit acoustic output in elevator machine room to 80 dBA.
2.3.1.1 Pump Motor

Provide intermittent-duty pump motor rated at 120 starts/hour. Provide motor that is sized so that the motor amperage does not exceed the motor data tag amperage in any operating condition, exclusive of acceleration and deceleration. Provide minimum of one megohm insulation resistance between conductors and motor frame. Provide motor and pump nameplate and data tags permanently mounted on the outside of the pump unit frame, with all data viewable without the use of mirrors or other tools.

2.3.2 Hydraulic Controls and Equipment

Provide control valve, overspeed (rupture) valve, blowout-proof muffler, and hydraulic pump discharge strainer in the hydraulic oil supply line. Provide 1/4 turn, manual shutoff ball-valves in the elevator machine room and in the hoistway pit. Provide scavenger pump in hoistway pit.

2.3.2.1 Hydraulic Control Valve

Provide constant-velocity, down-speed regulated, control valve. Down-speed regulated control valve allows the car to travel at the same speed in the down direction, regardless of the load on the elevator. In addition, the hydraulic control valve shall have built-in adjustment capability to operate the elevator at 140 percent of rated speed in the down direction to facilitate periodic testing of the overspeed safety valve.

2.3.2.2 Hydraulic Overspeed Safety Valve

Provide overspeed safety valve in hydraulic oil supply line, directly adjacent to the hydraulic cylinder. Provide threaded pipe connections between the hydraulic cylinder and the overspeed valve. Provide valve equipped with manufacturer's manual shutoff feature. Overspeed valve shall not be equipped with a manual lowering feature. Provide adjustable valve with means to seal adjustment after inspection and testing by certified elevator inspector.

2.3.2.3 Hydraulic Oil Scavenger Pump

Provide a scavenge oil reservoir with strainer and transfer pump. Provide a manual-reset pit flood switch to prevent pump operation if pit is flooded. Anchor pump and reservoir to pit floor.

2.3.3 Hydraulic Piping and Accessories

Provide ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 80, black steel piping with ASME B16.9 or ASME B16.11 fittings for supply piping. Extend schedule 80 piping from the pump control valve body, inside the pump unit, to the hydraulic cylinder in the hoistway. Provide welded or threaded forged pipe fittings for all fittings and components of the hydraulic oil supply line. For direct plunger cylinders, provide dielectric union or isolation couplings at each end of the hydraulic oil supply line. Provide hangers or supports for all piping and components.

2.3.3.1 Containment of Hydraulic Oil Supply Line

Protect all portions of hydraulic oil supply line that are installed below ground, including portions encapsulated in concrete or covered by construction, with continuous, Schedule 80, PVC. Inside diameter of PVC...
shall be 3 inches larger than the outside diameter of the hydraulic oil supply line pipe and couplings.

2.3.4 Hydraulic Elevator Type

2.3.4.1 In-Ground Direct Plunger

Provide a single-stage hydraulic cylinder/plunger assembly installed in the ground below the elevator cab. The cab frame is attached to the top of the plunger and moves up as hydraulic fluid is pumped into the cylinder from reservoir. Do NOT utilize roped-hydraulic elevator design.

2.3.4.2 Cylinder-Plunger (Jack) Unit

Provide a single-stage plunger of seamless steel construction. Provide cylinder with self-stabilizing mount that will support and hold cylinder plumb without the need for stabilization means at the bottom of the cylinder. Provide a threaded, 1/4 inch bleeder valve at the top of the cylinder, just below packing gland.

2.3.4.3 Cylinder Well System

For direct plunger type hydraulic elevator, the cylinder well system consists of a sealed, dry well casing and a PVC liner.

2.3.4.3.1 Well Casing

Locate and drill well for the cylinder well system. Line well with steel casing, minimum 1/4 inch wall with welded 1/2 inch steel bottom. Set casing plumb. Provide a dry, sealed well casing.

2.3.4.3.2 PVC or HDPE Cylinder Liner

Provide Schedule 80 PVC or HDPE pipe liner with bottom cap and couplings; joints sealed watertight using pipe manufacturer's recommended adhesive or heat welding methods. Provide liner inside diameter not less than 3 inches larger than elevator cylinder maximum outside diameter. Liner shall extend above hoistway pit finish floor. Liner may be provided as a cylinder manufacture's applied liner or as a separate component. For separate liner, set liner plumb in well casing, located as necessary for cylinder installation. Provide dry, salt-free sand below and around liner to top of well casing.

2.3.4.3.3 Cylinder Installation

Remove all moisture from inside of cylinder liner. Install cylinder plumb, inside liner. Provide a 1/4 inch copper evacuation tube inside the PVC liner. The bottom of the evacuation tube, shall be within 6 inch of the bottom of the liner. Top of evacuation tube shall extend at least 6 inch above liner. Provide top of test tube with removable cap to exclude foreign matter. Provide separate air pressure fitting in liner to facilitate pressure test of liner as specified in paragraph PRESSURE TEST OF PVC LINER/CYLINDER ASSEMBLY. Secure Liner/Cylinder Assembly as recommended by cylinder manufacturer.

2.3.4.3.4 Pressure Test of PVC Liner/Cylinder Assembly

Perform 8 psig pressure test of liner/cylinder assembly. Perform the test of liner/cylinder assembly as a sealed unit. Provide safety relief valve,
set to relieve at 10 psig. Provide 4.5 inch diameter dial pressure gage scaled for 0 to 50 psig and calibrated to 0.5 percent accuracy and an air pressure admission throttle and shutoff valve. For safety, pressure test shall only be performed when liner and cylinder are fully inserted and assembled in the well casing. Perform the test from remote location outside of the elevator pit. Perform test in the presence of, and witnessed by, a NAVFAC Certified Elevator Inspector.

2.3.4.3.5 Cylinder Liner Water and Oil Sensor System

Provide moisture sensor system designed to detect water and/or oil in the bottom of the cylinder liner. Water and oil sensors shall be located inside the cylinder liner and within 6 inches of the bottom of the liner. Water and oil sensor system shall include a control and alarm panel, located in the elevator machine room. System shall provide automatic actuation of audible and visual alarms upon detection of either water or oil inside the cylinder liner.

2.3.4.3.6 Seal Top of Well Casing

Upon successful test and certification of PVC Liner/Cylinder assembly, seal gap between steel well casing and PVC liner with foam insert strong enough to retain and support final grouting. Provide 3000 psi grout to a minimum of 4 inch thickness and level top of final grouting with pit floor.

2.4 CONTROL EQUIPMENT

Enclose all elevator control equipment in factory-primed and baked-enamel coated sheet-metal cabinets with ventilation louvers and removable or hinged doors. Mount cabinets at a height of 10 inches above machine room finish floor.

2.4.1 Motor Control Equipment

Provide elevator motor control with electronic, soft-start motor starter.

2.4.2 Elevator Microprocessor Controller

For each individual elevator controller, and for each group controller, provide a microprocessor controller that complies with the following paragraphs. Provide controller(s) package that includes all hardware and software required for the installation, maintenance, and service of the elevator, in its' entirety. Provide verification of technical support service that the controller manufacturer provides to any licensed elevator installation, service, and maintenance company.

Provide an elevator controller from a manufacturer that provides comprehensive factory training to include controller installation, adjustment, service, and maintenance. The training must be identified as available to any licensed elevator contractor. Provide verification of an established and documented training schedule, with pricing, for factory training classes that manufacturer has provided for a minimum period of one year prior to contract award date.

The elevator controller must be identified as available for purchase and installation by any licensed elevator contractor. All components, parts, diagnostic tools, and software must be available for purchase and installation and use by any licensed elevator contractor; "exchange-only" provisions for the purchase of spare parts are not acceptable. The
The elevator controller manufacturer must publish an industry competitive price listing for all controller parts, diagnostic tools, and software.

Provide verification of telephone and internet based technical support service that the elevator controller manufacturer provides to any licensed elevator installation, service, and maintenance company at an industry competitive price. The service must include live telephone based technical support for installation, adjustment, maintenance, and troubleshooting of the elevator controller and related elevator components. The service must be available during standard working hours.

Provide an elevator controller that is designed to automatically reestablish normal elevator operation following any temporary loss of power, regardless of duration.

2.4.2.1 Elevator Controller Interface Cabinet

For each individual elevator microprocessor controller, provide a separate elevator control cabinet with an integrated human interface system. For group elevator installations, a single cabinet and interface system with full access to each elevator controller may be utilized. The separate controller interface cabinet must be supplied by the elevator controller manufacturer and include a minimum 12 inch wide keyboard and a minimum 10 inch monitor. The elevator controller interface cabinet must comply with arc-flash protection requirements of NFPA 70E and UFC 3-560-01.

2.4.2.2 Elevator Microprocessor Human Interface

The interface system must provide complete elevator controller interface capability and must include the elevator controller manufacturer's comprehensive package of installation and diagnostic software. The microprocessor interface system must provide unrestricted access to all parameters, all levels of adjustment, and all flags necessary for installation, adjustment, maintenance, and troubleshooting of each elevator and for the elevator group. All software programming must be stored in non-volatile memory. The elevator controller fault log must provide non-volatile memory fault log storage of all faults, trouble calls, and fault history for a minimum of one year and the ability to download or print the fault log. The controller interface must also provide the capability to display and diagnose trouble calls, faults, and shutdowns. Expiring software, degrading operation, and "key" access controls are not acceptable.

2.4.2.3 Software and Documentation

Provide three copies of the manufacturer's maintenance and service diagnostic software, with complete software documentation, that will enable the same level of unrestricted access to all controllers of the same make and model, regardless of the installation date or location. Provide signed certification, from the manufacturer's corporate headquarters, that guarantees that the microprocessor software and access system will not terminate the unlimited and unrestricted access at any future date.

2.4.2.4 Elevator Controller Certification

For elevator installations in the United States, including United States territories, provide an elevator microprocessor controller that has a current certificate of safety code compliance issued by the Technical...
Standards and Safety Authority (TSSA), Toronto, Canada.

2.5 OPERATING PANELS, SIGNAL FIXTURES, AND COMMUNICATIONS CABINETS

2.5.1 Capacity and Data Plates

Attach faceplates with spanner security screws. On car panel, provide stainless steel capacity and data plates, with name of elevator manufacturer.

2.5.2 Car and Hall Buttons

Provide recessed tamper-proof push buttons of minimum 3/4 inch size satin-finish stainless steel, with illuminating jewel center.

2.5.3 Car-Operating Panel

Provide each car with one car operating panel that contains operation controls and communication devices. Provide exposed, flush mounted buttons for the controls that must be passenger accessible. Provide service cabinet or keyed switches for those switches that should not be passenger accessible. Allow maximum 48 inch height between car floor and center line of top operating buttons. Allow 35 inch height between car floor and center line of bottom button. Use engraving and backfilling or photo etching for button and switch designations. Do not use attached signs.

2.6 CONTROLS

2.6.1 Car-Operating Panel

a. Illuminating operating call buttons identified to correspond to landings served by elevator car. For two openings at a floor, provide two buttons, marked "FRONT" and "REAR" above buttons.

b. "DOOR OPEN" and "DOOR CLOSE" buttons.

c. Keyed "STOP" switch in accordance with ASME A17.1/CSA B44, rule 2.26.2.

d. "ALARM" button in compliance with UFAS, ADA, and ASME A17.1/CSA B44, Rule 2.27.1. Furnish a red alarm button with engraved legend "ALARM." Allow alarm button to illuminate when pushed. Locate "ALARM" button at panel bottom.

e. "FIRE DEPARTMENT" key switch, with "OFF-HOLD-ON" positions, in that order with key to be removable in all positions. Provide fire sign or jewel, and audible signal device, in accordance with ASME A17.1/CSA B44 Section 2.27.3. Both visual and audible signals are activated when Phase I key switch in hall is activated or when smoke detector activates return of elevator(s) to main fire response floor. Keep visual and audible signal activated until car has reached main or designated alternate fire response floor. Upon arrival at fire response floor visual signal remains illuminated and audible signal becomes silent.

f. Emergency two-way communication. Provide momentary pressure, single illuminating pushbutton operated communication device that complies with ASME A17.1/CSA B44, UFAS, and the Americans with
Disabilities Act.

g. An indicator shall be provided in the car operating panel which reads "EMERGENCY POWER" and shall flash when the system is on battery lowering.

2.6.1.1 Service Controls

a. Inspection switch that transfers car control to top-of-car inspection operating controls and prevents car operation from in-car control panel.

b. Independent service switch.

c. Two car light switches, one for light in car and one for lights on top and bottom of car frame.

d. Fan switch, two-speed.

e. 120-volt ac 60 Hz single-phase duplex electrical outlet of ground-fault-circuit-interrupt (GFCI) design.

f. Device for communication between car and elevator machine room.

g. Parking switch.

2.6.1.2 Certificate Window

Provide 4 inch high by 6 inch wide certificate window in car operating panel for elevator inspection certificate.

2.6.2 Semi-Selective Door Operation

For elevator with rear opening at elevations that differ from front opening, provide semi-selective door operation so that only car door or gate opposite hoistway door opens when car stops.

2.6.3 Full-Selective Door Operation

For elevator with one or more rear openings at same level as front opening, provide full-selective operation with car and door operating buttons clearly marked for front and rear openings, front and rear car button for each such floor, and front and rear "DOOR OPEN" and "DOOR CLOSE" buttons. Only door for which button was operated opens or closes.

2.6.4 Switches and Devices

Provide elevator manufacturer's standard grade for switches and devices on car operating panel. Legibly and indelibly identify each device and its operating positions. Locate car dispatching buttons in identical positions in car operating panels for corresponding floors.

2.6.5 In-Car Position and Direction Indicator and Signal

Include in-car direction indicator in the in-car position indicator fixture.
2.6.5.1 In-Car Position Indicator and Signal

Provide horizontal electronic LED digital position indicator located minimum of 84 inch above car floor. Arrange indicator to show floor position of car in hoistway and its traveling direction. Indicate position by illuminating of numeral or letter corresponding to landing at which car is passing or stopping. Provide audible signal to alert passenger that elevator is passing or stopping at a floor. Provide audible signals exceeding ambient noise level by at least 20 dbA with frequency not higher than 1500 Hz.

2.6.5.2 In-Car Direction Indicator and Signal

Provide visual and audible car direction indicators in car, indicating car traveling direction. For visual directional signal, provide arrow of minimum 2-1/2 inch in size. Use equilateral triangles for arrows, green for upward direction and red for downward direction. Provide audible signal that sounds once for upward direction and twice for downward direction.

2.6.6 Landing Position and Direction Indicator and Signal

Provide a single fixture containing the landing position and direction indicator.

2.6.6.1 Landing Position Indicator and Signal

Provide an electronic LED digital position indicator similar to the car position indicator. Arrange position indicator in wall horizontally above the door frame or vertically at the side of the door frame. Indicators to show floor position of car in hoistway. Indicate position by illumination of numeral or letter corresponding to landing at which car is passing or stopping. Use both tactile symbols and Braille.

2.6.6.2 Landing Direction Indicator and Signal

Provide landing direction indicator with visual and audible signal devices. Provide single direction indicator at terminal floors; "UP" and "DOWN" direction indicator at intermediate floors. Provide equilateral triangles minimum 2-1/2 inch in size, green for upward direction and red for downward direction. Provide electronic audible device that sounds once for upward direction and twice for downward direction. Provide audible signals exceeding ambient noise level by at least 20 decibels with frequency not higher than 1500 Hz. Use both tactile symbols and Braille.

2.7 HOISTWAY AND CAR EQUIPMENT

2.7.1 Guide Rails and Fastenings

Paint rail shanks with one coat black enamel. Only T-section type rail is acceptable.

2.7.2 Car Buffers

Provide buffer data plate on each buffer.
2.7.3 Pit Equipment

2.7.3.1 Pit "STOP" Switch

Provide push/pull type pit "STOP" switch for stopping elevator motor, independent of regular operating device. Locate on same side of hoistway as ladder.

2.7.3.2 Ladders

Provide galvanized steel ladder conforming to 29 CFR 1910.27 with minimum 7 inch distance between rung and wall. Locate ladder on hoistway side wall closest to hoistway door opening. In addition, ladder shall comply with ITG 2013-1, Paragraph 3-3.1 "Elevator Hoistway Pit Ladder" requirements.

2.7.3.3 Lighting of Pits

Locate pit light not less than 6 feet above pit floor. Locate switch on same side of hoistway as ladder. Provide GFCI duplex receptacle in each pit.

2.8 TERMINAL STOPPING DEVICES

Provide each elevator with a terminal stopping device.

2.8.1 Wiring and Traveling Cables

Suspend traveling cables by means of self-tightening webbed devices.

2.8.2 Emergency Signaling Device

Provide audible signaling device, operable from Car Operating Panel button marked "ALARM". Mount the audible signaling device in hoistway.

2.9 CAR AND HOISTWAY DOOR ACCESSORIES

ASME A17.1/CSA B44, Sections 2.12, 2.13, 2.14, and 3. Provide infra-red curtain unit (ICU) with multiple infra-red beams that protect to the full height of the door opening. Extend minimum coverage from 2 inches off the floor to 70 inch above floor level. Door operation must meet the requirements of ASME A17.1/CSA B44 Rule 2.27.1 and 2.13.5. Provide high-speed electric operator, safety interlocks for car and hoistway doors, and electric safety contact to prevent car operation unless doors are closed.

2.10 ELEVATOR GUIDES, FRAME, PLATFORM, AND ENCLOSURE

2.10.1 Roller Guides

Provide roller guide assemblies in adjustable mountings on each side of car in accurate alignment at top and bottom of car frame.

2.10.2 Car Enclosure, Car Door, and Car Illumination

Provide natural and forced ventilation, stainless steel hooks, with fire retardant pads.
2.10.2.1  Return Panels, Entrance Columns, Cove Base, and Transom

Provide 14 gauge minimum non perforated steel. Apply sound-deadening mastic on car shell and all exterior components.

2.10.2.2  Car Top

Provide reinforced 12 gauge minimum steel with hinged emergency exit openable by hand from car top only. Provide electrical contact which prevents operation of elevator when emergency exit is open. Provide sound-deadening mastic on all exterior components.

2.10.2.3  Car Door

Provide 16 gauge minimum steel, sandwich construction without binder angles. Provide a minimum of 2 door guide assembles per door panel, one guide at leading and one at trailing door edge with guides in the sill groove their entire length of travel.

2.10.2.4  Car Entrance Sill

Provide one piece cast white bronze or nickel silver entrance sill. Set sills level and flush with floor finish. Use same material for hoistway and car entrance sills.

2.11  ELEVATOR HOISTWAY DOORS AND ENTRANCES

Provide hoistway entrance assemblies which have a minimum 1-1/2 hour fire rating.

2.11.1  Hoistway Entrance Frames

Frame of 14 gauge thick stainless steel. Solidly grout uprights of entrances to height of 5 feet.

2.11.2  Hoistway Entrance Sills

Provide one-piece cast solid white bronze or nickel silver entrance sills. After sill is set level and flush with finished floor height, solidly grout under full length of sill. Use same material for hoistway and car door sills.

2.11.3  Hoistway Entrance Doors

Provide hoistway entrance door constructed with hollow metal non-vision construction with flush surfaces on car and landing sides. Provide a minimum of 2 door guide assembles per door panel, one guide at leading edge and one at trailing door edge with guides in the sill groove the entire length of travel.

2.11.4  Entrance Fascias and Dust Covers

Provide sheet metal hoistway door track dust covers at each landing. Dust covers must cover door locks and door roller tracks and extend the full width of the door track and associated hardware.
2.12  HANDICAPPED AND MEDICAL SERVICES ACCESS

2.12.1  Provision For Handicapped

Refer to 36 CFR 1191, Sections 4.10 for Elevators, 4.30 for Signage, and 4.31 for Telephones.

2.13  LOSS OF POWER OPERATION

Elevator shall be equipped with auxiliary power lowering operation. The main disconnect must include an auxiliary contact to prevent automatic lowering operation while the main line disconnect is in the open position. Upon outage of normal power, provide circuitry and wiring to operate elevator telephone or intercom to accomplish operation sequences. In multiple elevator system, one elevator travels automatically to the main floor, opens doors, and shuts down. An indicator shall be provided in the car operating panel which reads "EMERGENCY POWER" and shall flash when the system is on battery lowering.

PART 3  EXECUTION

3.1  INSTALLATION

Install in accordance with manufacturer's instructions, ASME A17.1/CSA B44, 36 CFR 1191, and NFPA 70.

3.1.1  Traveling Cables

Do not allow abrupt bending of traveling cables.

3.1.2  Automatic Shutoff Valve

Locate in supply-return line, as close as possible to cylinder-plunger unit.

3.1.3  Structural Members

Do not cut or alter. Restore any damaged or defaced work to original condition.

3.1.4  Safety Guards

Completely enclose selector cables or tapes exposed to possibility of accidental contact in machine room with 16 gage thick sheet metal or expanded metal guards, both horizontally and vertically. Protect exposed gears, sprockets, and selector drums from accidental contact in accordance with ASME A17.1/CSA B44.

3.1.5  Other Requirements

Include recesses, cutouts, slots, holes, patching, grouting, and refinishing to accommodate elevator installation. Use core drilling to drill all new holes in concrete. Finish work to be straight, level, and plumb. During installation, protect machinery and equipment from dirt, water, or mechanical damage. At completion, clean all work, and spot paint. Completion of firefighters' service includes installation and wiring of all smoke detectors in accordance with ASME A17.1/CSA B44, Section 2.27.3.2. Coordinate smoke detector installation for firefighters' service.
3.2 FIELD QUALITY CONTROL

a. After completing elevators system installation, notify Contracting Officer that elevator system is ready for final inspection and acceptance test. In conjunction with the notification submit a plan detailing the testing procedures 60 days prior to performing the elevator tests. Contracting Officer will obtain services of Naval Facilities Engineering Command certified elevator inspector.

b. Perform all required tests and demonstrate proper operation of each elevator system and prove that each system complies with contract requirements and ASME A17.1/CSA B44. Inspection procedures in ASME A17.2 form a part of this inspection and acceptance testing. Conduct all testing and inspections in the presence of both the Elevator Specialist and the Elevator Inspector. Demonstrate the proper operation of all equipment at various date settings, selected by the Elevator Inspector, ranging from the date of contract award through 1 January 2099.

c. The Elevator Inspector shall complete, sign and post the results of all tests and inspection results and form NAVFACENGCOM 9-11014/23 (Rev. 7-88), Elevator Inspection Certificate after successful completion of inspection and testing. The Contractor is responsible for all costs involved with reinspection and retesting required to correct discrepancies discovered during testing and the subsequent retesting required, including all costs and expenses incurred by the Government Furnished Inspector.

3.2.1 Testing Materials and Instruments

Provide testing materials and instruments required for final inspection. Include calibrated test weights, tachometer, 600-volt megohm meter, volt meter and ammeter, three Celsius calibrated thermometers, door pressure gage, spirit level, stop watch, hydraulic pressure test gauge, and a 100 foot tape measure.

3.2.2 Field Tests

Submit Field Tests Reports after completing each of the specified tests, as required in the Submittals paragraph.

3.2.2.1 Endurance Tests

Test each elevator for a period of one hour continuous run, with specified rated load in the car. Restart the one hour test period from beginning, following any shutdown or failure. During the test run, stop car at each floor in both directions of travel for standing period of 10 seconds per floor. The requirements for Rated Speed, Leveling, Temperature Rise, and Motor Amperes testing specified herein must be met throughout the duration of the Endurance test.

3.2.2.2 Automatic Shutoff Valve Tests

Test the automatic shutoff valve twice. Once at beginning of acceptance test and again at conclusion of one-hour Endurance test to ensure consistent performance of shutoff valve, regardless of temperature of equipment and oil.
3.2.2.3 Speed Tests

Determine actual speed of each elevator in both directions with rated load and with no load in elevator car. Make Speed tests before and immediately after Endurance test. Determine speed by tachometer reading, excluding accelerating and slow-down zones in accordance with ASME A17.2, Section 2.22.4. Minimum acceptable speed is the Rated Speed as specified. Maximum acceptable elevator speed is 110 percent of Rated Speed.

3.2.2.4 Leveling Tests

Test elevator car leveling devices for landing accuracy of plus or minus 1/4 inch at each floor with no load in car, symmetrical load in car, and with rated load in car in both directions of travel. Determine accuracy of floor landing both before and immediately after endurance tests.

3.2.2.5 Pressure Tests

Check operating pressure at pump and cylinder head under no load and rated load. Test pressure at which relief valve operates.

3.2.2.6 Insulation Resistance Tests

Perform tests to ensure wiring systems free from short circuits and grounds. Minimum acceptable insulation resistance for electrical conductors is one megohm between each conductor and ground and between each conductor and other conductors. Prior to megohm meter test, make provision to prevent damage to the electronic devices.

3.2.2.7 Temperature Rise Tests

Determine the temperature rise of the hydraulic pump motor during the full load test run for a minimum of one hour. Under these conditions, do not exceed maximum acceptable temperature rise indicated on the manufacturer's data plate. Start test only when equipment is within 5 degrees C of ambient temperature.

3.2.2.8 Motor Ampere Tests

Measure and record motor amperage when motor is running and elevator is lifting at rated load and speed. Measure and record motor amperage at the beginning and the end of Endurance test.

3.3 OPERATION AND MAINTENANCE TRAINING

The Elevator Specialist shall instruct Government personnel in care, adjustment, and maintenance of elevator equipment for a period of not less than 5 working days immediately following acceptance of system. Submit Operation and Maintenance Manuals as required in the Submittals paragraph.

3.4 CYBERSECURITY

Provide completed Cybersecurity Hygiene Checklist in accordance with Section 25 50 00.00 20 CYBERSECURITY OF FACILITY-RELATED CONTROL SYSTEMS.

3.5 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.
PART 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. GREEN BUILDING COUNCIL (USGBC)


1.2   SUMMARY

This project will have selected building systems commissioned. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CA) appointed by the Government will direct the commissioning process.

1.2.1   This Section Includes

Requirements for commissioning the Fire Suppression Systems, sub-systems and equipment. This Section supplements the general requirements specified in Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS.

1.2.2   Commissioning Activities

a. The commissioning activities have been developed to support the United States Green Building Council (USGBC) LEED™ rating program and to support delivery of project performance in accordance with the Contract Documents.

(1) Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" prerequisite of "Fundamental Building Systems Commissioning".

(2) Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" requirements for the "Enhanced Building System Commissioning" credit.

(3) Activities and documentation for the LEED™ section on "Measurement and Verification" requirements for the Measurement and Verification credit.

1.2.3   Related Sections

Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.
1.3 DEFINITIONS

Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.4 COMMISSIONED SYSTEMS

a. Commissioning of a system or systems specified in this Division 21 is part of the construction process. Documentation and testing of these systems, as well as training of User's Operation and Maintenance personnel, is required in cooperation with the Contracting Officer.

b. The following Fire Suppression systems will be commissioned:

(1) Fire Protection System Wet-pipe fire suppression, Dry-pipe fire suppression.

1.5 SUBMITTALS

a. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by User prior to forwarding to the Contractor. Refer to Section 01 33 00 SUBMITTAL PROCEDURES for further details.

b. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 SYSTEMS READINESS CHECKLISTS

The Contractor shall complete Systems Readiness Checklists to verify systems, sub-systems, and equipment installation is complete and systems are ready for Systems Functional Testing. The Commissioning Agent will prepare Systems Readiness Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the Contracting Officer and to the Commissioning Agent for review. The Commissioning Agent may spot-check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and re-submission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and re-submission. Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for System Readiness Checklists, Equipment Startup Reports, and other commissioning documents.
3.2 CONTRACTOR'S TESTS

Contractor tests as required by other sections of Division 21 shall be scheduled and documented. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.3 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Owner's Representative. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will direct and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF OWNER PERSONNEL

Training of User's operation and maintenance personnel is required in cooperation with the Contracting Officer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with Contracting Officer after submission and approval of formal training plans. Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS and Division 21 Sections for additional Contractor training requirements.

3.5 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 Construction and Demolition Waste Management for additional requirements.

-- End of Section --
PART 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

FM GLOBAL (FM)

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13 (2016; Standard for the Installation of Sprinkler Systems)


UNDERWRITERS LABORATORIES (UL)

UL 668 (2004; Reprint Dec 2012) Hose Valves for Fire-Protection Service


1.2 SYSTEM DESCRIPTION

Design and provide automatic wet pipe fire extinguishing sprinkler systems for complete fire protection coverage throughout the entire building.

1.3 SPRINKLER SYSTEM DESIGN

Except as modified herein, design automatic wet pipe fire extinguishing sprinkler systems in accordance with the required and advisory provisions of NFPA 13, including all recommendations and advisory portions, which shall be considered mandatory; this includes advisory provisions listed in the appendices of such standard(s), as though the word "shall" had been substituted for the word "should" wherever it appears. Design system by hydraulic calculations for uniform distribution of water over the design area. Hydraulic calculations shall assume a 12 psi pressure loss for the backflow preventer assembly. Locate sprinklers in a consistent pattern with ceiling grid, lights, air supply diffusers and other ceiling devices.
Provide sprinklers and piping system layout. All Devices and equipment for fire protection service shall be UL Fire Prot Dir listed or FM APP GUIDE approved for use in wet pipe sprinkler systems. Provide seismic protection for the sprinkler system. Design and install seismic protection in accordance with the requirements of NFPA 13 section titled "Protection of Piping Against Damage Where Subject to Earthquakes."

1.3.1 Location of Sprinklers

Sprinklers in relation to the ceiling and the spacing of sprinklers shall not exceed that permitted by NFPA 13 for the hazards indicated on the contract drawings. Uniformly space sprinklers on the branch piping. Sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces.

1.3.2 Water Distribution

Distribution shall be uniform throughout the area in which the sprinklers will open. Discharge from individual sprinklers in hydraulically most remote area shall be between 100 percent and 120 percent of the specified density.

1.3.3 Density of Application of Water

Size pipe to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the sprinklers shall be as indicated on the contract drawings.

1.3.4 Sprinkler Discharge Area

Area shall be the hydraulically most remote area indicated on the Contract Drawings. Area reductions and increases from NFPA 13 shall not be applied to this area.

1.3.5 Outside Hose Allowances

Hydraulic calculations shall include outside hose allowances as indicated on the drawings.

1.3.6 Water Supply

Base hydraulic calculations on the water supply data shown on the contract drawings.

Prior to performing hydraulic calculations, perform a hydrant flow test to confirm water supply data indicated on the Contract Drawings.

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.

Partial submittals and submittals not fully complying with the requirements and recommended practices of NFPA 13 and this specification section shall be returned disapproved without review. This contract
stipulation is non-negotiable.

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

Shop Drawings; G

Prepare 24 by 36 inch detail working drawings of sprinklers and piping. Floor plans shall be drawn to a scale not less than 1/8" = 1'-0". Show data essential for proper installation of each system. Show details, plan view, elevations and sections of the systems supply and piping. Show piping schematic of systems supply, devices, valves, pipe and fittings. Show point to point electrical wiring diagrams. Submit drawings signed by a registered fire protection engineer. Provide three copies of the Sprinkler System Shop Drawings, no later than 21 days prior to the start of sprinkler system installation. Include SD-05 Hydraulic Calculations with SD-02 Shop Drawings.

SD-03 Product Data

Pipe; G
Fittings; G
Valves, including gate, check, and globe; G
Sprinklers; G
Pipe hangers and supports; G
Sprinkler Alarm Switches; G
Fire department connections; G
Mechanical couplings; G
Backflow Prevention Assembly; G

Annotate descriptive data to show the specific model, type, and size of each item. Catalog cuts shall also indicate UL Listing/FM Approval and country of manufacture.

SD-05 Design Data

Hydraulic Calculations; G

Submit computer program generated hydraulic calculations to substantiate compliance with hydraulic design requirements. Calculations shall be performed by computer using software intended specifically for fire protection system design. Submit name of software program used. Include SD-05 Hydraulic Calculations with SD-02 Shop Drawings.

SD-06 Test Reports

Hydrant Flow Test; G
Request to schedule Preliminary Tests; G
Preliminary Test Report; G
Three copies of the completed Preliminary Test Report, no later that 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Engineer.

Request to schedule Final Acceptance Test; G

Final Acceptance Test Report

Three copies of the completed Final Acceptance Tests Reports, no later that 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Engineer.

SD-07 Certificates

Inspection by Fire Protection Engineer; G

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Engineer that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

Fire Protection Engineer; G

The name and documentation of certification of the proposed Fire Protection Engineer, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Sprinkler System Installer; G

Submit data showing the Sprinkler System Installer has successfully installed systems of the same type and design as specified herein. Data shall include names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months. Provide NICET certification of the system technician. Contractor shall submit data along with submittal of the Fire Protection Engineer Qualifications.

SD-10 Operation and Maintenance Data; G

Operating and Maintenance Instructions

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA as supplemented and modifies by this specification section.

Provide six manuals in accordance with NFPA 13. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier,
simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing a 4 hour on-site response to a service call on an emergency basis.

SD-11 Closeout Submittals

As-built drawings; G

As-built shop drawings, at no later than 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed. Provide electronic drawings in both dwg and pdf format.

On-site training

1.5 QUALIFICATIONS

1.5.1 Fire Protection Engineer

A Fire Protection Engineer is a registered professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES)

1.5.2 Sprinkler System Installer

The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months. Installation drawings, shop drawings and as-built drawings shall be prepared, by or under the supervision of, an system technician who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level III certification in Automatic Sprinkler System program or by a fire protection engineer.

1.6 QUALITY ASSURANCE

1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.6.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not
less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.6.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.6.4 Field Fabricated Nameplates

ASTM 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.

1.7 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

1.8 DELIVERY, STORAGE AND HANDLING

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

PART 2 PRODUCTS

2.1 UNDERGROUND PIPING COMPONENTS

2.1.1 Pipe

Pipe shall comply with NFPA 24. Minimum pipe size shall be 6 inches. Piping more than 5 feet outside the building walls shall comply with Section 33 11 00 WATER DISTRIBUTION.

2.1.2 Buried Utility Warning and Identification Tape

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold block letters continuously and repeatedly over the entire tape length. Warning and identification shall read "CAUTION BURIED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.
2.2 ABOVEGROUND PIPING COMPONENTS

All components of the aboveground piping shall fully comply with the requirements and recommended practices of NFPA 13 and this specification section. Aboveground piping shall be steel.

2.2.1 Steel Pipe

Pipe shall be rigid black steel. Steel piping shall be Schedule 40 for sizes less than 2-1/2 inches and Schedule 10 for sizes 2-1/2 inches or larger. Fittings into which sprinklers, sprinkler riser nipples, or drop nipples are threaded shall be welded, threaded, or grooved-end type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be permitted. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall be permitted in pipe sizes 1.5 inches and larger. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer. Steel piping with wall thickness less than Schedule 40 shall not be threaded. Side outlet tees using rubber gasketed fittings shall not be permitted. Sprinkler pipe and fittings shall be metal.

2.2.2 Grooved Mechanical Joints and Fittings

Grooved couplings, fittings and grooving tools shall be products of the same manufacturer.

2.2.3 Flexible Sprinkler Hose

The use of flexible sprinkler hose is not permissible.

2.2.4 Sprinklers

Provide sprinklers with k-factors as indicated on the Contract Drawings. Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Provide quick response sprinklers. Provide sprinkler types as indicated on the Contract Drawings. Temperature classification shall be ordinary or intermediate. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used. Deflector shall not be more than 3 inches below suspended ceilings. Ceiling plates shall not be more than 0.5 inch deep. Ceiling cups shall not be permitted.

2.2.5 Valves

Provide valves of types approved for fire service. Valves shall open by counterclockwise rotation. Provide an OS&Y or butterfly valve beneath each alarm. Check valves shall be clear opening swing-check type with inspection and access cover plate for sizes 8 inches and larger. Each control valve shall be electrically supervised; minimum contact ratings shall be 2.5 amps at 24 volts DC. Provide supervision against valve closure or tampering of valve.

2.2.6 Pipe Supports

Provide Pipe hangers and supports in accordance with NFPA 13.
2.2.7 Fire Department Connections

Fire department connection shall be pedestal type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a chromium plated finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains.

2.2.8 Backflow Prevention Assembly

Provide listed reduced pressure principle valve assembly backflow preventer. Each check valve shall have a drain. Backflow prevention assemblies shall have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR List. Listing of the specific make, model, design, and size in the FCCCHR List shall be acceptable as the required documentation."

2.3 ALARM INITIATING AND SUPERVISORY DEVICES

2.3.1 Sprinkler Alarm Switches

Provide vane type flow switch(es) with circuit opener or closer for the automatic transmittal of an alarm over the facility fire alarm system. Connection of switch shall be under Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM Vane type Alarm actuating devices shall have mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and shall instantly recycle. Flow switches for elevator power shunt shall have no retard feature. Provide properly lettered and approved metal sign to elevator flow switch stating the circuits' voltage, and identify the switch as an "Elevator Power Shunt Flow Switch". Flow switches serving elevator rooms shall have no time delay, they must trip instantaneously.

2.3.2 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.4 ACCESSORIES

2.4.1 Sprinkler Cabinet

Provide metal cabinet with extra sprinklers, including a representative sample of dry type sprinklers and sprinkler wrench adjacent to the building sprinkler riser. The number and types of extra sprinklers shall be as specified in NFPA 13.

2.4.2 Pipe Escutcheon

Provide split hinge metal plates for piping entering walls, floors, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.
PART 3   EXECUTION

3.1   INSPECTION BY FIRE PROTECTION ENGINEER

The Fire Protection Engineer shall inspect the sprinkler system periodically during the installation to assure the sprinkler system is being provided and installed in accordance with the contract requirements and the approved sprinkler system submittal(s). The Fire Protection Engineer shall attend both the preliminary and final tests, and shall sign the test results. After the preliminary testing has been completed, the Fire Protection Engineer, shall certify in writing the system is ready for the final inspections and tests. This report shall document any discrepancies found and what actions will be taken to correct. Any discrepancy noted during the periodic site visits or the preliminary testing shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.2   UNDERGROUND PIPING INSTALLATION

The methods of fabrication and installation of the underground piping shall fully comply with the requirements and recommended practices of NFPA 13, NFPA 24 and the contract drawings.

3.3   ABOVEGROUND PIPING INSTALLATION

The methods of fabrication and installation of the aboveground piping shall fully comply with the requirements and recommended practices of NFPA 13 and this specification section.

3.3.1   Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed. Exposed piping in finished areas shall be painted to match adjacent finishes. Pipe identification shall be omitted and exposed piping in finished spaces.

3.3.2   Pendent Sprinklers

Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch below the underside of the ceiling. Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grids.

3.3.3   Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. Bushings are prohibited.

3.3.4   Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with
pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07 84 00 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.3.5 Inspector's Test Connection

Provide test connections approximately 6 feet above the floor for each sprinkler system or portion of each sprinkler system equipped with an alarm device. Provide test connection piping to a drain location that can accept full flow where the discharge will be readily visible and where water may be discharged without property damage. Discharge to floor drains, janitor sinks or similar fixtures shall not be permitted. Provide discharge orifice of same size as corresponding sprinkler orifice. The penetration of the exterior wall shall be no greater than 2 feet above finished grade.

3.3.6 Backflow Preventer Test Connection

Provide downstream of the backflow prevention assembly UL 668 hose valves with 2.5 inch National Standard male hose threads with cap and chain. Provide one valve for each 250 gpm of system demand or fraction thereof. Provide a permanent sign in accordance with paragraph entitled "Identification Signs" which reads, "Test Valve."

3.3.7 Drains

Main drain piping shall be provided to discharge at the location indicated. Auxiliary drains shall be provided as required by NFPA 13.

3.3.8 Installation of Fire Department Connection

Connection shall be mounted approximately 3 feet above finished grade. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13.

3.3.9 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Valve identification signs shall be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum with red letters on a white background or white letters on red background. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.4 ELECTRICAL WORK

Except as supplemented and modified herein, electric equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 28 31 76 INTERIOR FIRE ALARM
3.5 PIPE PAINTING AND COLOR CODE MARKING

Paint and color code mark sprinkler piping system as specified in Section 09 90 00 PAINTS AND COATINGS.

3.6 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Submit request to schedule Preliminary Tests, no later than 21 days prior to the proposed start of the tests. Upon completion of specified tests, the Contractor shall submit for approval a Preliminary Test Report.

3.6.1 Underground Piping

3.6.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24.

3.6.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24.

3.6.2 Aboveground Piping

3.6.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13.

3.6.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly shall be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. The Contractor shall provide all equipment and instruments necessary to conduct a complete forward flow test, including 2.5 inch diameter hoses, playpipe nozzles, calibrated pressure gauges, and pitot tube gauge. The Contractor shall provide all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction) across the assembly shall be recorded. A metal placard shall be provided on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate determined during the preliminary testing. The pressure drop shall be compared to the manufacturer's data and the readings observed during the final inspections and tests.

3.7 HYDRANT FLOW TEST

Hydrant flow test procedures shall comply with NFPA 291. Submit request to schedule the Hydrant Flow Test no later than 21 days prior to the proposed test date. Notification shall include a map indicating the locations of the proposed test hydrants.
3.8 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. Submit request to schedule Final Acceptance Test, no later than 21 days prior to the proposed start of the tests. Notification shall include a copy of the Contractor's Material & Test Certificates.

An experienced technician regularly employed by the system installer shall be present during the inspection. The Fire Protection Engineer shall attend the final inspections and tests. At this inspection, repeat any or all of the required tests as directed. Correct defects in work provided by the Contractor, and make additional tests until the systems comply with contract requirements. Furnish appliances, equipment, water, electricity, instruments, connecting devices, and personnel for the tests. The Mid-Atlantic Division, Naval Facilities Engineering Command, Fire Protection Engineer, will witness formal tests and approve systems before they are accepted.

3.9 ON-SITE TRAINING

Submit request to schedule the On-site Training, at least 21 days prior to the start of related training but prior to the final inspections and tests. The sprinkler contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of two 8 hour sessions of normal working time and shall start after the system is functionally complete and after the Final Acceptance Test. The On-Site Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

3.10 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 Construction and Demolition Waste Management for additional requirements.

-- End of Section --
SECTION 22 00 70
PLUMBING, HEALTHCARE FACILITIES
11/11

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


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


AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001 (2008) Performance Requirements for Atmospheric Type Vacuum Breakers (ANSI approved 2009)


ASSE 1013 (2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers -
<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSE 1019</td>
<td>(2011) Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type (ANSI Approved 2004)</td>
</tr>
<tr>
<td>ASSE 1020</td>
<td>(2004; Errata 2004; Errata 2004) Performance Requirements for Pressure Vacuum Breaker Assembly (ANSI Approved 2004)</td>
</tr>
<tr>
<td>ASSE 1037</td>
<td>(2015) Performance Requirements for Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures</td>
</tr>
<tr>
<td>ASSE 1070</td>
<td>(2005) Performance Requirements for Water Temperature Limiting Devices</td>
</tr>
</tbody>
</table>

**AMERICAN WATER WORKS ASSOCIATION (AWWA)**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWWA 10084</td>
<td>(2005) Standard Methods for the Examination of Water and Wastewater</td>
</tr>
<tr>
<td>AWWA B300</td>
<td>(2010; Addenda 2011) Hypochlorites</td>
</tr>
<tr>
<td>AWWA B301</td>
<td>(2010) Liquid Chlorine</td>
</tr>
<tr>
<td>AWWA C606</td>
<td>(2015) Grooved and Shouldered Joints</td>
</tr>
<tr>
<td>AWWA C651</td>
<td>(2014) Standard for Disinfecting Water Mains</td>
</tr>
<tr>
<td>AWWA C652</td>
<td>(2011) Disinfection of Water-Storage Facilities</td>
</tr>
<tr>
<td>AWWA C700</td>
<td>(2015) Standard for Cold Water Meters - Displacement Type, Bronze Main Case</td>
</tr>
<tr>
<td>AWWA D100</td>
<td>(2011) Welded Steel Tanks for Water Storage</td>
</tr>
</tbody>
</table>
AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding

ASME INTERNATIONAL (ASME)

ASME A112.19.3/CSA B45.4 (2008; R 2013) Stainless Steel Plumbing Fixtures
ASME A112.36.2M (1991; R 2012) Cleanouts
ASME A112.6.1M (1997; R 2012) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3 (2001; R 2007) Standard for Floor and Trench Drains
ASME B1.20.1 (2013) Pipe Threads, General Purpose (Inch)
ASME B16.18 (2012) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21 (2011) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.23 (2011) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.29 (2012) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.34 (2013) Valves - Flanged, Threaded and Welding End
ASME B31.1 (2014; INT 1-47) Power Piping
ASME B31.5 (2013) Refrigeration Piping and Heat Transfer Components

ASME B40.100 (2013) Pressure Gauges and Gauge Attachments

ASME BPVC SEC IV (2010) BPVC Section IV-Rules for Construction of Heating Boilers

ASME BPVC SEC IX (2010) BPVC Section IX-Welding and Brazing Qualifications

ASME BPVC SEC VIII D1 (2010) Boiler and Pressure Vessel Code; Section VIII, Rules for Construction of Pressure Vessels Division 1


ASTM INTERNATIONAL (ASTM)


ASTM D2822/D2822M (2005; E 2011; R 2011) Asphalt Roof Cement


CAST IRON SOIL PIPE INSTITUTE (CISPI)


COPPER DEVELOPMENT ASSOCIATION (CDA)


CSA GROUP (CSA)

CSA B45.5/IAMPO Z124 2011 Plastic Plumbing Fixtures
FOUNATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)


INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO Z124.5 (2013) Plastic Toilet (Water Closet) Seats

INTERNATIONAL CODE COUNCIL (ICC)


INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)


MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110 (2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends


MSS SP-67 (2011) Butterfly Valves


MSS SP-70 (2011) Gray Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71 (2011; Errata 2013) Gray Iron Swing Check Valves, Flanged and Threaded Ends

MSS SP-72 (2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-78 (2011) Cast Iron Plug Valves, Flanged and Threaded Ends

MSS SP-80 (2013) Bronze Gate, Globe, Angle and Check Valves
Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2014) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NEMA MG 1 (2014) Motors and Generators

Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


NFPA 90A (2015) Standard for the Installation of
Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF/ANSI 14 (2014) Plastics Piping System Components
and Related Materials

NSF/ANSI 42 (2014) Drinking Water Treatment Units -
Aesthetic Effects

NSF/ANSI 53 (2015) Drinking Water Treatment Units -
Health Effects

NSF/ANSI 61 (2015) Drinking Water System Components -
Health Effects

NSF/ANSI 372 (2016) Drinking Water System Components -
Lead Content

CANADIAN STANDARDS ASSOCIATION / NATIONAL STANDARD OF CANADA

CAN/CSA C22.2 No. 120 (2013) Refrigeration Equipment

PLUMBING AND DRAINAGE INSTITUTE (PDI)


SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (2009) Hose Clamp Specifications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

PL 93-523 (1974; A 1999) Safe Drinking Water Act

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

10 CFR 430 Energy Conservation Program for Consumer
Products

40 CFR 50.12 National Primary and Secondary Ambient Air

SECTION 22 00 70 Page 7
1.2 SYSTEM DESCRIPTION

Provide complete and operable plumbing systems including sanitary and storm drainage, domestic water, plumbing fixtures, valves, pumps, water heaters, supports, and all associated appurtenances.

1.2.1 Sustainable Design Requirements

1.2.1.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

1.2.1.2 Environmental Data

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

1.2.2 Performance Requirements

1.2.2.1 Plumbing Fixtures

Water flow and consumption rates shall, at a minimum, comply with requirements in PL 102-486.

1.2.3 Accessibility of Equipment

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, and equipment requiring access, in locations freely accessible through access doors.

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

Plumbing System; G

SD-03 Product Data

Local/Regional Materials
Environmental Data
Pipe and Fittings; G
Pipe Hangers, Inserts, and Supports; G
Valves; G
Plumbing Fixtures; G
Backflow Preventers; G
Drains and Backwater Valves; G
Cleanouts; G
Water Heaters; G
Storage Tanks; G
Pumps; G
Water Softener System; G
Water Service Meter; G
Reverse Osmosis System; G
Vibration-Absorbing Features; G
Plumbing System

SD-06 Test Reports

Tests, Flushing and Disinfection
Test of Backflow Prevention Assemblies.

SD-07 Certificates

Materials and Equipment
Welding
Bolts

SD-10 Operation and Maintenance Data

Plumbing System; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 Manufacturer Qualifications

Manufacturers shall be regularly engaging in the manufacturing, supplying, and servicing of specified products and equipment, as well as, providing engineering and/or start-up services as specified. Provide evidence demonstrating compliance for a minimum of 5 years, and on 5 projects of similar complexity.

1.4.1.2 Installer Qualifications

Installer shall be licensed, and shall provide evidence of the successful completion of at least five projects of equal or greater size and
complexity. Provide tradesmen skilled in the appropriate trade.

1.4.2 Welding

Weld piping in accordance with qualified procedures using performance-qualified welders and welding operators. Submit a list of names and identification symbols of qualified welders and welding operators. Provide documentation that welders, and welding operators are certified in accordance with American Welding Society Standard AWS B2.1/B2.1M. Qualify procedures and welders in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. Notify the Contracting Officer 24 hours in advance of tests, and perform the tests at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record.

1.4.3 Regulatory Requirements

1.4.3.1 International Code Council (ICC) Codes

Unless otherwise required herein, perform plumbing work in accordance with the ICC IPC.

a. For ICC Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

b. For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4.3.2 Referenced Publications

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.4.4 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.
1.4.5 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.5 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.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Provide standard products that have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

2.2 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. See also paragraph "Nameplates" in PART 3.

2.3 MATERIALS AND EQUIPMENT

Submit manufacturer's catalog data with highlighting to show model, size, options, etc., that are intended for consideration. Provide adequate data to demonstrate compliance with contract requirements. Submit certificate stating that the design, fabrication, and installation conform to the code, where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code.

a. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for reverse osmosis water service shall bear the NSF seal "NSF-PW."

b. Cast-iron pipe shall contain a minimum of 95 percent recycled content. Hubless cast-iron soil pipe shall not be installed underground or under concrete floor slabs.

c. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers...
shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as water coolers, lavatory faucets, kitchen and bar faucets, ice makers, supply stops and end point control valves used to dispense water for drinking shall meet the requirements of NSF/ANSI 61, Section 9.

2.4 PIPE AND FITTINGS

2.4.1 Domestic Water Piping

Domestic water piping at service entrance (from 1 foot inside building to 5 feet outside): Same as indicated for outside utilities.

a. 2 inches and smaller after service entrance above grade:

(1) Copper tube conforming to ASTM B88, type L, with soldered joints and wrought copper ASME B16.22 or cast brass ASME B16.18 fittings.

b. Below grade:

(1) Copper tube conforming to ASTM B88, type K soft, with brazed joints and wrought copper ASME B16.22 fittings.

(2) Where below-grade run of piping is shorter than 50 feet, below-grade joints are not acceptable.

c. 2-1/2 to 4 inches after service entrance:

(1) Copper tube conforming to ASTM B88, type L, with soldered joints and wrought copper ASME B16.22 or cast brass ASME B16.18 fittings.

2.4.2 Reverse Osmosis Water Piping

CPVC Plastic Pipe, Fittings, and Solvent Cement: ASTM D2846/D2846M, Schedule 40 CPVC. Provide transition union connections or threaded gate valve between copper tubing and chlorinated polyvinyl chloride (CPVC) piping. Provide male threaded adapters with PTFE (polytetrafluoroethylene) pipe thread paste for threaded connections to valves, strainers, and equipment.

2.4.3 Drainage Piping (Soil, Waste, Vent, Indirect, and Storm)

a. Above grade:

(1) Cast-iron conforming to ASTM A74, hubbed pipe and fittings with ASTM C564 elastomeric push joints.

(2) Cast-iron conforming to CISPI 301 or ASTM A888, hubless pipe, fittings, and CISPI 310 elastomeric sealing sleeves with stainless-steel or cast iron clamps.

(3) Copper tube conforming to ASTM B306, type DWV or heavier, with soldered joints and wrought copper ASME B16.29 or cast brass ASME B16.23 drainage and vent fittings. Piping within MRI shielding shall be copper.
b. Below grade: Cast-iron conforming to ASTM A74, hubbed pipe and fittings with ASTM C564 elastomeric push joints.

2.4.4 Pressure Drainage Piping

a. Galvanized steel, cast iron drainage fittings with threaded joints.

2.4.5 Exposed Piping in Finished Areas

a. Chrome or nickel plated brass to wall or floor.

b. Piping 2 inches and larger may be provided with chrome or nickel plated brass sleeves to cover pipe and fittings in lieu of plating.

2.4.6 Trap Primer Pipe Between Primer Device and Drain

a. Above grade: Copper tube conforming to ASTM B88, type K or L, with soldered joints and wrought copper ASME B16.22 or cast brass ASME B16.18 fittings.

b. Below grade: Copper tube conforming to ASTM B88, type K soft, with soldered joints and wrought copper ASME B16.22 or cast brass ASME B16.18 fittings.

2.5 PIPE JOINT MATERIALS

Hubless cast-iron soil pipe shall not be used under ground. Solder containing lead shall not be used with copper pipe. Mark cast iron soil pipe and fittings with the collective trademark of the Cast Iron Soil Pipe Institute. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310


c. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

d. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

e. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

f. Solder Material: Solder metal shall conform to ASTM B32 and be Code approved "Lead Free" having a chemical composition equal to or less than 0.2 percent lead.

g. Solder Flux: Flux shall be liquid form, non-corrosive, Code approved "Lead Free" and conform to ASTM B813, Standard Test 1.
h. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.

i. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C564.


k. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M. Submit written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

2.6 MISCELLANEOUS MATERIALS

Miscellaneous materials shall conform to the following:


c. Asphalt Roof Cement: ASTM D2822/D2822M.

d. Hose Clamps: SAE J1508.

e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

f. Metallic Cleanouts: ASME A112.36.2M.

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.

i. Hypochlorites: AWWA B300.

j. Liquid Chlorine: AWWA B301.

k. Gauges - Pressure Indicating Dial Type - Elastic Element: ASME B40.100.

l. Thermometers: ASTM E1. Mercury shall not be used in thermometers.

2.7 PIPE INSULATION MATERIAL

Provide insulation as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.
2.8 PIPE HANGERS, INSERTS, AND SUPPORTS

Provide pipe hangers, inserts, and supports conforming to MSS SP-58.

2.9 VALVES

Provide valves on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

<table>
<thead>
<tr>
<th>Description</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butterfly Valves</td>
<td>MSS SP-67</td>
</tr>
<tr>
<td>Cast-Iron Gate Valves, Flanged and Threaded Ends</td>
<td>MSS SP-70</td>
</tr>
<tr>
<td>Cast-Iron Swing Check Valves, Flanged and Threaded Ends</td>
<td>MSS SP-71</td>
</tr>
<tr>
<td>Ball Valves with Flanged Butt-Welding Ends for General Service</td>
<td>MSS SP-72</td>
</tr>
<tr>
<td>Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends</td>
<td>MSS SP-110</td>
</tr>
<tr>
<td>Cast-Iron Plug Valves, Flanged and Threaded Ends</td>
<td>MSS SP-78</td>
</tr>
<tr>
<td>Bronze Gate, Globe, Angle, and Check Valves</td>
<td>MSS SP-80</td>
</tr>
<tr>
<td>Steel Valves, Socket Welding and Threaded Ends</td>
<td>ASME B16.34</td>
</tr>
<tr>
<td>Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends</td>
<td>MSS SP-85</td>
</tr>
<tr>
<td>Backwater Valves</td>
<td>ASME A112.14.1</td>
</tr>
<tr>
<td>Vacuum Relief Valves</td>
<td>ANSI Z21.22/CSA 4.4</td>
</tr>
<tr>
<td>Water Pressure Reducing Valves</td>
<td>ASSE 1003</td>
</tr>
<tr>
<td>Water Heater Drain Valves</td>
<td>ASME BPVC SEC IV, Part HLW-810</td>
</tr>
<tr>
<td>Trap Seal Primer Valves</td>
<td>ASSE 1018</td>
</tr>
<tr>
<td>Temperature and Pressure Relief Valves for Hot Water Supply Systems</td>
<td>ANSI Z21.22/CSA 4.4</td>
</tr>
<tr>
<td>Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers</td>
<td>ASME CSD-1 Safety Code, Part CW, Article 5</td>
</tr>
<tr>
<td>Thermostatic Mixing Valves</td>
<td>ASSE 1017</td>
</tr>
</tbody>
</table>

2.9.1 Thermostatic Mixing Valves

2.9.1.1 Master Mixing Valves

ASSE 1017. Provide high/low type mixing valve assembly with large type thermostatic water mixing valve for exposed piping with solid bimetal
thermostat linked directly to valve porting, adjustable limit stop, color coded dial: "C" to "H", wall support, union angle strainer checkstops on inlets, rough bronze finish, outlet ball valve, pilot actuated regulating valve with pressure gage, intermediate type thermostatic water mixing valve, union angle strainer checkstops on inlets, thermostat, adjustable limit stop, color coded dial: "C" to "H", outlet ball valve, dial thermometer (range 0 to 140 degrees F), rough bronze finish, inlet piping manifold, factory assembled and tested. Mixing valve assembly and domestic hot water return shall be piped according to manufacturer's recommended piping method. Set mixing valves as indicated on Contract Drawings. Mixing valves shall maintain water temperature within 4 degrees F of setpoint.

2.9.1.2 Lavatory and Sink Mixing Valves

ASSE 1070. Provide thermostatic mixing valve for each lavatory and/or sink faucet in restrooms. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Set mixing valves at 105 degrees F. Mixing valves shall maintain water temperature within 4 degrees F of setpoint.

2.10 PLUMBING FIXTURES

2.10.1 General

Fixtures shall be water conservation type, in accordance with ICC IPC. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. Provide vitreous china fixtures that are nonabsorbent, hard-burned, and vitrified throughout the body. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Equip fixtures with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years shall be copper alloy with all visible surfaces chrome plated. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature. Maximum allowable lead content in wetted surfaces of pipes, pipe fittings, plumbing fittings and fixtures, as determined by a weighted average shall not exceed 0.25 percent.

2.10.2 Flushometer Valves

Provide flushometer valves with an ADA compliant, metal oscillating, non-stand-open handle, backcheck angle control stop, and vacuum breaker. Flushometer valves shall be either a large diaphragm, or fixed volume
piston type with filtered metering bypass. Valve shall not be able to be converted externally or internally to exceed a low consumption flush. Handle packing, main seat, stop seat and vacuum breaker shall be molded from a chloramine resistant rubber compound. Provide valve body, cover, tailpiece and control stop in conformance with ASTM Alloy Classification for semi-red brass. All exposed surfaces shall be chrome plated. Handle shall have factory applied antimicrobial coating. Flushometer valves shall conform to ASSE 1037.

2.10.3 Fixture Descriptions

2.10.3.1 Electric Water Coolers

Provide self-contained, mechanically refrigerated electric water coolers with more than a single thickness of metal between the potable water and the refrigerant in the heat exchanger, wall-hung, bubbler style, air-cooled condensing unit, stainless steel splash receptor and basin, and stainless steel cabinet. Provide 8 gph minimum capacity of 50 degrees F water when supplied with 80 degrees F inlet water and a 90 degrees F room temperature. Control bubblers by push levers or push bars, front mounted or side mounted near the front edge of the cabinet. Bubbler spouts shall be mounted at maximum of 36 inches above floor and at front of unit basin with 27 inch minimum knee clearance from bottom of unit to finished floor. Spouts shall direct water flow at least 4 inches above unit basin and trajectory parallel or nearly parallel to the front of unit. Provide chrome plated 3/8 inch OD soft-copper tube supplies with set-screw escutcheons, and loose key stops. Provide chrome plated 1-1/4 x 1-1/2 inch semi-cast P-trap with cleanout with 17 gage x 1-1/2 inch chrome plated copper tube trap arm with set-screw escutcheon. Provide filters for chlorine in supply piping to faucets. Provide ASME A112.6.1M concealed steel pipe chair carriers.

2.10.3.1.1 EWC-1 (JSN R2201C)

Accessible (forward facing), dual-level, recessed, brushed stainless steel, recessed refrigeration unit, dual level extensions with oval receptors, recessed bottle filler, access panel cover, rounded corners, rounded edges, designed to eliminate splashing and standing waste water. Provide self-closing, semi-circular push bars with full 180 degree activation.

2.10.3.1.2 EWC-2 (JSN R2202A)

In-wall recessed bottle filling station. Unit shall be stainless steel construction with plastic ABS alcove and lower hinged grille panel for access and servicing. Sensor-activation with an auto 20-second shut-off timer. Shall include display indicating count of plastic bottles saved from waste. Bottle filler shall provide 1.1-1.5 gpm flow rate with laminar flow to minimize splashing. Shall include 3000-gallon capacity filter, certified to NSF/ANSI 42 and NSF/ANSI 53, with visual monitor to indicate when replacement is necessary. Shall include integrated silver ion anti-microbial protection in key areas. Unit shall meet ADA guidelines. Unit shall be lead free design which is certified to NSF/ANSI 61 and NSF/ANSI 372 and meets Federal and State low-lead requirements. Unit shall be certified to UL 399 and CAN/CSA C22.2 No. 120.

2.10.3.2 Emergency Fixtures

Provide copper alloy control valves. Provide an air-gap with the lowest
potable eye and face wash water outlet located above the overflow rim by not less than the International Plumbing Code minimum. Provide a pressure-compensated tempering valve, with leaving water temperature setpoint adjustable throughout the range 60 to 95 degrees F. Provide packaged, UL listed, alarm system; including an amber strobe lamp, horn with externally adjustable loudness and horn silencing switch, mounting hardware, and waterflow service within NEMA Type 3 or 4 enclosures.

2.10.3.2.1 EW-1 (JSN P2000)

Eye/face wash, ANSI/ISEA Z358.1, wall-mounted self-cleaning, non-clogging eye and face wash with quick opening, full-flow valves, corrosion-resisting steel eye and face wash receptor. Unit shall deliver 3 gpm of aerated water at 30 psi flow pressure, with eye and face wash nozzles 33 to 45 inches above finished floor. Provide 1-1/4 inch standard chrome drain fitting. ANSI/ISEA Z358.1 and ASSE 1071 compliant.

2.10.3.2.2 ES-1 (JSN P5210)

Combination drench shower and eye/face wash, ANSI/ISEA Z358.1. Components shall be mounted on a minimum 1-1/4 inch diameter stainless steel pipe stanchion with floor flange. Provide chrome plated split ring support to adjacent wall surface 12 inches below shower arm connection. Eye/face wash, swing down, self-cleaning, non-clogging eye and face wash with quick opening, 1/2 inch IPS chrome-plated brass full-flow push to activate stay-open valve. Eye/face wash shall deliver 3 gpm of aerated water at 30 psi flow pressure. Shower head shall be a minimum of 8 inch diameter. Shower valve shall be 1 inch IPS chrome-plated brass stay-open valve with stainless steel actuating arm and pull rod. Shower shall deliver 30 gpm flow and 20 inch pattern at 60 inches above floor. This unit shall be suitable for and installed for handicap access.

2.10.3.3 Lavatories

a. Provide ASME A112.19.2/CSA B45.1, white vitreous china, integral back type wall hung lavatories with supply openings for use with top mounted faucet, and openings for concealed arm carrier installation. Provide chrome plated 3/8 inch OD soft-copper tube supplies with set-screw escutcheons, and loose key stops. Provide chrome plated 1-1/4 x 1-1/2 inch semi-cast P-Trap with cleanout with 17 gauge x 1-1/2 inch chrome plated copper tube trap arm with set-screw escutcheon. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 31 inches above the floor, except 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor for accessible lavatories.

(1) L-1 (Similar to JSN P3100): 20 x 18. Fixture shall be equipped with combination faucet, 4-inch centers, elevated gooseneck spout with non-aerated flow outlet, and 4-inch wrist action handles. Faucet body shall not have a pop-up drain rod hole. Plugged holes are not acceptable. The flow shall be limited to 0.35 gpm at a flowing water pressure of 80 psi. Provide chrome plated cast brass offset grid drain fitting with chrome plated cast brass elbow and 17 gauge 1 1/4-inch seamless brass offset tailpiece, "P" trap, and heavy duty brass body chrome plated angle stop valves. Provide accessible protection on exposed water supplies and "P" trap and drain piping with insulation kit molded from impact-resistant, stain-resistant, antimicrobial vinyl.
(2) L-4 (Similar to JSN P3100): 20 x 18. Fixture shall be equipped with chrome plated brass combination faucet, 4-inch centers, elevated plain end gooseneck spout with laminar flow device in the spout base, and 4-inch wrist action handles. Faucet body shall not have a pop-up drain rod hole. Plugged holes are not acceptable. The flow shall be limited to 1.5 gpm at a flowing water pressure of 80 psi. Provide chrome plated cast brass offset grid drain fitting with chrome plated cast brass elbow and 17 gauge 1 1/4-inch seamless brass offset tailpiece, "P" trap, and heavy duty brass body chrome plated angle stop valves. Provide accessible protection on exposed water supplies and "P" trap and drain piping with insulation kit molded from impact-resistant, stain-resistant, antimicrobial vinyl.

(3) L-5 (Similar to JSN P3100): 20 x 18. Fixture shall be equipped with chrome plated brass, single lever hot and cold water mixing faucet with laminar flow outlet. Faucet body shall not have a pop-up drain rod hole. Plugged holes are not acceptable. The flow shall be limited to 1.5 gpm at a flowing water pressure of 80 psi. Provide chrome plated cast brass offset grid drain fitting with chrome plated cast brass elbow and 17 gauge 1 1/4-inch seamless brass offset tailpiece, "P" trap, and heavy duty brass body chrome plated angle stop valves. Provide accessible protection on exposed water supplies and "P" trap and drain piping with insulation kit molded from impact-resistant, stain-resistant, antimicrobial vinyl.

b. Lavatory system specified under section 12 36 00.00 20 MANUFACTURED VANITIES with integral bowl(s), including support assembly. Provide chrome plated cast brass offset grid drain fitting with chrome plated cast brass elbow and 17 gauge, 1 1/4-inch seamless brass offset tailpiece, "P" trap, and heavy duty brass body chrome plated angle stop valves. Provide chrome plated 3/8-inch OD soft-copper tube supplies with set-screw escutcheons, and loose key stops. Supplies, stops, and waste shall be installed within shroud furnished with fixture. Coordinate faucet location(s) with required openings on plumbing fixture(s).

(1) L-2 (JSN P3100A): Single station lavatory system. Fixture shall be equipped with chrome plated brass, single lever hot and cold water mixing faucet with elevated spout and non-aerated flow outlet, deck mounted, single hole installation. Faucet body shall not have a pop-up drain rod hole. Plugged holes are not acceptable. The flow shall be limited to 0.35 gpm at a flowing water pressure of 80 psi. Provide chrome plated cast brass offset grid drain fitting with chrome plated cast brass elbow and 17 gauge 1 1/4-inch seamless brass offset tailpiece, "P" trap, and heavy duty brass body chrome plated angle stop valves.

(2) L-3 (JSN P3100B): Two station lavatory system. At each lavatory station, fixture shall be equipped with chrome plated brass, single lever hot and cold water mixing faucet with elevated spout and non-aerated flow outlet, deck mounted, single hole installation. Faucet body shall not have a pop-up drain rod hole. Plugged holes are not acceptable. The flow shall be limited to 0.35 gpm at a flowing water pressure of 80 psi.
2.10.3.4  Mop Service Basin

a. Provide terrazzo mop sinks made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

b. MS-1 (JSN P4700): 36 x 24 x 12 inches, precast terrazzo with integral stainless steel caps with tiling flange, 3-inch cast brass drain with stainless strainer, lead caulk drain connection and 20 gage, type 304 stainless steel splash/wall guards. Provide chrome plated, 8-inch centers, wall mounted cast brass service sink faucet with rigid spout with integral vacuum breaker, 3/4-inch hose threads, pale hook, wall brace, indexed lever handles, hose, hose bracket, and mop hanger. Provide ball valves and check valves above ceiling in supply piping to service sink faucet.

2.10.3.5  Plaster Traps

2.10.3.5.1  PT-1 (JSN P7650)

Small, 10 inches high by 6 inches wide by 6 inches long; shall be cast aluminum, rectangular with solid top and hinged bottom having integral baffles and 1/4 inch drain plug; bolted bottom shall provide easy access for removal of screens for cleaning and recovery of items in sediment bucket.

2.10.3.6  Showers

Provide single control pressure equalizing shower valves with body mounted from behind the wall with threaded connections. Provide tubing mounted from behind the wall between faucets and shower assembly. Provide separate globe valves or angle valves with union connections in each supply to faucet. The top of drain outlets shall be polished stainless steel.

2.10.3.6.1  SH-1 (JSN P5040)

Wall mounted detachable spray assembly, 24 inch wall bar, elevated vacuum breaker, supply elbow and flange and valve. All external trim, chrome plated metal. Plastic shower head with flow control to limit discharge to 1.5 gpm, 5 foot length of rubber lined corrosion resistant steel, chrome plated metal flexible, or white vinyl reinforced hose and supply wall elbow. Design showerhead to fit in palm of hand. Provide corrosion resistant steel or chrome plated metal wall bar with an adjustable swivel hanger for showerhead. Fasten wall bar securely to wall for hand support. Combination thermostatic and pressure anti-scald balancing valve, with chrome plated metal lever type operating handle adjustable for rough-in variations and chrome plated metal or corrosion resistant steel face plate. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, corrosion resistant steel or thermoplastic material. Valve inlet and outlet shall be 1/2 inch IPS. Provide external screwdriver check stops, vacuum breaker and temperature limit stops. Set stops for a maximum temperature of 105 degrees F. All exposed fasteners shall be vandal resistant. Valve shall provide a minimum of 6 gpm at 45 psi pressure drop. Provide CSA B45.5/IAMPO Z124 prefabricated shower floor, ADA compliant, reinforced solid surface material, color and texture shall be continuous throughout solid surface material, "S" pattern molded into floor; refer to "Floor Finish
Identification" schedule on contract drawing AF610.

2.10.3.7 Sinks

Provide ASME A112.19.3/CSA B45.4, Type 302(18-8) or 304(18-8) stainless steel sinks with integral mounting rim for flush installation, with undersides fully sound deadened, with supply openings for use with top mounted faucet, and with 3.5 inch drain outlet. Sink depth less than or equal to 10 inch shall be 18 gage. Sink depth greater than 10 inch shall be 16 gage. Provide flow restrictor (laminal flow type) in base of faucet spout. Provide spout with plain cup. Water flow rate shall be 1.5 gpm when measured at a flowing water pressure of 60 psi. Provide chrome plated 3/8 inch OD soft-copper tube supplied with set-screw escutcheons, and loose key stops. Provide chrome plated 1-1/2 inch semi-cast P-trap with cleanout with 17 gage x 1-1/2 inch chrome plated copper tube trap arm with set-screw escutcheon. Provide separate 1.5 inch P-trap and drain piping to vertical vent piping from each compartment. Coordinate hole quantities, locations, and centerings with faucet types indicated in fixture descriptions. Provide exact numbers of holes necessary. Use of faucet hole covers is not acceptable. Dimensions given are overall, and bowl in the following order: left to right, front to back depth. Sinks located in casework designated as handicap accessible shall be same as specified except the basin depth shall not be greater than 6 inches and the drain outlet shall be located to the rear of the basin.

2.10.3.7.1 S-1 (JSN CS010)

Single bowl, counter-mounted, 17-1/2 x 15 x 6 inches, bowl 12 x 12 x 6 inches. Drain outlet shall be located to the rear of the basin. Faucet shall be 4 inch centerset with two 4 inch wristblades and 5 inch diameter fixed gooseneck spout.

2.10.3.7.2 S-2 (JSN CS090)

Single bowl, counter-mounted, 22 x 19-1/2 x 7-1/2 inches, bowl 18 x 14 x 7-1/2 inches. Faucet shall be 4 inch centerset with two 4 inch wristblades and 5 inch diameter fixed gooseneck spout.

2.10.3.7.3 S-3 (JSN CS140)

Single bowl, counter-mounted, 19-1/2 x 19 x 10-1/8 inches, bowl 16 x 13-1/2 x 10-1/8 inches. Faucet shall be 4 inch centerset with two 4 inch wristblades and 5 inch diameter fixed gooseneck spout.

2.10.3.7.4 S-4 (JSN CS150)

Single bowl, counter-mounted, 22 x 19-1/2 x 10-1/8 inches, bowl 18 x 19 x 10-1/8 inches. Faucet shall be 4 inch centerset with two 4 inch wristblades and 5 inch diameter fixed gooseneck spout.

2.10.3.7.5 S-5 (JSN CS180)

Single bowl, counter-mounted, 25 x 22 x 12-1/8 inches, bowl 21 x 15-3/4 x 12-1/8 inches. Faucet shall be 4 inch centerset with two 4 inch wristblades and 5 inch diameter fixed gooseneck spout.

2.10.3.7.6 S-6 (JSN CS200)

Single bowl, counter-mounted, 31 x 22 x 11-1/2 inches, bowl 28 x 16 x
11-1/2 inches. Faucet shall be 4 inch centerset with two 4 inch wristblades and 5 inch diameter fixed gooseneck spout.

2.10.3.7.7 S-7 (JSN A1195)

Triple bowl, counter mounted, 54 x 22 x 10-1/8 inches, each bowl 16 x 16 x 10-1/8 inches. Provide deck-mounted 8-inch centerset, chrome plated solid brass body faucet with 4-inch wrist blade handles, quarter-turn ceramic cartridges and 8-inch chrome plated cast brass swing spout centered on the right two bowls (facing sink). Provide commercial grade, deck-mounted, adjustable, 8-inch centerset, chrome plated solid brass body pre-rinse fitting with lever handles, chrome plated brass riser with 44-inch stainless steel hose with outer spring coil, self-closing spray head with hold down ring and chrome plated riser support and hook assembly centered on the left bowl (facing sink). Additional backing shall be provided in the wall for installation of the riser support.

2.10.3.7.8 S-8 (JSN D0680, D0680A, D0680B, D0680C, D0680D)

Government furnished, contractor installed. Provide rough-in and final connections.

2.10.3.7.9 S-9 (JSN P6500)

Enameled cast iron service sink with integral back and wall hanger supports, minimum dimensions of 22 inches wide by 20 inches front to rear, with two supply openings in 10 inch high back. Provide floor supported wall outlet cast iron P-trap and stainless steel rim guards as recommended by service sink manufacturer. Provide back mounted washerless service sink faucets with vacuum breaker and 3/4-inch external hose threads, pail hook and wall bracket support.

2.10.3.8 S-10 (JSN D0960)

Specified under Section 11 74 00. Provide rough-in and final connections.

2.10.3.9 Sink, Surgeons Scrub

2.10.3.9.1 SSS-1 (Similar to JSN P6990)

Two station, wall-mounted, gooseneck spouts, electronically timed with long (10 minute) and short (3, 4, 5 minute) cycles. Construction shall be of seamless welded 16 gauge, Type 304, stainless steel. Cabinet shall be sound-deadened with a fire-resistant material. Unit shall be wall mounted using a mounting carrier. Front panels shall be easily removed for access to the water control valves, waste connections, stops and strainers. Sink bottoms shall be sloping to minimize splashing and a 1-1/2 inch OD tailpiece with an 3 inch flat strainer drain. Provide each compartment (station) with a gooseneck assembly with a 1-1/2 inch sprayhead that can be removed for sterilization. Provide adjustable thermostatic mixing valve with anti-scald feature for each compartment and controlled from the top mounted control panel. Control shall be watertight and top mounted. Timing device shall be internal to reduce tampering. Plastic splash shield shall be provided between compartments. Provide foot-controlled soap dispensers at each compartment. Sink shall include 120 volt, 2 ampere power to an internal junction box.
2.10.3.10 Urinals

Provide ASME A112.19.2/CSA B45.1, white vitreous china, wall-mounted, wall outlet, urinals with integral trap, drain line connection, and extended side shields. The trap design shall comply with the IPC. Install urinal rim 24 inches above the floor at non-accessible locations. Urinals installed in compliance with ADA requirements shall be mounted with the rim 17 inches above the floor. Provide ASME A112.6.1M concealed chair carriers. Urinals equipped with flush valves shall have a flushing volume of the urinal and flush valve combination not exceeding the fixture design rating. Mount flush valves not less than 11 inches above the fixture.

2.10.3.10.1 U-1 (Similar to JSN P8100)

High efficiency washout for manual flush valve. The maximum water use allowed shall be 0.125 gallons per flush at a flowing water pressure of 80 psi.

2.10.3.10.2 U-2

Same as U-1 except accessible mounting height per ICC A117.1.

2.10.3.11 Water Closets

Provide ASME A112.19.2/CSA B45.1, white vitreous china, elongated bowl, wall-hung water closets. The trap design shall comply with the IPC. Install top of toilet seat 14 to 15 inches, above the floor at non-accessible locations. Water closets installed in compliance with ADA requirements shall be mounted with rim of seat 17 to 19 inches above the floor. Water closets equipped with flush valves shall have a flushing volume of the water closet and flush valve combination not exceeding the fixture design rating. Water flushing volume of the water closet and flush valve combination shall not exceed 1.28 gallons per flush. Provide white solid plastic elongated open-front seat without cover, with check hinge. Seat shall conform to IAPMO Z124.5. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls. Provide ASME A112.6.1M heavy duty 500 pound capacity chair carriers.

2.10.3.11.1 WC-1 (Similar to JSN P9050)

High efficiency (HET), siphon-jet for manual flushometer valve. High efficiency washout for solenoid valve. The maximum water use allowed shall be 1.28 gallons per flush at a flowing water pressure of 80 psi.

2.10.3.11.2 WC-2 (Similar to JSN P9050)

Same as WC-1 except accessible mounting height per ICC A117.1. Provide riser with grab bar offset. Install flush valve with handle facing the wide side of the water closet.

2.10.3.12 Hose Bibbs and Hydrants

2.10.3.12.1 HB-1

Hose bibb with vacuum-breaker backflow preventer, brass construction with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose
connection. Handle shall be securely attached to stem.

2.10.3.12.2 WHY-1

Wall hydrant (freezeproof) ASSE 1019 with vacuum-breaker backflow preventer and shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. Provide brass or bronze operating rod within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. Provide brass or bronze valve with coupling and union elbow having metal-to-metal seat. Valve rod and seat washer shall be removable through the face of the hydrant. Provide hydrant with 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.10.3.13 Plumbing Utility Boxes

2.10.3.13.1 PWB-1 (JSN P8710)

Recessed plumbing wall box constructed of minimum 18 gage, type 304 stainless steel with plugged and capped waste and supply sizes as shown. Provide with 16 gage stainless steel cover plate with stainless screws to conceal utility connections for future sink/equipment. Note: Waste line is not trapped in wall at Plumbing Wall Boxes.

2.10.3.13.2 Gas Valve Boxes

Recessed gas valve box constructed of minimum 16 gage, type 304 stainless steel. Provide with 16 gage stainless steel hinged door polished to a satin finish with keyed lock cylinder. Box shall be minimum 12 x 12 x 4 inches deep to allow for installation of gas isolation valve within box. Provide rubber grommets to seal pipe penetrations through box. Turn over lock keys to the Contracting Officer.

2.11 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced-pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR Manual. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.12 DRAINS AND BACKWATER VALVES

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.12.1 Floor and Shower Drains

Provide floor and shower drains with coated cast iron bodies, double drainage pattern for embedding in the floor construction, and seepage pan having weep holes or channels for drainage to the drainpipe. The
grate/strainer shall be adjustable to floor thickness. Provide an integral clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane when required. Provide with threaded outlet connection. Between the outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.6.3. Grate/strainer weight loading classification is based on ASME A112.6.3. Dimensions are nominal. Provide drain with trap primer connection, trap primer, and connection piping.

2.12.1.1 FD-1
12 inch diameter flashing collar, 4 inch deep body and 8 inch diameter removable, non-tilt stainless steel strainer with minimal free area of 1.5 times free area of outlet pipe size.

2.12.1.2 FD-2
10 inch diameter invertible flashing collar, 2 inch deep body, and 6 inch square removable, secured, stainless steel strainer with minimum free area of 1.5 times free area of outlet pipe size.

2.12.1.3 FD-3
10 inch diameter invertible flashing collar, 2 inch deep body, and 6 inch diameter removable, secured, stainless steel strainer with minimal free area of 1.5 times free area of outlet pipe size.

2.12.2 Floor Sinks
Provide floor sinks with stainless steel bodies, and double drainage pattern for embedding in the floor construction, and seepage pan having weep holes or channels for drainage to the drainpipe. Provide an integral clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane when required. Provide with threaded outlet connection. Between the outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor sinks shall conform to ASME A112.6.3. Provide aluminum sediment bucket. Grate/strainer weight loading classification is based on ASME A112.6.3. Dimensions are nominal. Full grate free area shall be a minimum of 1.5 times the free area of the outlet pipe size. Provide drain with trap primer connection, trap primer, and connection piping.

2.12.2.1 FS-1
12 inch square top, 6 inch deep with 1/2 stainless steel grate.

2.12.3 Backwater Valves
Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded
countersunk plugs.

2.13 CLEANOUTS

a. Provide cleanouts with coated cast-iron bodies (unless otherwise noted) with extra-heavy, threaded, tapered, brass plug with solid hexagonal nut and American Standard pipe threads. Provide flashing collars and clamps for cleanout bodies being installed in floors with finishes installed over waterproofing. Cleanouts on piping completely accessible from within pipe chases do not require covers. Cleanouts in exposed piping in equipment rooms do not require covers.

b. Provide interior floor-mounted cleanouts with a two-piece, threaded, adjustable housing. Provide top and cover based on floor finish:

1. Resilient tile and sheet finish: Round flange top with scoriated stainless steel cover.

2. Ceramic tile finish: Square flange top with scoriated stainless steel cover.


5. Terrazzo finish: Round top with recessed-for-terrazzo cover.

6. Quarry tile finish: Square, heavy-duty top with heavy-duty stainless steel scoriated cover.

7. Concrete finish (unfinished areas): Heavy, round frame; stainless steel scoriated tractor top, ANSI heavy duty load class.

2.14 TRAPS

2.14.1 Fixture Traps

Unless otherwise specified, traps shall be copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be with a cleanout. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches and not more than 4 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.
2.14.2 Drain Traps

Unless otherwise specified, traps shall be cast iron, one piece pattern, deep seal with depth of water seal of 4 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. The trap assembly shall be a standard manufactured unit. Traps for drains located in fan and plenum housings shall maintain seal against the static pressure.

2.15 TRAP PRIMER ASSEMBLIES

Provide fully automatic trap primer assemblies, factory assembled and prepiped and including 3/4 inch NPT female inlet, bronze body 3/4 inch female NPT ball valve, 3/4 inch water hammer arrester, ASSE 1001 atmospheric vacuum breaker, and ASTM B88 3/4 inch Type L copper tubing distribution manifold. Distribution manifold shall be calibrated to provide equal water distribution to each trap. Provide minimum supply of 2 ounces of water to each trap. Provide manifold with 5/8 inch x 1/2 inch compression fitting outlets. All solder joints shall be made with lead free solder. Provide electronic assembly tested and certified per UL 73 and including circuit breaker, 5 second dwell function, manual override, 24 hour geared timer, and solenoid valve. Provide single point water supply and power supply connections. Components shall be installed in a NEMA 250 Type 1 surface mounted cabinet.

2.16 WATER HEATERS

Provide water heaters with replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. Each gas-fired water heater and booster water heater shall have controls with an adjustable range that includes 120 to 180 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to or exceed the requirements of ASHRAE 90.1 - IP, or 10 CFR 430 whichever is the most stringent for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials, polyetherimide (PEI) and polyethersulfone (PES), are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 200 degrees F water temperature and 150 psi working pressure.

2.16.1 Performance of Water Heating Equipment

Standard rating condition terms are as follows:

<table>
<thead>
<tr>
<th>ET</th>
<th>Thermal efficiency with 70 degrees F delta T.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC</td>
<td>Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).</td>
</tr>
</tbody>
</table>
2.16.1.1 Unfired Hot Water Storage

All volumes and inputs: tank surface shall be thermally insulated to R12.5 per ASHRAE 90.1 - IP.

2.16.1.2 Instantaneous Water Heater

2.16.1.2.1 Gas

<table>
<thead>
<tr>
<th>Input Rating</th>
<th>Rating Condition</th>
<th>In accordance with</th>
</tr>
</thead>
<tbody>
<tr>
<td>50,000 to 200,000 Btu/h</td>
<td>EF 0.62-0.0019V</td>
<td>10 CFR 430</td>
</tr>
<tr>
<td>more than 200,000 Btu/h</td>
<td>ET 80 percent</td>
<td>ANSI Z21.10.3/CSA 4.3</td>
</tr>
</tbody>
</table>

2.16.1.2.2 Oil

<table>
<thead>
<tr>
<th>Input Rating</th>
<th>Rating Condition</th>
<th>In accordance with</th>
</tr>
</thead>
<tbody>
<tr>
<td>210,000 Btu/h or less</td>
<td>minimum EF 0.59-0.0019V</td>
<td>10 CFR 430</td>
</tr>
<tr>
<td>more than 210,000 Btu/h</td>
<td>ET 80 percent</td>
<td>ANSI Z21.10.3/CSA 4.3</td>
</tr>
</tbody>
</table>

2.16.2 Automatic Storage Type

Provide heaters complete with control system, and ASME rated combination pressure and temperature relief valve.

2.16.2.1 Gas-Fired Type

Provide natural gas-fired heaters that are ultra-high efficiency condensing type with minimum 4:1 modulation, facility Direct Digital Control (DDC) system interface module (coordinate DDC communication protocol with system selected), linked operating control system for multiple units with lead/lag capabilities, copper and/or stainless steel heat exchanger, factory mounted all bronze system circulating pump, flame sensor and spark ignition, onboard operating and diagnostic controls with LCD display, low NOx operation, sealed combustion, flow switch, ASME T & P relief valves, temperature and pressure gauges, tank sensor, adjustable high limit with manual reset, condensate neutralization kit (one per heater) and room air vent kits. Heaters shall be connected to a separate storage tank as indicated and in accordance with the Manufacturer's installation requirements. Flues shall be provided by the Division 23 contractor. Coordinate Manufacturer venting requirements for the heater.
selected with the Division 23 contractor prior to installation. Venting requirements may vary from Manufacturer to Manufacturer. Pipe condensate neutralization kit drains to nearest floor drain or floor sink.

2.16.3 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22/CSA 4.4. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.17 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by one manufacturer, ASME stamped for the working pressure, and shall have the National Board (ASME) registration. The tank shall be cement-lined or glass-lined steel type in accordance with AWWA D100. The heat loss shall conform to TABLE III as determined by the requirements of ASHRAE 90.1 - IP. Each tank shall be equipped with a thermometer, conforming to ASTM E1, Type I, Class 3, Range C, style and form as required for the installation, and with 7 inch scale. Thermometer shall have a separable socket suitable for a 3/4 inch tapped opening. Tanks shall be equipped with a pressure gauge 6 inch minimum diameter face. Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

2.18 EXPANSION TANKS

ASME BPVC SEC VIII D1 and as applicable for a working pressure of 125 psig. Tank shall be provided with an elastomeric EPDM bladder which separates the system fluid from the tank walls and is suitable for a maximum operating temperature of 240 degrees F. Expansion tank acceptance volume shall be as shown. Total tank size and arrangement shall be as indicated on the Contract Drawings.

2.19 PUMPS

2.19.1 Sump Pumps

Provide sump pumps of the automatic, electric motor-driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. The pumps shall be direct-connected by an approved flexible coupling to a vertical electric motor having a continuous oiling device or packed bearings sealed against dirt and moisture. Motors shall be totally enclosed, fan-cooled of sizes as indicated and shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 4 enclosure. Each pump shall be fitted with a high-grade thrust bearing mounted above the floor. Each shaft shall have an alignment bearing at each end, and the suction inlet shall be between 3 and 6 inches above the sump bottom. The suction side of each
pump shall have a strainer of ample capacity. A float switch assembly, with the switch completely enclosed in a NEMA 250, Type 4 enclosure, shall start and stop each motor at predetermined water levels. Duplex pumps shall be equipped with an automatic alternator to change the lead operation from one pump to the other, and for starting the second pump if the flow exceeds the capacity of the first pump. The discharge line from each pump shall be provided with a union or flange, a non-clog swing check valve, and a stop valve in an accessible location near the pump.

2.19.2 Hydraulic Elevator Sump Pumps

Provide sump pump and control system capable of pumping water while containing oil. The system shall function automatically and shall provide for an alarm in the event of the presence of oil in the sump, high liquid in the sump, or high amps or a locked rotor condition. An alarm that sounds only in the event of a high liquid condition shall not be acceptable. Provide submersible type pump. Pump shall be approved to UL 778 standards and shall include thermal and overload protection. Provide motor capable of operating continuously or intermittently. Provide motor housing constructed of 304 stainless steel, and mechanical seals housed in a separate oil-filled compartment. Provide controls approved to UL 508 standards and housed in a NEMA 4X enclosure with stainless steel hinged hardware. The controls shall include dual relays with variable sensitivity settings, magnetic contactor with separate over-current relay, self-cleaning stainless steel sensor probe, high decibel warning horn with illuminated red light and alarm silencing switch, dual floats, clearly marked terminal board and remote monitoring contact. All cables between the pump and control unit shall be a minimum of 16 feet long and the cable and plug from the control unit shall be a minimum of 8 feet long. The control unit, pump, floats, and sensor probe shall be factory assembled as a complete, ready to use system and shall be tested and approved by a nationally recognized testing laboratory such as ENTELA.

2.19.3 Circulating Pumps

Provide electrically driven, single-stage, centrifugal domestic hot water circulating pumps with mechanical seals, suitable for the intended service. Revolutions per minute shall not exceed 3000. Pump and motor shall be supported by the piping on which it is installed. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze. Motor shall be totally enclosed, fan-cooled and shall have sufficient horsepower for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover. Pump motors smaller than 1 horsepower shall have integral thermal overload protection in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Guards shall shield exposed moving parts.

2.19.4 Sewage Pumps

Provide duplex type with automatic controls to alternate the operation from one pump to the other pump and to start the second pump in the event the first pump cannot handle the incoming flow. Provide high water alarm and check valve.

2.20 DOMESTIC WATER SERVICE METER

Cold water meters 2 inches and smaller shall be positive displacement type
conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall
be turbine type conforming to AWWA C701. Meter register may be round or
straight reading type, indicating gallons. Meter shall be provided with a
pulse generator, remote readout register and all necessary wiring and
accessories. Provide trans-data recorder to interface advanced metering
infrastructure system provided under Division 26.

2.21 WATER SOFTENER SYSTEM

Water softener system shall be central supply, fully automatic type and
shall consist of two softener tanks and one brine tank, interconnecting
pipings, valves and controller. The softener shall operate in alternating
arrangement with one softener on-line at all times. Water softener system
shall reduce the total hardness to less than 171 mg/L as determined by
EDTA titration test AWWA 10084-2005. Softener components, valves,
controller, piping between vessels and brine tank and other appurtenances
shall be provided by a single manufacturer. The system shall be a fully
piped and fully wired factory assembled and test skid mounted assembly. Install on concrete housekeeping pad.

Softener tanks shall be welded steel design for a listed minimum working
pressure of 100 psig. Side shells shall be adequate to allow for bed
expansion during backwash. Tanks shall have two 4-inch x 6-inch hand holds
(top and bottom). Tanks shall be sandblasted, lined with NSF/ANSI 61
approved epoxy material (8-10 mils minimum) and painted with epoxy
material (4-6 mils minimum) and shall be supported with four structural
legs. Piping shall be schedule 10 316L stainless steel. Skid piping shall
be flanged construction. Grooved fittings are not acceptable. Each vessel
shall be supplied with cation exchange resin having a capacity of 68.65
kg/m3 when regenerated with 240 kg/m3 of salt. The exchange resin shall be
supported by a gravel bed. The internals shall be Schedule 80 PVC with a
single point distributor upper distributor and hub and lateral lower
Distributor. Provide tanks with minimum 50 percent tank freeboard with
cation resin (minimum 8 percent cross-linked) with two (2) quartz support
bed layers.

The brine tank shall be high-density polyethylene with cover and is
included with an eductor, a level controlled brine draw, and a refill
valve. The brine tank shall be designed as a wet system. This means that
the salt level in the tank shall always below the air check on the brine
draw valve. The brine tank shall be sized for at least three consecutive
regenerations before additional salt must be loaded. The brine tank shall
be provided loose and located as indicated on the Contract Drawings.
Provide a separate water connection with backflow preventer to the brine
tank for brine dilution/re-fill. Field connect the brine tank to the
softener with Schedule 80 PVC pipe with solvent joints. Provide salt for
initial fill, testing, training and top off to full capacity at turn-over
to the Government. Provide additional salt for a minimum of 10 complete
system regeneration cycles (both tanks regenerated per cycle). System
manufacturer shall include the required salt quantity in pounds for a
complete two tank system regeneration in the water softener system
submittal. Stored salt quantity shall comply with the manufacturer's
system requirements, per cycle. Provide concrete housekeeping pad for
brine tank.

Provide pneumatically actuated automated control valves for process and
air vent (air to open, spring to close). Valves shall fail in the closed
position in the event of loss of air pressure/power.
The water softeners shall operate in two modes: service and regeneration. Duplex alternating operation consists of two vessels that will run with one in Service mode and one in standby. Upon request of a regeneration cycle, the vessel in service mode will regenerate, while the vessel in standby mode will enter service mode. A totalizing meter shall initiate regeneration. The process shall be programmable to allow for off hour regenerations and have manual override capabilities to allow an operator to manually initiate the regeneration process at any time. The softener controls shall be housed in a single carbon steel NEMA 250, Type 4 control panel mounted on the skid. All skid wiring (for instrumentation, etc.) and pneumatic tubing (for automated valves) originate from the control panel. This single control panel shall provide control and monitoring. The control panel shall be provided with a Programmable Logic Controller (PLC) and operator interface. A 6-inch Touch Screen, Human Machine Interface (HMI), shall act as the interface between the operator and the process. The controller shall be provided with dry contacts for remote annunciation of a general alarm (system fault) condition through the building automation system.

A complete water-testing set furnished by the manufacturer shall be provided with the water softener assembly, with complete instructions for conducting either the American Public Health Association test or other suitable test for hardness. Two Baume hydrometers, calibrated for the range necessary for testing saturated brine solution, and three glass cylinders of heat-resistant glass to hold sufficient brine for testing shall be provided.

Manufacturer shall provide factory trained and authorized representative for start-up and Owner training.

2.22 REVERSE OSMOSIS SYSTEM

A complete pressurized reverse osmosis system shall be provided for pure water rinse water for the central sterile suite washers and disinfectors. The system shall consist of a 0.10 cubic meter (0.09 cubic meter resin) activated carbon pre-filter filled with virgin carbon, reverse osmosis (RO) unit and bladder type RO storage tank. The RO unit shall be a factory assembled and tested single pass RO assembly consisting of vertical centrifugal high pressure feed pump, low energy spiral wound thin film composite RO membranes, schedule 80 PVC low pressure feed, reject, recycle and product piping, brass high pressure piping and a microprocessor controller mounted on a polyurethane coated structural steel frame. All high pressure valves shall be brass globe style. Sample valves shall be provided for unit feed and product lines. Each pressure vessel shall be provided with an individual sampling valve for analyzing individual vessel performance. Provide quick connect cleaning connections for cleaning and sanitizing RO membranes. Provide UL listed solid state micro-processor based programmable controller and motor starter housed in a NEMA 250, Type 4X enclosure. System shall be completely wired and designed for a single point electrical connection. Controller shall include the following features:

1. Input/Output: Discrete 12 point (8 input and 4 output).

2. Warning Alarms:
   a. Low product quality
   b. High Pressure Pump Discharge
   c. Low feed pressure
d. High feed/product water temperature

3. Shutdown Alarms:
   a. Low product quality
   b. High Pressure Pump Discharge
   c. Low feed pressure
   d. High feed/product water temperature
   e. Motor Overload
   f. Storage Tank Full (non-alarming start and stop condition)

4. Status Indicator Lights:
   a. Low product quality
   b. High Pressure Pump Discharge
   c. Low feed pressure
   d. High feed/product water temperature
   e. Motor Overload
   f. Storage Tank Full

5. Miscellaneous Controls:
   a. Elapsed run time indicator
   b. Audible alarm
   c. Serial data port
   d. Auxiliary contacts for remote alarm annunciation through building automation system.

System stop/start shall be initiated based on pressure within the bladder tank. A pressure sensor shall be employed for automatic start and stop of RO generation for filling of the RO storage tank. The system shall activate fill at 30 psig and deactivate at 45 psig.

The RO storage tank shall be a pressurized bladder type tank with stainless steel or fiberglass outer shell construction with polyethylene inner shell and 1 1/2-inch male NPT connection. The tank shall be listed for 125 psig operating pressure at 120 degrees F. The tank shall be fully compatible with RO water.

2.23 ELECTRICAL WORK

a. Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, corresponding to the applications in accordance with NEMA MG 11. In addition to the requirements of Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM, provide polyphase, squirrel-cage medium induction motors with continuous ratings, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

b. Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency
start-stop operation and minimum encountered interval between start
and stop. Motor torque shall be capable of accelerating the connected
load within 20 seconds with 80 percent of the rated voltage maintained
at motor terminals during one starting period. Motor bearings shall
be fitted with grease supply fittings and grease relief to outside of
the enclosure.

c. Controllers and contactors shall have auxiliary contacts for use with
the controls provided. Manual or automatic control and protective or
signal devices required for the operation specified and any control
wiring required for controls and devices specified, but not shown,
shall be provided. For packaged equipment, the manufacturer shall
provide controllers, including the required monitors and timed restart.

d. Power wiring and conduit for field installed equipment shall be
provided under and conform to the requirements of Section 26 20 00
INTERIOR DISTRIBUTION SYSTEM.

2.24 FACTORY PAINTING

a. Manufacturer's standard factory painting systems may be provided
subject to certification that the factory painting system applied will
withstand 125 hours in a salt-spray fog test, except that equipment
located outdoors shall withstand 500 hours in a salt-spray fog test.
Salt-spray fog test shall be in accordance with ASTM B117, and for
that test the acceptance criteria shall be as follows: immediately
after completion of the test, the paint shall show no signs of
blistering, wrinkling, or cracking, and no loss of adhesion; and the
specimen shall show no signs of rust creepage beyond 1/8 inch on
either side of the scratch mark.

b. The film thickness of the factory painting system applied on the
equipment shall not be less than the film thickness used on the test
specimen. If manufacturer's standard factory painting system is being
proposed for use on surfaces subject to temperatures above 120 degrees
F, the factory painting system shall be designed for the temperature
service.

2.25 IDENTIFICATION MATERIALS

General: Provide manufacturer's standard products of categories and types
required for each application. Where more than single type is specified
for application, selection is Installer's option, but provide single
selection for each product category.

2.25.1 Valve Tags

Provide 19-gage polished brass valve tags with stamp-engraved piping
system abbreviation in 1/4-inch high letters and sequenced valve numbers
1/2-inch high, and with hole for fastener, or engraved plastic laminate
valve tags, with piping system abbreviation in 1/4-inch high letters and
sequenced valve numbers 1/2-inch high, and with hole for fastener. Provide
manufacturer's standard solid brass chain (wire link or beaded type), or
solid brass S-hooks of the sizes required for proper attachment of tags to
valves, and manufactured specifically for that purpose. Compile valve
schedule for each service. For each page of valve schedule, provide
laminated plastic coated cardboard stock sheets.

a. Provide 1 1/2-inch diameter tags, except as otherwise indicated.
b. Provide size and shape as specified or scheduled for each piping system.
c. Fill tag engraving with black enamel.

2.25.2 Engraved Plastic Laminate Signs

Provide engraving stock melamine plastic laminate, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.25.3 Plastic Equipment Markers

Provide manufacturer's standard laminated plastic, color coded equipment markers. Include terminology matching equipment schedules as closely as possible. Provide approximate 2-inch by 4-inch markers for control devices, and 4-inch by 6-inch for equipment. Identify equipment and electrical devices furnished under this section.

2.25.4 Plasticized Tags

Provide pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately, 2-inch by 6-inch with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.25.5 Lettering and Graphics

Coordinate names, abbreviations and other designations used in plumbing identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of plumbing systems and equipment. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Mixing Valve No. 2, Pump No. 1).

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 GENERAL INSTALLATION REQUIREMENTS

a. Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Piping shall be concealed wherever possible. Under no circumstances reduce pipe size on Contract
Documents without written consent of Contracting Officer. Extend water and drainage piping 5 feet outside the building, unless otherwise indicated. A OS&Y valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the average local frost depth or 18 inches below finish grade whichever is greater. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

b. Provide piping to fixtures, outlets, and equipment requiring drainage, vent, and water utilities. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

c. The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

d. Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

e. Branch sizes to individual fixtures shall be as scheduled. Consult manufacturer's data, Architectural drawings, and/or Plumbing drawings of rooms containing equipment and plumbing fixtures prior to roughing in piping. Stub piping through wall directly behind equipment item, or fixture being served. Connect equipment furnished by Owner or other divisions of the specification in accordance with this section.

3.3 DOMESTIC WATER PIPING SYSTEMS

3.3.1 General

Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or
to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings.

3.3.2 Service Entrance

Provide service entrance installation through slab on grade with reaction anchor at buried elbow where water service pipe turns up below floor. Terminate end of exterior piping material with flange connection and tie flange back to buried elbow with tie rods of same diameter as flange bolts. Provide minimum of one tie rod for each two flange bolt holes. Provide permanent corrosion protection for below-grade tie rods.

3.3.3 Pipe Drains

Pipe drains shall consist of 3/4 inch hose bibb with renewable seat and full port ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.3.4 Valves

Provide manual isolation valves at base of risers, on branch runouts from piping mains, on each branch serving a rest room, on each branch serving an equipment item, and on each branch to hose bibb or wall hydrant. Wire isolation valves on emergency fixture supply open and tag "Do Not Close". Balance hot water circulation system.

3.3.5 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, or manufactured expansion fittings. Risers shall be securely anchored to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.

3.3.6 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2.5 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown.
Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.3.7 Commercial-Type Water Hammer Arresters

Provide commercial-type water hammer arresters on hot- and cold-water supplies. Arresters shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201 Sizing and Placement Data. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns (air chambers) shall not be permitted.

3.3.8 Water Meter Remote Readout Register

a. Provide true absolute remote readout encoder register providing direct electronic transfer of meter reading information from water meter to automatic meter reading device. The remote register shall be mounted at the location indicated, or as directed by the Contracting Officer. The meter shall be provided with dual pulse outputs for connection to building automation system (DDC) and future point of presence panel.

b. Provide permanently sealed register to exclude dirt and/or moisture infiltration. Provide with a straight reading odometer-type display, and 360 degree test circle with center sweep hand and low flow (leak) detector. Provide tamperproof locking feature to resist tampering with the register. Provide factory potted moisture resistant wire assembly for pit applications.

c. Provide registers with full 6-wheel encoding, and a 6-wheel odometer assembly for direct manual reading. The register shall transmit data using open architecture variable length protocol in ASCII format (American Standard Code for Information Interchange). Provide with capacity of remote installation up to 300 feet to an outside wall mounted touch pad.

d. The register shall use an absolute encoder to directly read the actual position of the index odometer wheels, when interrogated by a reading device. The reading device shall provide all necessary power. Pulse outputs and/or memory shall not require programming. The register shall not require battery power to operate. When a reading device interrogates the register, the translator encoder shall communicate to the device in ASCII computer language the absolute meter reading, and an eight-digit identification number. Any error or nonread shall be immediately indicated by the meter reading equipment.

3.3.9 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers
shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit. Reduced pressure principle backflow prevention devices shall be installed horizontally and located in an accessible location not more than 4 feet above finished floor. Pipe drain from reduced pressure principle backflow prevention devices to the exterior, or a floor drain of adequate capacity, or a mop sink.

3.4 DRAINAGE AND VENT PIPING SYSTEMS

3.4.1 General

a. Provide wye fittings and eighth bends, or combination wye and eighth fittings at changes of direction and junctions. Sanitary tee fittings shall only be used in vertical pipe. Sanitary crosses are not permitted. Provide P-trap for each direct waste-pipe connection to equipment. Provide ice makers with an indirect drain consisting of either a floor sink or a dedicated, under-counter P-trap. Provide air gaps at indirect drains.

b. Install horizontal soil, waste, and storm piping with the following minimum slopes; 3 inch and smaller pipes shall be 1/4 inch per foot; 4 inch to 6 inch shall be 1/8 inch per foot; 8 inch and larger pipes: 1/16 inch per foot. Slopes indicated on plans override those indicated here.

c. Provide vent stacks parallel to soil and waste stacks to receive branch vents from fixtures. Each vent stack shall originate from a soil or waste stack at its base. To permit proper flashing, offset through-the-roof piping away from walls on roof before passing through roof. Carry vent stacks 4 inch and larger full size through roof. Install vent lines so they will drain and not trap water. Where possible combine soil, waste or vent stacks before passing through roof to minimize roof openings. Where minimum vent-through-roof size is larger than vent size, provide increaser a minimum of 12 inch below roof line.

d. Provide drip pans under drainage piping installed over critical areas to include but not limited to: operating rooms, recovery rooms, central service areas, and electronic data processing areas. Provide drain piping from drip pans. Discharge drain piping to drain in exposed area.

e. Installed piping shall not be insulated, concealed, or furred around until it has been tested to satisfaction of the Contracting Officer. If inspection or test indicates defects, replace such defective work or material and repeat inspection and tests. Repairs shall be made with new materials. Peening and chiseling of holes or screwed joints is not allowed.

3.4.2 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend.
or one or two 1/8 bends extended to the location shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron. Provide cleanout extensions through floor above where cleanouts are required in piping above critical areas, or to an accessible location outside of critical area.

3.4.3 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.5 JOINTS

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.5.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.5.2 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.
3.5.3 Cast Iron Soil Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.5.4 Copper Tube and Pipe

3.5.4.1 Brazed Joint

In conformance with AWS B2.2/B2.2M and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

3.5.4.2 Soldered Joint

Make with flux. Soldered joints shall conform to ASME B31.5 and CDA A4015.

3.5.4.3 Mechanically Extracted Joint

Make in accordance with ICC IPC.

3.5.5 Other Joint Methods

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.6 PIPE SLEEVES AND FLASHING

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.6.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for supply, drainage, waste and vent pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal.
between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete, masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.6.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulkimg recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.6.3 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be
accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 6 inches in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.6.4 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.6.5 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.6.6 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.7 PIPE HANGERS, INSERTS, AND SUPPORTS

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58, except as modified herein.

a. Type 1, provide with adjustable type steel support rods.

b. Types 5, 12, and 26 shall not be used.

c. Type 3 shall not be used on insulated pipe.

d. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

e. Type 19 and 23 C-clamps shall be used for attachment to steel joists and shall be torqued per MSS SP-69. Provide both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

f. Type 20 attachments shall be used on steel angles and vertical web steel channels and shall be furnished with an added malleable-iron heel plate or adapter. Attach to horizontal web steel channel with drilled hole on centerline and double nut and washer.

g. Type 21, 28, 29, and 30 clamps shall be used for attachment to steel W or S beams.

h. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

i. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39
saddles shall be welded to the pipe.

j. Type 40 shields shall:
   (1) Be used on insulated pipe less than 4 inches.
   (2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.
   (3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.

k. Horizontal pipe supports shall be spaced as specified in MSS SP-58 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

l. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

m. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:
   (1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
   (2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
   (3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

n. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

o. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

p. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

q. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting
the load. Pipe guides and anchors shall be installed to keep pipes in
accurate alignment, to direct the expansion movement, and to prevent
buckling, swaying, and undue strain. Piping subjected to vertical
movement when operating temperatures exceed ambient temperatures shall
be supported by variable spring hangers and supports or by constant
support hangers. In the support of multiple pipe runs on a common
base member, a clip or clamp shall be used where each pipe crosses the
base support member. Spacing of the base support members shall not
exceed the hanger and support spacing required for an individual pipe
in the multiple pipe run. Threaded sections of rods shall not be
formed or bent.

3.7.1 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in
concrete inserts, built-in anchors, or masonry anchor devices. Inserts
and anchors shall be applied with a safety factor not less than 5.
Supports shall not be attached to metal decking. Supports shall not be
attached to the underside of concrete filled floor or concrete roof decks
unless approved by the Contracting Officer. Masonry anchors for overhead
applications shall be constructed of ferrous materials only.

3.8 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided
where exposed to view. Angle stops, straight stops, stops integral with
the faucets, or concealed type of lock-shield, and loose-key pattern stops
for supplies with threaded, sweat or solvent weld inlets shall be
furnished and installed with fixtures. Where connections between copper
tubing and faucets are made by rubber compression fittings, a beading tool
shall be used to mechanically deform the tubing above the compression
fitting. Exposed traps and supply pipes for fixtures and equipment shall
be connected to the rough piping systems at the wall, unless otherwise
specified under the item. Drain lines and hot water lines of fixtures for
handicapped/accessible fixtures shall be insulated and do not require
polished chrome finish. Plumbing fixtures and accessories shall be
installed within the space shown.

3.8.1 Fixture Connections

Connections between earthenware fixtures and flanges on soil pipe shall be
made gastight and watertight with a closet-setting compound or neoprene
gasket and seal. Use of natural rubber gaskets or putty will not be
permitted. Fixtures with outlet flanges shall be set the proper distance
from floor or wall to make a first-class joint with the closet-setting
compound or gasket and fixture used.

3.8.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the
long finished top spud connecting tube to wall adjacent to valve with
approved metal bracket. Flushometer valves for water closets shall be
arranged to avoid interference with grab bars. In addition, for water
closets intended for handicap use, the flush valve handle shall be
installed on the wide side of the enclosure. Bumpers for water closet
seats shall be installed on the wall.
3.8.3 Height of Fixture Rims Above Floor

Unless otherwise noted, mounting heights shall be as indicated. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1.

3.8.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.8.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.8.5.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.8.5.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.8.5.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.8.5.4 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.8.6 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.
3.8.7 Escutcheons

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be one-piece held in place by setscrew.

3.9 WATER HEATERS AND HOT WATER STORAGE TANKS

3.9.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The pressure and temperature relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the pressure and temperature valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

3.9.2 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.9.3 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. Adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.9.4 Gas-Fired Water Heaters

Installation shall conform to NFPA 54.

3.9.5 Direct Fired Domestic Water Heaters

Notify the Contracting Officer when any direct fired domestic water heater over 117,124.2 Watts (400,000 BTU/hour) is operational and ready to be inspected and certified.

3.10 IDENTIFICATION SYSTEMS

Identify piping and physical hazards in accordance with 29 CFR 1910.144, ANSI A13.1, ANSI Z53.1. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment. Identify each piping system and item of equipment indicated on contract drawings.

a. Near each valve and control device.
b. Near each branch; mark each pipe at branch, where there could be question of flow pattern.

c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

d. At access doors, manholes and similar access points which permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.

f. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 20 feet in congested areas of piping and equipment.

3.10.1 Piping System Identification

Install plastic pipe markers on each system, and include arrows to show normal direction of flow. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, crawl spaces) and exterior non-concealed locations.

3.10.2 Valves

Provide valve tag on every valve, cock and control device in each piping system. List each tagged valve in valve schedule for each piping system. Turn valve schedules over to Contracting Officer. Provide 1/2-inch red adhesive identification dots on ceiling tiles located immediately below balancing valves and shutoff valves.

3.10.3 Plumbing Equipment

Install engraved plastic laminate sign or plastic equipment marker on or near each major item of plumbing equipment and each operational device. Provide minimum 1/4-inch high lettering for name of unit where viewing distance is less than 1/2-inch high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering. In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.10.4 Labels

Provide labels for sensor operators at flush valves and faucets. Include the following information on each label:

a. Identification of the sensor and its operation with written and Braille description.

b. Range of the sensor.

c. Battery replacement schedule.
3.10.5 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.10.6 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover.Unless otherwise directed, the color code symbols shall be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room.

3.11 PAINTING

3.11.1 General

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS. New equipment painting shall be factory applied or shop applied, and shall be as specified herein or in PART 2 paragraph FACTORY PAINTING, and provided under each individual section.

3.11.2 Shop Painting Systems for Metal Surfaces

a. Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

b. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

(1) Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.
(2) Temperatures Between 120 and 400 Degrees F: Metal surfaces shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

(3) Temperatures Greater Than 400 Degrees F: Metal surfaces shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

3.12 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to 20 percent of the lowest equipment rpm. Submit details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

3.13 TRAINING

a. Provide the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

b. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

c. 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.

3.14 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.15 TESTS, FLUSHING AND DISINFECTION

Submit test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance
with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

3.15.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, submit a testing procedure to the Contracting Officer for approval.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.


3.15.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. Submit written documentation of the tests performed and signed by the individual performing the tests. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

<table>
<thead>
<tr>
<th>Data on Device</th>
<th>Data on Testing Firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Assembly</td>
<td>Name</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Address</td>
</tr>
<tr>
<td>Model Number</td>
<td>Certified Tester</td>
</tr>
<tr>
<td>Serial Number</td>
<td>Certified Tester No.</td>
</tr>
<tr>
<td>Size</td>
<td>Date of Test</td>
</tr>
<tr>
<td>Location</td>
<td></td>
</tr>
<tr>
<td>Test Pressure Readings</td>
<td>Serial Number and Test Data of Gauges</td>
</tr>
</tbody>
</table>

If the unit fails to meet specified requirements, the unit shall be repaired and retested.
3.15.1.2 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 1 inch for a period of 24 hours. Any drop in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

3.15.1.3 Submittal Requirements

Submit the following:

a. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Plan, elevation, view, and detail drawings, shall be drawn to scale.

b. Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

c. Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

3.15.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.15.3 System Flushing

3.15.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with hot potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor is responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.
3.15.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Comply with ASHRAE 90.1 - IP for minimum efficiency requirements. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 50.12 Part 141.80(c)(1).

The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.15.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

3.15.5 Disinfection

After operational tests are complete, disinfect the entire domestic hot- and cold-water distribution system. Flush the system as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Except as herein specified, water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Use a properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual
chlorine levels are satisfied. The system, including the tanks, shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Contracting Officer. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.16 WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 Construction and Demolition Waste Management for additional requirements.

-- End of Section --
PART 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. GREEN BUILDING COUNCIL (USGBC)


1.2 SUMMARY

This project will have selected building systems commissioned. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CA) appointed by the Government will direct the commissioning process.

1.2.1 This Section Includes

Requirements for commissioning the plumbing systems, sub-systems and equipment. This Section supplements the general requirements specified in Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS.

1.2.2 Commissioning Activities

a. The commissioning activities have been developed to support the United States Green Building Council (USGBC) LEED™ rating program and to support delivery of project performance in accordance with the Contract Documents.

(1) Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" prerequisite of "Fundamental Building Systems Commissioning".

(2) Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" requirements for the "Enhanced Building System Commissioning" credit.

(3) Activities and documentation for the LEED™ section on "Measurement and Verification" requirements for the Measurement and Verification credit.

1.2.3 Related Sections

Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.
1.3 DEFINITIONS

Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.4 COMMISSIONED SYSTEMS

a. Commissioning of a system or systems specified in this Division 22 is part of the construction process. Documentation and testing of these systems, as well as training of User's Operation and Maintenance personnel, is required in cooperation with the Contracting Officer and the Commissioning Agent.

b. The following Plumbing systems will be commissioned:

1. Domestic Hot Water systems (gas water heaters, hot water circulating pumps and motors, controls, combustion burners/fans/motors, backflow preventers, water meters).
2. Medical Gas systems nitrous oxide and oxygen, Medical Gas Alarm System).
3. Domestic Water Booster Pumps (controls, piping, compression tanks, pumps, motors, and Variable Speed Drives).
4. Dental Gas Systems (surgical vacuum pumps, dental air compressors, valves, oral evacuation vacuum pumps and accumulators, amalgam separators).
5. Sewage Ejection Pumps (sump level controls, pump alternator, alarms and alarm panel, pumps and motors).
6. Domestic Water Filtration and Softener Systems (Tanks and casings, gages and instruments, controls, pumps and motors - if applicable, packaged piping, alarms).
7. Process Water Systems (controls, piping, tanks and casings, gages and instruments, pumps, motors, and Variable Speed Drives - if applicable for reverse osmosis (RO) and deionized water (DI) systems).
8. Emergency Plumbing Fixtures (showers, eye wash stations, water tempering valves, instruments and gages).

1.5 SUBMITTALS

a. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by NAVFAC prior to forwarding to the Contractor. Refer to Section 01 33 00 SUBMITTAL PROCEDURES for further details.

b. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS.
are ready for Systems Functional Testing. The Commissioning Agent will prepare Systems Readiness Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the Contracting Officer and to the Commissioning Agent for review. The Commissioning Agent may spot-check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and re-submission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and re-submission. Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for System Readiness Checklists, Equipment Startup Reports, and other commissioning documents.

3.2 CONTRACTOR'S TESTS

Contractor tests as required by other Sections of Division 22 shall be scheduled and documented. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.3 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Contracting Officer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will direct and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF OWNER PERSONNEL

Training of User's operation and maintenance personnel is required in cooperation with the Contracting Officer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with Contracting Officer after submission and approval of formal training plans. Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS and Division 22 Sections for additional Contractor training requirements.

-- End of Section --
PART 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 SANITARY ENGINEERING (ASSE)

ASSE 6000 SERIES (2012) Professional Qualification Standard for Medical Gas Systems Installers, Inspectors and Verifiers

ASME INTERNATIONAL (ASME)


ASME B16.50 (2013) Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings

ASME B40.100 (2013) Pressure Gauges and Gauge Attachments

ASME BPVC SEC VIII D1 (2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)


1.2 SYSTEM DESCRIPTION

a. Provide the following gas, support, and vacuum systems conforming to NFPA Category 3 criteria: dental compressed air (DA), laboratory compressed air (LA), process compressed air (PA), and oral evacuation (OE).

b. Provide the following gas, support, and vacuum systems conforming to NFPA Category 2 criteria: oxygen (O), nitrous oxide (NO), dental surgical vacuum (DSV), and waste anesthetic gas disposal (WAGD).

1.2.1 Design Requirements

1.2.1.1 Patient Care Systems

Oxygen (O), and, Nitrous Oxide (NO), systems intended for patient care
shall not be supplied to or used for any purpose other than patient care applications.

1.2.1.2 Dental Surgical Vacuum (DSV), and Waste Anesthesia Gas Disposal (WAGD)

   Systems are dry vacuum systems and shall not be supplied to or used for any purpose other than patient care applications.

1.2.1.3 Oral Evacuation (OE)

   System is a wet vacuum system and shall not be supplied to or used for any purpose other than patient care applications.

1.2.1.4 Support Utilities

   Dental Compressed Air (DA), Laboratory Compressed Air (LA), and Process Compressed Air (PA) systems are support utilities and shall not be supplied to or used for patient respiration applications.

1.2.1.5 Laboratory Compressed Air (LA) and Process Compressed Air (PA)

   a. Combined with and powered by the Dental Compressed Air (DA) system, in which case the LA and/or PA system shall conform to NFPA 99 Level 3 criteria.

1.2.2 Sustainable Design Requirements

1.2.2.1 Local/Regional Materials

   Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

1.2.2.2 Environmental Data

   Submit Table 1 of ASTM E2129 for the following products: Amalgam Separators.

1.2.3 Performance Requirements

   a. Provide all labor, equipment and services necessary for and incidental to the installation of piped dental gas, support, and vacuum systems and medical gas, support, and vacuum systems. All systems shall be complete, started, tested and ready for use.

   b. Government Furnished Materials provided to the Contractor for installation under this section include initial supply of gases in cylinders or containers as appropriate for cylinder sources.

   c. Provide system delivery pressure as follows:

<table>
<thead>
<tr>
<th>System</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen, medical compressed air, nitrous oxide, carbon dioxide</td>
<td>55 psi</td>
</tr>
<tr>
<td>Dental compressed air</td>
<td>90 psi</td>
</tr>
</tbody>
</table>

   SECTION 22 60 70  Page 3
Laboratory compressed air | 50-55 psi  
Process compressed air | 90-100 psi  
d. Provide system vacuum as follows:

| Service                           | Vacuum  
|----------------------------------|---------
| Dental surgical vacuum           | 19 inches Hg vacuum |
| Dental oral evacuation           | 8 inches Hg vacuum |
| Waste anethesia gas disposal     | 12 inches Hg vacuum |

1.2.4 Accessibility of Equipment

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, and equipment requiring access, in locations freely accessible through access doors.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. 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

Local/Regional Materials; G  
Environmental Data; G  
Manufacturer qualifications  
Installer qualifications  
Inspector qualifications  
Verifier qualifications  
Inspection, Testing, and Verification Agency

SD-02 Shop Drawings

Dental Gas, Support and Vacuum Systems; G  
Medical Gas, Support and Vacuum Systems; G

SD-03 Product Data

Cylinder Manifold Supply Source; G  
Dental Compressed Air (DA) Source; G  
Dental Surgical Vacuum (DSV) Source; G  
Dental Oral Evacuation (OE) Source; G  
Pipe and Fittings; G  
Valves and Assemblies; G  
Hangers and Supports; G
Dental Gas and Support Systems Outlets and Vacuum Systems Inlets; G
Medical Gas and Support Systems Outlets; G
Warning Systems; G
Vibration-Absorbing Features; G

SD-06 Test Reports
Test Reports
SD-07 Certificates
Station Outlets/Inlets
SD-10 Operation and Maintenance Data
Dental Gas, Support, and Vacuum Systems; G
Medical Gas and Support Systems; G

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer Qualifications

Manufacturers shall be regularly engaging in the manufacturing, supplying, and servicing of specified products and equipment, as well as, providing engineering services, for gas and vacuum systems for healthcare facilities. Provide evidence demonstrating compliance for a minimum of 5 years, and on 5 projects of similar complexity.

1.4.2 Installer Qualifications

a. Dental gas, support, and vacuum systems and Medical gas and support systems shall be installed only by Certified Medical Gas Installers. Installer ASSE 6000 SERIES (Standard #6010 Medical Gas System Installer) certification card shall have been issued within the previous 36 months and Installers certified through a recognized third party certification agency. Certification shall include the successful completion of a minimum 32-hour training course including a written and a practical examination covering all facets of ASSE 6000 SERIES Standard #6010, NFPA 99, and NFPA 55. Course instruction shall have been conducted by a Medical Gas Systems Instructor certified to ASSE 6000 SERIES (Standard #6050 Medical Gas Instructors). The installer shall have a minimum of four (4) years of documented practical experience in the installation of medical gas and vacuum piping systems. Detail drawings for the complete systems including piping layouts and location of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams; and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, include loadings and proposed support method. All plans, elevations, views, and details, shall be drawn to scale.

b. Dental oral evacuation systems shall be installed only by contractors/tradespersons who have at least 5 years experience installing central oral evacuation systems for dental operatories.

1.4.3 Agency Qualifications

Retained by the general contractor, but independent of the facility,
installing contractor, and product manufacturer(s).

1.4.3.1 Inspector qualifications

Systems shall be inspected only by Certified Medical Gas System Inspectors. Inspector ASSE 6000 SERIES (Standard #6020 Medical Gas Systems Inspectors) certification card shall have been issued within the previous 36 months and Inspectors certified through a recognized third party certification agency. Certification shall include the successful completion of a minimum 24-hour training course including a written and a practical examination covering all facets of ASSE 6000 SERIES (Standard #6020), NFPA 99, NFPA 55. Course instruction shall be conducted by a Medical Gas Systems Instructor certified to ASSE 6000 SERIES (Standard #6050 Medical Gas Systems Instructors). Certification to ASSE 6000 SERIES (Standard #6030 Medical Gas Systems Verifier) meets the requirements of this section. The inspector shall have a minimum of four (4) years of documented practical experience in the inspection of medical gas and vacuum systems.

1.4.3.2 Verifier qualifications

Systems shall be verified only by Certified Medical Gas System Verifiers. Verifier ASSE 6000 SERIES (Standard #6030 Medical Gas System Verifiers) certification card shall have been issued within the previous 36 months and verifiers certified through a recognized third party certification agency. Certification shall include the successful completion of a minimum 32-hour training course including a written and a practical examination covering all facets of ASSE 6000 SERIES Standard #6030, NFPA 99, NFPA 55 and CGA M-1. Course instruction shall be conducted by a Medical Gas Systems Instructor certified to ASSE 6000 SERIES (Standard #6050 Medical Gas Systems Instructors). The verifier shall have a minimum of four (4) years of documented practical experience in the verification of medical gas and vacuum systems. The verifier shall have a current certificate of insurance, in the individual's name or employing verification company for general liability, and professional liability insurance.

1.4.4 Certifying Agency Qualifications

Agency shall be an American National Standards Institute accredited certifier. Agency is responsible for testing and certifying individuals in compliance with ASSE 6000 SERIES Standards. Provide installer, inspector, and verifier certifications by one of the following agencies or by an agency with comparable qualifications:

a. Medical Gas Professional Healthcare Organization (MGPHO).


1.4.5 Regulatory Requirements

1.4.5.1 Standards

The Standards for design, materials, installation, and testing of gas and vacuum systems for healthcare facilities:


c. The advisory provisions in NFPA 99 and NFPA 55 shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "Authority Having Jurisdiction" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

d. The provisions of Chapter 1, "Administration" in NFPA 99 and NFPA 55 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.

1.4.5.2 Referenced Publications

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.4.5.3 Alternative Qualifications

Products having less than a three-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.

1.4.5.4 Service Support

Provide equipment items supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract. Submit manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver equipment and parts to site factory cleaned and processed in their original factory sealed package ready for installation. 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 COMMISSIONING

1.6.1 Inspection, Testing, and Verification Agency

Commissioning shall include retaining the Inspection, Testing, and
Verification Agency prior to commencement of the installation of these systems. The Inspection, Testing, and Verification Agency shall coordinate their scope of work with that of the Project CxC, Commissioning Specialist and shall function in coordination with, not in lieu of, the Project CxC, Commissioning Specialist.

1.6.2 Responsibilities

The Inspection, Testing, and Verification Agencies responsibilities include:

a. Review of the project drawings and specifications and providing comments and additional clarification(s), as needed, to the Contracting Officer and the Designer of Record.

b. Witnessing by a certified inspector or certified verifier of the brazing of a minimum of two joints (one vertical and one horizontal) by each brazer assigned to the project. Evaluation of adequacy of the brazed joints shall be through observation of the brazing techniques, and by destructive methods (cutting the joints in half). This will be required of all brazers utilized throughout the duration of the project. Brazing of project materials shall not be permitted until the brazer qualifications, and the adequacy of their joints have been determined to be acceptable.

c. Review and comment on the compliance of the project submittals required under "SUBMITTALS" and the specified items. Review shall be concurrent with the review being performed by the designated representative of the Government.

d. Performing site observation visits prior to 1) backfilling exterior or interior below grade piping, 2) concealing above ceiling piping, and 3) concealing in wall piping. Conduct site observation visits by a certified inspector or certified verifier. Provide for each visit a written report stating progress of installation and any deficiencies needing corrective action.

e. Review of revisions/substitutions relating to the Contract Documents and/or the Project Commissioning Plan.

f. Coordination with the Project CxC, Commissioning Specialist in establishing a commissioning plan for components specific to the systems specified herein.

g. Coordination with the Project CxC, Commissioning Specialist of the equipment start-up, and the system testing and verification procedures required by this specification.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products, essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening, and have been in satisfactory commercial or industrial use for 3 years prior to bid opening. The 3-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale
on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 3 year period. Submit manufacturer's catalog data with highlighting to show model, size, options, etc., that are intended for consideration. Provide adequate data to demonstrate compliance with contract requirements.

2.2 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.

2.3 CYLINDER MANIFOLD SUPPLY SOURCE

Provide complete factory-packaged, factory-tested, continuous-duty source(s). Each source shall contain control panel, source shutoff, isolation valves and other components required by NFPA 99, and necessary to provide complete performance. Each source shall require single-point connections to power wiring, warning system wiring, and piping system. Each source shall have minimum quantity of cylinders on each side as indicated on the Contract Drawings.

a. Design the cylinder supply source so that when the switchover from the primary cylinders to the secondary cylinders occurs, there will be no drop or fluctuation in the line pressure. The control cabinet shall have a visual signal to indicate switchover from the primary to the secondary supply. Resetting of the control unit shall be accomplished automatically. Provide with a bronze-bodied poppet-type pressure-relief adjusted to relieve at 50 percent above maximum working pressure. Equip with an approved pressure switch for actuating a warning signal when, or before, the secondary bank goes into operation. The control valve shall be contained within a cabinet designed to prevent tampering by unauthorized personnel. One bank of cylinders shall be in service while the other bank is in reserve. Each bank shall be equipped with a master regulator and a gauge for 4,000 psi or greater cylinder-contents pressure. Switching from the empty bank of cylinders to the full bank of cylinders shall be fully automatic and shall not require resetting of the regulators.

b. Provide cylinder supply sources as indicated on the Contract Drawings.

2.4 DENTAL COMPRESSED AIR (DA) SOURCE

a. Provide two complete factory-packaged, factory-tested, continuous-duty source(s). Each source shall contain air compressors, receiver, dryers, filters, control panel, source shutoff, compressor isolation valves and other components required by NFPA 99, and necessary to provide complete performance. Each source shall require single-point connections to power wiring, warning system wiring, and piping system. The air compressor package shall have a short-circuit rating of 65,000 amps.

b. Air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name and catalog number, on a nameplate securely attached to the equipment. Provide guards to shield exposed moving parts. Provide an intake air filter and silencer with each compressor. Provide aftercooler and moisture separator between
compressors and air receivers, to remove moisture before the air enters the receiver. Aftercoolers shall be air cooled. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors.

2.4.1 Air Compressors

Provide scroll type compressors. Provide a pressure gauge calibrated to 300 psi, and equipped with a gauge cock and pulsation dampener for installation adjacent to the pressure switch. The motor and compressors shall be directly connected or operated by V-belt drive. Compressors shall be sequenced to start automatically when the pressure drops to a preset point. Compressors shall be air cooled. Provide each compressor chamber with a high-temperature sensor to activate a local alarm. Provide continuous duty NEMA rated, open dripproof motor with 1.15 service factor, and maximum of 3600 RPM.

2.4.2 Air Receiver

Provide air receiver delivering air to dental operatories designed for 150 psi working pressure, factory air tested to 1.5 times the working pressure, meeting ASME BPVC SEC VIII D1. Provide receiver equipped with safety relief valves and accessories, including but not limited to pressure gauge, sight glass, and automatic and manual drains. The outside of receiver shall be galvanized or supplied with factory applied commercial enamel finish. The interior of the receiver shall be a factory applied vinyl lining. Provide a display of the ASME seal on the receiver, or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code. Provide receiver(s) with a three (3) valve bypass for servicing.

2.4.3 Control Panel

Provide UL 508A listed and labeled control panel in a NEMA 250 Type 12 enclosure. Provide Hand-Off-Auto switch for each compressor for selection of normal operation (automatic alternation) or manual selection of lead and lag compressors. Provide automatic alternation of compressors based on a first-on/first-off principle with provisions for simultaneous operation. The lag compressor shall be able to start automatically if the lead compressor fails to operate. Provide manual reset for thermal malfunction shutdown. All control and alarm functions shall remain energized while any compressor in the system remains electrically online. Provide magnetic motor starters with integral overload and short circuit protection, with lockable disconnecting means. Provide running light and elapsed run-time meter for each compressor. Provide circuit breakers with single point power feed connection. Provide 120 VAC control circuit transformers with fused primary and secondary. Provide pressure control switches or pressure transducer. Provide integral PLC controller for automatically switching operating sequence of compressors. Provide back-up circuit in case of PLC failure. Provide digital display interface. User interface shall display all alarm conditions, pump maintenance intervals, compressor performance warnings, average system air demand, average dewpoint and CO levels on system, compressors on/off status, system model number and serial number, and phone number to call for service. Provide audible and visual local alarms with silence button, remote alarm connections, and safety devices as required by NFPA 99. Local alarms shall have contacts to allow indication of a fault condition at the master alarm panel if one or more local alarms are activated.
Provide the following alarms:

a. Lag compressor In Use.

b. High discharge temperature.

c. High carbon monoxide levels.

2.4.4 Desiccant Air Dryers

Provide two identical twin-tower heatless desiccant air dryers. Provide dryers to achieve a pressure dewpoint -40 degrees F at the maximum calculated NFPA system capacity. Provide lubricant free operation. Provide economizer cycle that reduces purge air requirements to match actual moisture loading. Provide solid-state cycle timer, OSHA purge exhaust mufflers, and a pressure gauge for each tower.

2.4.5 Filtration and Pressure Reducing Station

Provide two pre-filters rated 0.01 micron filtration with an efficiency of 99.9999 percent D.O.P. (Validated), two activated carbon filters, and two 1 micron final filters with an efficiency 99.9999 percent D.O.P. (Validated) installed downstream of the carbon filters. Provide all filters with a differential pressure gauge with color change indicator and automatic drain valve except the activated carbon filters. Provide downstream of the final filters a dual-line pressure regulating assembly consisting of two pressure regulators with pressure gauges, inlet and outlet isolation ball valves, and pressure relief valves. All filters/pressure regulators shall be arranged so that the isolation of one filter/regulator will not affect the operation of the second filter/regulator.

2.4.6 Dew Point Monitor

Provide dew point monitor to continuously monitor the dew point of the dental compressed air. Provide ceramic type (aluminum oxide type is not acceptable) sensor with system accuracy of +/- 2 degrees F. The dew point alarm shall be factory set at 36 degrees F and be field adjustable. Provide activation of local alarm and all master alarms when the dew point at system pressure exceeds + 39 degrees F. Provide activation of monitor's signal at all master alarm panels if the monitor loses power. Monitor shall meet requirements of NFPA 99.

2.4.7 Carbon Monoxide Monitor

Provide carbon monoxide monitor to continuously monitor the dental compressed air for carbon monoxide and to actuate a local alarm if the carbon monoxide level is 10 ppm or higher. Provide activation of monitor's signal at all master alarm panels if the monitor loses power. Monitor shall meet requirements of NFPA 99.

2.5 DENTAL SURGICAL VACUUM (DSV) SOURCE

Provide complete factory-packaged, factory-tested, continuous-duty source(s). Each source shall contain vacuum pumps, receiver, control panel, source shutoff, pump isolation valves and other components required by NFPA 99, and necessary to provide complete performance. Each source shall require single-point connections to power wiring, warning system wiring, and piping system.
2.5.1 Vacuum Pumps

Provide non-contacting dry claw vacuum pumps. Mount each pump and its motor on modular skids in a horizontal or vertical configuration with coupling and guard. Pumps and motors for small systems may be tank mounted. Provide shutoff valve on each pump inlet. Provide vacuum gauge at each pump inlet. The vacuum pump package shall have a short-circuit rating 65,000 amps.

b. Provide non-contacting dry claw style rotary pumps. Internal construction shall be friction free and the rotors shall be non-contacting. The air end shall be oil free and require no sealants. Each pump shall be air cooled and continuous duty rated. Each pump shall be provided with a single lubricated gearbox requiring oil change not more often than 5,000 operating hours. Each pump shall be provided with an exhaust silencer. The pumps shall be equipped with high vacuum shutdown, high temperature shutdown and alarm. The lubricant supplied shall be inert with oxygen. Each pump shall be fitted with a 5 micron inlet filter and be equipped with a vacuum relief valve, check valve to prevent backflow through off-cycle units, flexible connector, isolation valve, and vibration isolators at each mounting location. Provide continuous duty NEMA rated, C-face, TEFC motor with 1.15 service factor, and maximum of 3500 RPM.

2.5.2 Vacuum Receiver

Provide receiver designed for 150 psi minimum working pressure, factory air tested to 1.5 times the working pressure, meeting ASME BPVC SEC VIII D1. Provide receiver equipped with safety relief valves and accessories, including but not limited to vacuum gauge, sight glass, and automatic and manual drains. The outside of receiver shall be galvanized or supplied with factory applied commercial enamel finish. The interior of the receiver shall be a factory applied vinyl lining. Provide a display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code. Provide receiver(s) with a three (3) valve bypass for servicing.

2.5.3 Control Panel

Provide UL 508A listed and labeled control panel in a NEMA 250 Type 12 enclosure. Provide Hand-Off-Auto switch for each vacuum pump for selection of normal operation (automatic alternation) or manual selection of lead and lag vacuum pump. Provide automatic alternation of vacuum pumps based on a first-on/first-off principle with provisions for simultaneous operation. The lag vacuum pump shall be able to start automatically if the lead vacuum pump fails to operate. Provide manual reset for thermal malfunction shutdown. All control and alarm functions shall remain energized while any vacuum pump in the system remains electrically online. Provide magnetic motor starters with integral overload and short circuit protection, with lockable disconnecting means. Provide running light and elapsed run-time meter for each vacuum pump. Provide circuit breakers with single point power feed connection. Provide 120 VAC control circuit transformers with fused primary and secondary. Provide vacuum control switches. Provide integral PLC controller for automatically switching operating sequence of vacuum pumps. Provide back-up circuit in case of PLC failure. Provide digital display interface. User interface shall display all alarm conditions, vacuum pump maintenance intervals, vacuum pump performance warnings, average system
vacuum demand, vacuum pumps on/off status, system model number and serial number, and phone number to call for service. Provide audible and visual local alarms with silence button, remote alarm connections, and safety devices as required by NFPA 99. Local alarms shall have contacts to allow indication of a fault condition at the master alarm panel if one or more local alarms are activated. Provide the following alarms: Lag vacuum pump In Use.

2.6 DENTAL ORAL EVACUATION (OE) SOURCE

Provide complete factory-packaged, factory-tested, continuous-duty source(s). Each source shall contain vacuum pumps, separator(s), control panel, source shutoff, pump isolation valves and other components required by NFPA 99, and necessary to provide complete performance. Each source shall require single-point connections to power wiring, warning system wiring, and piping system.

2.6.1 Vacuum Pumps

Provide oil-lubricated rotary-vane vacuum pumps. The pumps shall be connected in parallel to the central wet separator tanks.

2.6.1.1 Rotary-Vane Vacuum Pump

Provide two sets of low speed, positive displacement, oil lubricated rotary-vane vacuum pumps with separate, standard NEMA frame size, high efficiency motors. Provide automatic lubrication of moving pump parts by an oiling system not dependent on moving parts and operated only by gravity and vacuum. Provide vacuum pump constructed to provide protection against ingesting particulates larger than 15 µ into pump, operating with insufficient lubrication, and water contamination of oil. Provide electrical overload by thermal sensors built into single phase motors or thermal sensors built into three phase motor starters; three phase motor starters additionally protected against single phasing. Provide continuous duty, NEMA rated, C-face, TEFC motor with 1.15 service factor, and maximum of 1800 RPM.

2.6.1.2 Regenerative Blower

<table>
<thead>
<tr>
<th>Lead Pump</th>
<th>Continuous Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lag and Follow</td>
<td>Start 5 inches Hg vacuum</td>
</tr>
<tr>
<td>Pumps</td>
<td>Stop 8 inches Hg vacuum</td>
</tr>
</tbody>
</table>

2.6.2 Pipe Isolators

Provide flexible, resilient band-sealed (clamped) sleeves furnished to isolate the vacuum pump from associated piping. Size sleeve couplings in accordance with the exhauster intake and output connections. Provide pipe isolators with steel coupling guards.

2.6.3 Valves

2.6.3.1 Volume Control Valve

Provide the input of each vacuum pump with an adjustable air volume control valve to prevent accidental vacuum pump overload and to provide a
means of adjusting the upper design capacity limit. The volume control valve shall be built in or immediately adjacent to the first or input stage of the vacuum pump and shall be preset by the manufacturer during certification procedure. The valve shall be a butterfly type with cast iron body with corrosive resistant internals.

2.6.3.2 Antisurge Valve

Provide the input of each vacuum pump with an antisurge valve that will operate proportionally and automatically throughout the vacuum pump's designed range. This valve shall continually sense the motor current and maintain a predetermined operational level of volume by proportionally bleeding air into the system. The valve shall be equipped with a silencer to attenuate air noise to 85 dBA or below. The valve shall be installed in, on, or near the first stage of the vacuum pump and can be mounted in conjunction with the directional flow valve.

2.6.3.3 Directional Flow Valve

Provide the input of each vacuum pump with a directional flow valve to prevent back flow of air through the shutdown. The directional flow valve shall be cast iron with corrosive resistant internals.

2.6.4 Exhaust Silencer

Provide each vacuum pump exhaust with a separate air discharge silencer of the open-bore expansion type. No interior baffling or shrouding will be permitted. The silencer shall satisfactorily attenuate air noise to a level below 85 dBA.

2.6.5 Control Panel

Provide each set of vacuum pump systems with microprocessor master control panel in a NEMA 250 Type 12 enclosure. Provide controls connections for vacuum pressure switch oral evacuation remote control panel and each individual vacuum pump controller to microprocessor. Microprocessor shall provide for selection of normal operation (automatic alternation) or manual selection of lead, lag, and vacuum pumps. Provide automatic alternation of vacuum pumps based on a first-on/first-off principle with provisions for simultaneous operation. The lag vacuum pump shall be able to start automatically if the lead vacuum pump fails to operate. Provide manual reset for thermal malfunction shutdown. All control and alarm functions shall remain energized while any vacuum pump in the system remains electrically online. Provide a magnetic motor starter with integral overload and short circuit protection, with lockable disconnecting means at each vacuum pump. Provide running light and elapsed run-time meter for each vacuum pump. Provide circuit breakers with a single point power feed connection to each vacuum pump. Provide control circuit transformers with fused primary and secondary. Provide vacuum control switches. Provide integral PLC controller for automatically switching operating sequence of vacuum pumps. Provide back-up circuit in case of PLC failure. Provide digital display interface. User interface shall display all alarm conditions, vacuum pump maintenance intervals, vacuum pump performance warnings, average system vacuum demand, vacuum pumps on/off status, system model number and serial number, and phone number to call for service. Contacts shall be provided to transmit system on/off status to the facility Direct Digital Control (DDC) system to enable the separator tank liquid level control sequence. Provide audible and visual local alarms with silence button, remote alarm connections, and
safety devices as required by NFPA 99. Local alarms shall have contacts to allow indication of a fault condition at the master alarm panel and the building automation system if one or more local alarms are activated. The master control panel shall be provided with a remote control panel with visual indication of start/stop status located in the reception area adjacent to the master alarm and area alarm control panels. The master control panel shall also have integrated controls for automatic actuation of the accumulator tank auto-wash system during off hours. For each vacuum pump system, provide the following alarms at the master alarm panel: Lag vacuum pump in use, system malfunction.

2.6.6 Central Wet Separators

The OE system shall utilize a central wet separator. Provide separator tanks constructed of a nonmetallic, noncorrosive, inert material or composite such as glass-reinforced plastic (GRP). Tanks shall be of one-piece construction, with smooth, interior walls. Tanks shall be freestanding. Tanks shall be high-pressure vessels able to withstand a constant negative pressure of 15 inches Hg vacuum. Provide separator tanks equipped with mechanical overflow protection. Provide preplumbed with a 360 degree nozzle internal washdown system with timer. The washdown system shall include a 115 VAC automatic-flush clock-controlled mechanism which shall effect a complete washdown of the interior of the separator at any predetermined time of day or night. Washdown time shall be adjustable for up to at least 3 minutes. The timers shall be in the main electric control panel. The cold water supply to the automatic tank flush unit shall be equipped with an in-line filter with 40-mesh stainless steel screens. Filter shall be supplied as part of the OE system. Each separator tank shall be equipped with an electronic high-low liquid level sensor which shall perform as the primary overfill protector. Each sensor shall control a 115 volt ac electrically operated output air solenoid valve located to control the outgoing air from the tank to the vacuum pump. Each tank shall be equipped with a gate and swing type check valve at the bottom drain. With negative pressure in the tank, the check valve shall remain closed to maintain vacuum. When negative pressure ceases, either by vacuum pump shutdown or by closure of the outgoing air solenoid control by the liquid level sensor, the check valve shall open and the tank shall undergo gravity drain.

2.6.7 Vacuum Relief Valve

Provide vacuum relief valve. The valve shall operate automatically. The valve shall be equipped with a silencer to attenuate air noise to 85 dBA.

2.6.8 Amalgam Separator

Provide amalgam separator, consisting of a sedimentation collection chamber that is removable. Separation process shall be sedimentation which may be supplemented with filtration, and/or ion exchange. Unit shall be compatible for use on wet and dry vacuum systems. Assembly shall be wall or floor mounted. Provide minimum 1-1/2 inch inlet and outlet connection. Unit shall be ISO 11143 Certified and have a minimum of 99 percent removal efficiency.

2.7 PIPE AND FITTINGS

2.7.1 Service Entrance

Piping at service entrance (from 12 inches inside building to 5 feet...
outside): Same as Indicated for outside utilities.

2.7.2 Positive pressure piping systems up to 200 psi

Hard-drawn seamless copper tubing (ASTM B819), Type K or L, bearing one of the following markings, OXY, MED, OXY/MED, and brazed solder-type wrought copper fittings (ASME B16.22), or brazed fittings (ASME B16.50) cleaned for oxygen service by the manufacturer in accordance with Pamphlet CGA G-4.1. Cast fittings shall not be used. Minimum size shall be 1/2 inch. Install branch piping full size to each terminal device, including vertical drops, and provide reducer fitting at the device pigtail. Type L tubing is not acceptable for installation below grade. Provide with NF nitrogen purge and capped/plugged ends until prepared for installation. Tubing joining material shall be ANSI/AWS-BCuP series filler material.

2.7.3 Dental surgical and WAGD vacuum piping systems up to 20 inches Hg vacuum

Hard-drawn seamless copper tubing (ASTM B819), Type K or L, and solder-type wrought copper fittings (ASME B16.22) or brazed fittings (ASME B16.50). Cast fittings shall not be used. Minimum size shall be 3/4 inch. Install branch piping full size to each terminal device, including vertical drops, and provide reducer fitting at the device pigtail. Tubing joining material shall be ANSI/AWS-BCuP series filler material. Nitrogen purge not required. Labeled or otherwise identified prior to installation in order to preclude inadvertent inclusion into the pressurized systems. Labeling is not required if installation meets all requirements for pressurized piping including prohibition of flux on copper-to-copper joints and the use of a NF nitrogen purge during brazing.

2.7.4 Dental Oral Evacuation System

Provide polyvinyl chloride (PVC) drainage, waste and vent (DWV) pipe and fittings conforming to ASTM D2665. Solvent cement for PVC pipe fittings shall conform to ASTM D2564. Fittings, supports, and joint assembly shall comply with ICC IPC. Fittings shall be the long-radius type for turns and the wye type for branches. The most distant end of each trunk line from the separators may terminate with a vacuum relief valve.

2.7.5 Compressed Air Intake and Vacuum Pump Exhaust Line(s)

Hard-drawn seamless copper tubing (ASTM B88 or ASTM B819), Type K or L, and solder-type wrought copper fittings (ASME B16.22). Cast fittings shall not be used. Tubing joining material shall be ANSI/AWS-BCuP series filler material.

2.8 VALVES AND ASSEMBLIES

2.8.1 Valves

a. Positive pressure piping systems up to 200 psi: Bronze, full port, quarter-turn ball type, three piece construction, 600 psi WOG, blow-out proof stem, in-line repairable. Cleaned for oxygen service by manufacturer in accordance with Pamphlet CGA G-4.1. All sizes: 316 stainless steel ball and stem, glass reinforced polytetrafluoroethylene (RPTFE) seat seals and packings. Clean, cap and deliver to site in sealed package bearing manufacturer's identifying tag or stamp. Keep sealed until prepared for installation. Provide with valve manufacturer installed brazed Type K
copper tube extensions a minimum of 6 inch long on the inlet and outlet side of the valve for making connection to the pipeline(s). A purge port shall be provided on both the inlet and outlet tube extensions. Valves in locations other than zone valve boxes shall be lockable.

b. Vacuum piping systems up to 20 inches Hg vacuum: Bronze full port, quarter-turn ball type, three piece construction, 29 inches Hg vacuum, blow out proof stem, in-line repairable. All sizes: 316 stainless steel ball and stem, glass reinforced polytetrafluoroethylene (RPTFE) seat seals and packings. Provide with valve manufacturer installed brazed Type K copper tube extensions a minimum of 6 inch long on the inlet and outlet side of the valve for making connection to the pipeline(s). A purge port shall be provided on both the inlet and outlet tube extensions. Valves in locations other than zone valve boxes shall be lockable.

2.8.2 Zone Valve Assemblies

a. Recessed wall box, minimum 18 GA sheet steel, baked enamel finish. Stainless steel or chrome front trim. Transparent plastic door with pull handle or ring for emergency access to valves. Service access to valves shall be by removal and replacement of door, which shall neither cause damage nor require special tools. Opaque plastic is not acceptable. Openings to box interior shall be dust-tight. Provide each shutoff valve with pressure gauge and integral extension tubes for joining to piping system outside of box. Provide gauge port on each tubing extension. Valves shall not be lockable.

b. Up to 5 shutoff valves of 1 inch size or smaller may be installed in one box. Use single-valve boxes for 1-1/4 inch valves and larger. Front trim with interlocking edges where single-valve boxes are jointed together for multiple valve installations. Provide custom-made boxes as specified above for those valves that are too large for pre-manufactured boxes.

c. Arrange shutoff valves in following order from top to bottom: Oxygen, nitrous oxide, dental compressed air, WAGD, and dental surgical vacuum. If 2 or more valves for same service are located in common box, larger of valves shall be lower.

2.9 HANGERS AND SUPPORTS

Pipe hangers and supports shall be copper plated when in direct contact with copper tubing. Tubing installed on trapeze hanger shall be secured in place with appropriately sized clamp and be fully isolated from dissimilar metals.

2.10 GAUGES

a. Provide for line pressure use adjacent to source equipment, ASME B40.100 pressure gauges, 4 1/2 inches in diameter with metal case for oxygen, nitrous oxide, carbon dioxide, dental compressed air, medical compressed air, laboratory compressed air, process compressed air, and nitrogen, accurate to within two percent. Range shall be two times operating pressure. Dial graduations and figures shall be black on a white background, or white on a black background. Gauges shall be expressly made for and cleaned for oxygen use, labeled for appropriate service, and marked "USE NO OIL". Provide bourdon tube
and brass movement. Install with gauge cock. Gauges for all services downstream of main shutoff valve shall be same as those adjacent to source equipment except diameter may be reduced to 1-1/2 inches. Dial ranges shall be 0 to 100 psi for pressurized gases and compressed air services except nitrogen and instrument compressed air; 0 to 300 psi for nitrogen and instrument compressed air.

b. Provide for vacuum line use adjacent to source equipment, ASME B40.100 vacuum compound gauges, 4 1/2 inches in diameter with metal case for dental surgical vacuum, medical-surgical vacuum, dental oral evacuation, WAGD, and laboratory dust evacuation, accurate to within two percent. Dial graduations and figures shall be black on a white background, or white on a black background. Label for vacuum service. Provide with bourdon tube and brass movement. Install with gauge cock. Gauges for all services upstream of main shutoff valve shall be same as those adjacent to source except diameter may be reduced to 1 1/2 inches. Dial range shall be 0 to 30 inches Hg vacuum.

2.11 DENTAL GAS, MEDICAL GAS, AND SUPPORT SYSTEMS OUTLETS AND VACUUM SYSTEMS INLETS

2.11.1 Station Outlets/Inlets

Submit proof that outlets/inlets, as an assembly, are listed by Underwriters Laboratories, Inc., and are manufactured in accordance with applicable NFPA 99 and CGA standards. Provide station outlets/inlets (Oxygen, Nitrous Oxide, Dental Surgical Vacuum, WAGD) conforming to NFPA 99. Provide station outlets/inlets for concealed piping made of brass and having an adjustable valve mechanism to compensate for variation in wall thickness. Each unit shall be securely mounted and self-sealing. Each unit as an assembly shall conform to the requirements of the Underwriters Laboratories Inc.; submit proof of such conformance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, the Contractor may submit a written certificate from any approved nationally recognized testing organization adequately equipped and competent to perform such services, including the follow-up service, stating that the item has been tested and conforms to the requirements, including method of testing, of the specified agency. Station outlets/inlets shall be equipped with threaded DISS connector per CGA standards noninterchangeable quick disconnect coupler, except for nitrogen which shall be equipped with DISS connections as assigned for gas and vacuum systems in CGA V-5, except that inlets for the WAGD system shall be 7/8 inch nonthreaded connections. DISS outlets shall be used for all dental vacuum and ceiling mount applications. Provide recessed wall type outlets/inlets unless specified otherwise. Station outlets shall be cleaned for oxygen service in accordance with Pamphlet CGA G-4.1 and the assembly shall be capped and the finished assembly poly bagged for shipment.

2.11.1.1 Couplers

Where quick-disconnect couplers are furnished they shall be of the noninterchangeable type. Connector shall lock firmly into position and shall have a finger-type quick release. Coordinate coupler type with the ROICC.

2.11.1.2 Faceplates

Faceplates shall be polished chromium-plated metal or satin-finish
stainless steel secured with chromium-plated countersunk screws. Provide service identification either cast into, or permanently etched by the manufacturer into each faceplate.

2.11.1.3 Rough-In Assembly

The rough in assembly shall be of modular design and include a gas specific 16 gauge steel mounting plate designed to permit on-site ganging of multiple outlets, on 5 inch center line spacing. A machined brass outlet block shall be permanently attached to the mounting bracket to permit the 1/2 inch OD, type-K copper inlet to swivel 360 degrees for attachment to the piping system. The rough in assembly shall contain a double seal to prevent gas leakage between the rough in and latch-valve assemblies after the wall is finished. A single o-ring seal shall not be acceptable. The latch-valve assembly shall telescope up to 3/4 inches to allow for variation in finished wall thickness from 1/2 to 1-1/4 inches.

2.11.1.4 Vacuum Slides

Provide one vacuum slide of the same manufacturer of the vacuum inlet for each vacuum inlet. Coordinate location with room elevations.

2.11.2 Dental Compressed Air Outlets

Provide dental compressed air outlets as follows:

a. Provide dental treatment rooms (DTR) with a 1/2 inch service pipe terminated with a 1/2 x 3/8 inch compression angle stop valve.

b. Dental laboratory. Provide each of the following, and coordinate locations with the laboratory casework supplier.

   (1) 1/2 inch service pipe terminated with a ball valve.

   (2) 1/2 inch service pipe terminated with a needle valve.

   (3) 1/2 inch service pipe terminated with a quick disconnect brass body coupler and sleeve, 3/8 inch NPT, 300 psi maximum pressure rating, Buna-N seals, and complying with the dimensional requirements of military specification MIL-C-4109.

   c. Provide dental instrument processing center with a 5/8 inch OD service pipe terminated with a quick disconnect brass body coupler and sleeve, 3/8 inch NPT, 300 psi maximum pressure rating, Buna-N seals, and complying with the dimensional requirements of military specification MIL-C-4109.

2.11.3 Dental Oral Evacuation Inlets (Dental Treatment Room)

Provide dental treatment rooms (DTR) with a 1/2 inch service pipe terminated 2 inches above bottom of floor box or above finished floor. Cover pipe end to prevent entrance of debris. Prepare end for continuation of service by another Division.

2.12 LABORATORY COMPRESSED AIR AND PROCESS COMPRESSED AIR TERMINATION

Provide 1/2 inch tube at each location and terminate 4 inches from finished face of wall/partition with 1/2 inch ball valve and 6 inch long capped extension.
2.13 WARNING SYSTEMS

Alarm panels for gas and vacuum systems shall be located as specified and indicated. Each signal and gauge shall be appropriately labeled "OPERATING" and "EMERGENCY." Each gauge and device shall be clearly identified by means of engraved plastic nameplates. Alarms and pressure gauges shall be provided for each pressurized system. Alarms and vacuum gauges shall be provided for each vacuum, WAGD, and oral evacuation system. Signal systems shall be energized by the normal and emergency power systems.

2.13.1 Master Alarm Panels

a. Master alarm panel features:

   (1) Provide recessed panel, complete with all necessary displays, factory wiring, transformers, and circuitry requiring only 120 VAC 60 Hz primary power connected to the Life Safety branch. Provide with metallic back (rough-in) box. Provide panel that is compliant with NFPA 99 and UL Listed as an assembly.

   (2) Provide one green Light Emitting Diode (LED) indicating that the panel is powered and operating normally, and one red LED indicating a fault in the panel power and/or microprocessor has been detected. The red LED shall not be able to be reset until the fault has been repaired, and then the red LED shall automatically reset to green. Muting of the audible alarm in "Abnormal" status shall not cancel illumination of the red LED. Only correction of the abnormal condition shall allow resetting of the LED to green.

   (3) Provide each individual signal with one green and one red LED. Provide illuminated green LED for "Normal" status. Provide illuminated red LED for "Abnormal" status. Muting of the audible alarm in "Abnormal" status shall not cancel illumination of the red LED. Only correction of the abnormal condition shall allow resetting of the LED to green.

   (4) Provide audible alarm upon actuation of any abnormal condition. Provide audible signal producing a minimum sound pressure level of 80 dBA measured at a distance of 3 feet. The audible alarm shall be provided with a reset relay to shut off only the audible alarm and not affect the illuminated "Abnormal" LED, until the condition is corrected. The audible alarm shall sound again upon actuation of any additional abnormal condition.

   (5) Provide back (rough-in) box factory configured for internal sensor mounting. Provide gas specific sensors for periodic testing without interrupting pipeline pressures or vacuum. External sensors, when applicable, shall be designed to function up to 5,000 feet from the alarm panel.

   (6) Provide front panel TEST button to initiate a self-test function to test the LED indicators, visual displays, audible alarm, and to view alarm set points.

   (7) Provide contacts for connecting to BAS (UFGS 23 09 23.13 20). Alarms requiring installation of additional circuit boards for
PC-based monitoring are not acceptable.

b. Provide alarm points based on installed systems:

1. Oxygen Changeover to Secondary Supply Notify
2. Oxygen Main Line Pressure High/Low
3. Nitrous Oxide Changeover to Secondary Supply Notify
4. Nitrous Oxide Main Line Pressure High/Low
5. WAGD Main Line Vacuum Low
6. Dental Compressed Air Main Line Pressure High/Low
7. Dental Surgical Vacuum Main Line Vacuum Low
8. Dental Oral Evacuation Vacuum Low
9. Dental Compressed Air Compressor(s) Local Alarm
10. Dental-Surgical Vacuum Pump(s) Local Alarm

2.13.2 Area Alarm Panels

a. Area alarm panel features:

1. Provide recessed panel, complete with all necessary displays, factory wiring, transformers, and circuitry requiring only 120 VAC 60 Hz primary power connected to the Life Safety branch. Provide with metallic back (rough-in) box. Provide panel that is compliant with NFPA 99 and UL Listed as an assembly.

2. Provide one green Light Emitting Diode (LED) indicating that the panel is powered and operating normally.

3. Provide each individual signal with one green and one red LED. Provide illuminated green LED for "Normal" status. Provide illuminated red LED for "Abnormal" status. Muting of the audible alarm in "Abnormal" status shall not cancel illumination of the red LED. Only correction of the abnormal condition shall allow resetting of the LED to green.

4. Provide audible alarm upon actuation of any abnormal condition. Provide audible signal producing a minimum sound pressure level of 80 dBA measured at a distance of 3 feet. The audible alarm shall be provided with a reset relay to shut off only the audible alarm and not affect the illuminated "Abnormal" LED, until the condition is corrected. The audible alarm shall sound again upon actuation of any additional abnormal condition.

5. Provide back (rough-in) box factory configured for internal sensor mounting. Provide gas specific sensors for periodic testing without interrupting pipeline pressures or vacuum. External sensors are not permitted.

6. Provide front panel TEST button to initiate a self-test function to test the LED indicators, visual displays, audible alarm, and to
Alarm panels shall be provided in each nursing unit on a wing/ward basis as indicated, but these panels shall not include nitrous oxide, nitrogen, nor WAGD and oral evacuation vacuum alarms, unless specifically indicated.

b. Provide alarm points based on installed systems:

(1) High/Low Line Pressure (for each positive pressure system piped to the area). Actuation when the pressure in the line being monitored reaches approximately 20 percent above or below normal operating pressure.

(2) Low Line Vacuum (for each vacuum system piped to the area). Medical-surgical alarm shall be actuated when the vacuum in the line being monitored reaches 12 inches Hg vacuum. WAGD and oral evacuation alarms shall be actuated when the vacuum in the line being monitored reaches 6 inches Hg vacuum.

2.13.3 Local Alarm Panels

a. Provide alarm points based on installed systems:

(1) Dental Compressed Air Source Backup (Lag) Compressor Operating

(2) Dental Compressed Air Source Carbon Monoxide High

(3) Dental Compressed Air Source High Discharge Air Temperature

(4) Dental Compressed Air Source High Water in Receiver

(5) Dental Compressed Air Source Dew Point High

(6) Dental-Surgical Vacuum Source Backup (Lag) Vacuum Pump Operating

2.14 IDENTIFICATION MATERIALS

General: Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.14.1 Plastic Pipe Markers

Provide snap-on or adhesive type pipe markers with nomenclature that closely matches contract drawings. Comply with designations indicated on contract drawings for piping system nomenclature and abbreviate only as necessary for each application length. Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.


b. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ASME A13.1.
c. Application: For exterior diameters greater than 2-inch (including insulation if any), provide continuous directional flow arrow tape around pipe circumference; two places, before and after pipe marker. Provide adhesive plastic pipe markers. For external diameters less than 2 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

(1) Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
(2) Adhesive lap joint in pipe marker overlap.
(3) Laminated or bonded application of pipe marker to pipe (or insulation).

2.14.2 Valve Tags

Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4-inch high letters and sequenced valve numbers 1/2-inch high, and with hole for fastener, or engraved plastic laminate valve tags, with piping system abbreviation in 1/4-inch high letters and sequenced valve numbers 1/2-inch high, and with hole for fastener. Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose. Compile valve schedule for each service. For each page of valve schedule, provide laminated plastic coated cardboard stock sheets.

a. Provide 1 1/2-inch diameter tags, except as otherwise indicated.

b. Provide size and shape as specified or scheduled for each piping system.

c. Fill tag engraving with black enamel.

2.14.3 Engraved Plastic Laminate Signs

Provide engraving stock melamine plastic laminate, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.14.4 Plastic Equipment Markers

Provide manufacturer's standard laminated plastic, color coded equipment markers. Include terminology matching equipment schedules as closely as possible. Provide approximate 2-inch by 4-inch markers for control devices, and 4-inch by 6-inch for equipment. Identify equipment and electrical devices furnished under this section.

2.14.5 Plasticized Tags

Provide pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately, 2-inch by 6-inch with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary
2.14.6 Lettering and Graphics

Coordinate names, abbreviations and other designations used in plumbing identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of plumbing systems and equipment. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Oral Evacuation Pump No. 2, Dental Air Compressor No. 1).

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 CYLINDER MANIFOLD SUPPLY SOURCE

a. Obtain a complete set of full primary and secondary cylinders from the Government after successful completion of final tests. Install full cylinders and manifolds. Coordinate source of cylinders with Owner.

b. Pipe system relief discharges to exterior of building.

c. Provide check valve between each cylinder head and the manifold header. Each header shall be connected to the manifold controls with shutoff valves. The relief valve shall be vented to the outside atmosphere if the total capacity of the system is more than 2,000 cubic feet of gas. Venting shall be accomplished by piping the relief valve to the outside atmosphere or by approved ductwork having a minimum opening of 72 square inches. The manifold shall be installed according to the manufacturer's recommendation and as required by NFPA 99.

3.3 COMPRESSED AIR AND VACUUM SOURCES

Installation shall be in accordance with manufacturer's instructions and recommendations. Align compressor and vacuum pump couplings in accordance with manufacturers' specifications. Provide factory service representative to supervise installation and to set pressure and vacuum switches. System start-up shall be performed by factory trained personnel and documented.

3.3.1 Amalgam Separator for Dental Oral Evacuation

Amalgam separator shall be installed between the treatment rooms and the central wet separator in a location that is accessible from a standing position adjacent to the separator.

3.4 PIPING SYSTEMS

a. Piping shall be cleaned, tested, and installed as specified in NFPA 99.

c. Make up threaded joints, as permitted by NFPA 99, with polytetrafluoroethylene tape, or other thread sealant approved for oxygen service. Thread sealant shall be applied to male threads only.

d. Install pipe lines where they will not be subject to physical damage.

e. Install branch piping full size to each outlet/inlet, including vertical drops. Provide reducer at the outlet/inlet pigtail connection.

f. Provide protection of underground piping against frost, corrosion, and physical damage by installing piping in nonmetallic ducts or casings. Encase underground piping passing beneath load bearing surfaces and traffic areas in split PVC pipe sized to accommodate piping. Secure split PVC piping with galvanized steel draw bands. Support at regular intervals by insulating spacers providing complete circumferential clearance.

g. Piping shall be connected near the top of receivers.

h. Compressed air intake pipe, and vacuum pump exhaust pipe shall be extended to the outside of the building and their end turned down and screened against insects.

i. Provide vibration-absorbing couplings between the compressed air and vacuum source(s) and the system pipeline, and the compressed air and vacuum sources and the intake air/vacuum pump exhaust piping.

j. Provide laboratory and process air piping system(s) separate from the dental compressed air system.

k. Dental oral evacuation system piping shall be installed with a minimum slope of 1/4 inch per 10 feet from the DTR utility box to the separator tanks.

l. Provide pipelines with appropriate system labeling conforming to NFPA 99.

3.5 STATION OUTLETS/INLETS

3.5.1 Wall Outlets/Inlets

Wall outlets/inlets shall be located 60 inches from finished floor or as indicated. Back boxes shall be permanently stamped with the gas or vacuum service identification and shall be safety-keyed to accept only the appropriate gas or vacuum faceplate.

3.5.2 DISS Connections

Where threaded connections are furnished, DISS connections as described in CGA V-5 shall be used to provide noninterchangeable connections. In order to facilitate connection making, the threads of the connection shall engage before the check valve is depressed and pressure is allowed to enter the attached fitting. No leakage shall occur when threads are
fingertight.

3.6 VALVES AND ASSEMBLIES

Valve cabinets shall be recess mounted on the corridor side of the partition. Cabinets shall house alarm system sensors and zone control valves. The valves shall be installed in the cabinet 5 feet above the floor at the center line of the box and shall provide complete shutoff of each of the piped services. Provide valves and exposed piping connecting the valves with appropriate system labeling conforming to NFPA 99. Valves and exposed piping connecting the valves shall be labeled or identified in an approved manner with colors as follows:

<table>
<thead>
<tr>
<th>System</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressed Air</td>
<td>Yellow</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Green</td>
</tr>
<tr>
<td>Nitrous Oxide</td>
<td>Blue</td>
</tr>
<tr>
<td>Vacuum</td>
<td>White</td>
</tr>
</tbody>
</table>

Each valve shall be securely mounted in a fixed position by means of brackets. Position of each valve shall allow for a firm grip to facilitate easy closing and opening. Each valve or valve box shall be labeled in substance as follows:

"Caution - (Name of applicable system) Valves. Do not close except in emergency. This valve controls (Name of applicable system) to insert room name/number."

3.7 GAUGES

a. Calibrate and zero gauges at job site.

b. Permanently label gauges with system name.

3.8 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features unless otherwise shown. Each foundation shall include standard isolation units as indicated. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed loading rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to 10 percent of the lowest equipment rpm. Submit details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

3.8.1 Tank or Skid Mounted Compressors

Floor attachment shall be as recommended by compressor manufacturer.

3.8.2 Foundation Mounted Compressors

Foundation attachment shall be as recommended by the compressor manufacturer.
3.9 TRAINING

a. Provide the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

b. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

c. 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.

3.10 GAS, SUPPORT, AND VACUUM SYSTEMS TESTING

3.10.1 Test Reports

a. Certified installers, inspectors, and verifiers shall conduct, document tests in accordance with NFPA 99, furnish their own test equipment and supplies (including gases) for their respective tests. Reports shall be certified with the signature of an officer of the company responsible for conducting the test.

b. Submit reports in booklet form, within two weeks of test date with separate copies of each report for Contractor Quality Control, and Contracting Officer. Submit reports of both failed and passed tests. Except as indicated under specific test description, reports may be subdivided by tested area to allow timely submission. Submit test reports showing all field tests performed to adjust each component and field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed systems. Each test report shall indicate the final position of controls.

c. Document each report separately in an easy-to-follow manner, organized by areas and systems tested. (An area is typically a group of outlets downstream of a zone valve assembly.)

d. At the beginning of each report, document the following information:

(1) Name of project.
(2) Date of report.
(3) Name of company responsible for performing test.
(4) Name of person conducting test.
(5) Date of test.
(6) Area(s) tested.

(7) Name and address of facility.

e. Pressure readings shall be made with calibrated gauges that have accuracies of +/- 1 psi.

f. Temperature readings shall be made with calibrated thermometers that have accuracies of +/- 1 degrees F.

3.10.2 Report Status

Project is acceptable only after systems have passed tests performed by the Inspection, Testing, and Verification Agency. Failure of test requires corrective action and retesting. Corrective actions taken to pass test and subsequent retesting shall be provided at no extra cost.

3.10.3 Category 3 Systems Testing

3.10.3.1 General

a. Inspection and testing shall be performed on all new piped systems, additions, renovations, temporary installations, or repaired systems, to ensure by a documented procedure, that all applicable provisions of NFPA 99 and the Contract Documents have been adhered to and system integrity has been achieved or maintained.

b. Inspection and testing shall include all components of the system or portions thereof, including, but not limited to, medical gas source(s), compressed air sources (e.g., compressors, dryers, filters, regulators), alarms and monitoring safeguards, pipelines, isolation valves, and station inlets (vacuum) and outlets (positive pressure gases).

c. All systems that are breached and components that are subject to additions, renovations, or replacement (e.g., new medical gas sources, compressors, dryers, alarms) shall be inspected and tested. Systems shall be deemed breached at the point of pipeline intrusion by physical separation or by system component removal, replacement, or addition. Breached portions of the systems subject to inspection and testing shall be confined to only the specific altered zone and components in the immediate zone or area that is located upstream (inlet side) for vacuum systems and downstream (outlet side) for positive pressure gases at the point or area of intrusion.

d. Provide inspection, testing and verifier reports containing detailed findings and results directly to the Contracting Officer. All inspection, testing, and verification records shall be maintained on-site within the facility. The Contracting Officer shall review the records prior to the use of all systems.

e. The Contracting Officer will accept the Verifier's Report as determining that the gas/vacuum delivered to the outlet/inlet is that shown on the outlet/inlet label and the proper connecting fittings are installed for the specific gas/vacuum service.
3.10.3.2 Initial Tests and Reports - All Category 3 Systems

The installing Contractor, a representative of the system supplier, or a representative of the system manufacturer is responsible for conducting and documenting these tests. Test gas shall be oil-free, dry Nitrogen NF. Provide all necessary materials and test apparatus to satisfactorily perform tests.

a. Initial Blow Down Test.

b. Initial Pressure Test for Positive Pressure Gas Systems and Copper Vacuum Piping.

c. Initial Leak Test for PVC Vacuum Piping. Subject piping to a vacuum of not less than 12 inches Hg vacuum.

d. Initial Cross-Connection Test. Conduct this test only after completion of every system within test area.

e. Initial Piping Purge Test.

f. Initial Standing Pressure Test for Positive-Pressure Gas Piping.

g. Initial Standing Vacuum Test for Copper and PVC Vacuum Systems. Subject PVC piping to a vacuum of not less than 12 inches Hg which shall not reduce to less than 8 inches Hg vacuum at the end of the 24 hour test period.

3.10.3.3 I,T&V Agency Tests and Reports

The Inspection, Testing and Verification Agency is responsible for conducting and documenting gas and Nitrogen tests. Test gas shall be oil-free, dry Nitrogen NF. Provide all necessary materials and test apparatus to satisfactorily perform tests.

a. Verifier Standing Pressure Test.

b. Verifier Cross-Connection Test.

c. Verifier Warning System Test.

d. Verifier Piping Purge Test.

e. Verifier Piping Particulate Test.

f. Verifier Piping Purity Test.

g. Verifier Operational Pressure Test.

h. Verifier Gas Concentration Test.

i. Labeling.

j. Oxygen and Nitrous Oxide Source Equipment Operational Test.

3.10.3.4 Final Tests and Reports - All Category 3

The installing Contractor, a representative of the system supplier, a representative of the system manufacturer, or a certified system verifier
is responsible for conducting and documenting Gas, Support, and Vacuum Systems (except Oxygen and Nitrous Oxide) tests. Test gas shall be oil-free, dry Nitrogen NF. Provide all necessary materials and test apparatus to satisfactorily perform tests.

a. Final Standing Pressure Test.
b. Final Standing Vacuum Test.
c. Final Cross-Connection Test.
d. Final Piping Purge Test.
e. Labeling.
g. Vacuum Systems Source Equipment Operational Test.
h. Dental Oral Evacuation (OE) System Test

Materials needed: Two vacuum gauges, accuracy of at least ±0.5" Hg at 6-8" Hg. Flow restrictors (quantity = 70 percent x number of dental treatment rooms). Flow restrictor components:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Part A</td>
<td>Hose, smooth bore OE tubing, 5/8 inch ID x 4 inch long.</td>
</tr>
<tr>
<td>Part B</td>
<td>Hose adaptor, brass, 1/2 inch male pipe thread x 3/8 inch hose barb.</td>
</tr>
<tr>
<td>Part C</td>
<td>Tubing, vinyl, 1/2 inch ID x 1-3/8 inch long.</td>
</tr>
<tr>
<td>Part D</td>
<td>Tubing, vinyl, 1/2 inch OD, 3/16 inch ID x 1 inch long.</td>
</tr>
<tr>
<td>Part E</td>
<td>Tubing, soft copper, 5/16 inch x 2 inch long.</td>
</tr>
</tbody>
</table>

(2) Clear burrs on cut ends with 15/16 inch drill bit.

Flow restrictor assembly:

a. Insert threaded end of the hose barb (Part B) completely into the 5/8 inch OE hose (Part A).
b. Slip the 1/2 inch ID tubing (Part C) completely over the hose barb (Part B).
c. Slip 1/2 inch OD tubing (Part D) into the 1/2 inch ID tubing (Part C) to butt against the hose barb (Part B).
d. Slip the copper tubing (Part E) into the 1/2 inch OD tubing (Part D) approximately 3/4 inch.
e. Flow restrictors as designed allow a flow of 7.4 SCFM when attached to plumbing under 6 inches Hg vacuum pressure.

(1) Install vacuum gauge No. 1 on a pipe common to the power units close to the separating tanks. Install this gauge in a manner that will have minimal effect on airflow through the pipe.
(2) Install vacuum gauge No. 2 on the OE inlet in the floor box of the dental treatment room (DTR) farthest from the vacuum power units. Note that this inlet will be closed, with no flow passing through it.

(3) Place a flow restrictor over one OE inlet in 70 percent of the facility DTRs. DTRs fitted with flow restrictors should include a mix of DTRs most distant and DTRs nearest the vacuum source.

(4) Block off all other OE inlets and any other openings in the fixed pipe system.

(5) Operate the vacuum system with one pump inoperable and note the readings on the two vacuum pressure gauges. Next, operate the vacuum system with a different pump inoperable and note the reading on both vacuum pressure gauges. Continue this process until a vacuum reading has been obtained with each of the system pumps taking a turn as the inoperable pump.

(6) An acceptable OE system shall be able to maintain a minimum of 6 inches Hg vacuum as measured on the vacuum gauge on the furthest DTR inlet (gauge No. 2) under the conditions outlined above. The system piping pressure drop between the vacuum gauge near the power units (gauge No. 1) and the vacuum gauge at the farthest DTR (gauge No. 2) should be no more than 1 inch Hg vacuum.

3.10.4 Category 2 Systems Testing

3.10.4.1 General

a. Inspection and testing shall be performed on all new piped systems, additions, renovations, temporary installations, or repaired systems, to assure by a documented procedure, that all applicable provisions of NFPA 99 and the Contract Documents have been adhered to and system integrity has been achieved or maintained.

b. Inspection and testing shall include all components of the system or portions thereof, including, but not limited to, bulk source(s), cylinder manifolds, compressed air sources (e.g., compressors, dryers, filters, regulators), source alarms and monitoring safeguards, master alarms, pipelines, isolation valves, area alarms, zone valves, and station inlets (vacuum) and outlets (pressure gases).

c. All systems that are breached and components that are subject to additions, renovations, or replacement (e.g., new gas sources: bulk, manifolds, compressors, dryers, alarms) shall be inspected and tested. Systems shall be deemed breached at the point of pipeline intrusion by physical separation or by system component removal, replacement, or addition. Breached portions of the systems subject to inspection and testing shall be confined to only the specific altered zone and components in the immediate zone or area that is located upstream for vacuum systems and downstream for pressure gases at the point or area of intrusion.

d. Provide inspection, testing, and verifier reports containing detailed findings and results directly to the Contracting Officer. All inspection, testing, and verification records shall be maintained on-site within the facility. The Contracting Officer or their
appointed representative shall review the records prior to the use of all systems.

e. Before piping systems are initially put into use the Contracting Officer shall accept the Verifier's Report as determining that the gas/vacuum delivered to the outlet/inlet is that shown on the outlet/inlet label and the proper connecting fittings are installed for the specific gas/vacuum service.

3.10.4.2 Installer Performed Tests and Reports

The installing Contractor is responsible for conducting and documenting these tests. Test gas shall be oil-free, dry Nitrogen NF. Provide all necessary materials and test apparatus to satisfactorily perform tests. Tests apply to all Gas, Support, and Vacuum Systems.

a. Initial Blow Down Test.

b. Initial Pressure Test.

c. Cross Connection Test.

d. Piping Purge Test.

e. Standing Pressure Test for Positive Pressure Piping.

f. Standing Vacuum Test for Vacuum Piping.

3.10.4.3 I,T&V Agency Tests and Reports

The Inspection, Testing, and Verification Agency is responsible for conducting and documenting these tests. Test gas shall be oil-free, dry Nitrogen NF. Provide all necessary materials and test apparatus to satisfactorily perform tests. Tests apply to all Gas, Support, and Vacuum Systems.

a. Standing Pressure Test.

b. Cross Connection Test.

c. Individual Pressurization Test.

d. Pressure Differential Test.

e. Valve Test.


g. Piping Purge Test.

h. Piping Particulate Test.

i. Piping Purity Test.

j. Operational Pressure Test.

k. Medical Gas Concentration Test.

l. Medical Compressed Air Purity Test.
m. Labeling.

o. Source Equipment Verification:
   (1) Gas Cylinder Supply Sources.
   (2) Medical Compressed Air Compressor Sources.
   (3) Medical-Surgical Vacuum Sources.

3.11 WARNING SYSTEM

Provide wiring required for warning system except for power source at each alarm panel, which is provided by Electrical Specification Division contractor. Install wiring in conduit including underground portion to the bulk oxygen site.

a. Label each alarm position on each alarm panel. Coordinate designations with using facility. Coordinate area designations with associated zone valve assembly designations.

b. Master alarm panels shall not be daisy-chained. Provide panel dedicated sensors and wiring from the alarm points to each installed master alarm panel.

c. Provide master alarm panels at the locations indicated on the Contract Drawings.

d. Provide master alarm connection to BAS (UFGS 23 09 23.13 20).

e. Area alarm panels shall not be daisy-chained.

3.12 IDENTIFICATION SYSTEMS

Identify piping and physical hazards in accordance with 29 CFR 1910.144, ANSI A13.1, ANSI Z53.1. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment. Identify each piping system and item of equipment indicated on contract drawings.

3.12.1 Piping System Identification

Install plastic pipe markers on each system, and include arrows to show normal direction of flow. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, crawl spaces) and exterior non-concealed locations.

a. Near each valve and control device.

b. Near each branch; mark each pipe at branch, where there could be question of flow pattern.

c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
d. At access doors, manholes and similar access points which permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.

f. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 20 feet in congested areas of piping and equipment.

3.12.2 Valves

Provide valve tag on every valve, cock and control device in each piping system. List each tagged valve in valve schedule for each piping system. Turn valve schedules over to Contracting Officer. Provide 1/2-inch red adhesive identification dots on ceiling tiles located immediately below balancing valves and shutoff valves.

3.12.3 Medical/Dental Source Equipment

Install engraved plastic laminate sign or plastic equipment marker on or near each major item of plumbing equipment and each operational device. Provide minimum 1/4-inch high lettering for name of unit where viewing distance is less than 1/2-inch high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering. In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.12.4 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.12.5 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8-inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 3-foot width, height, and 1/2-inch thickness. The board shall be made of wood fiberboard and framed under glass or 1/16-inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 3/4-inch in diameter and the related lettering in 1/2-inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room.
3.13 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- 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 201  (2002; R 2011) Fans and Systems
AMCA 220  (2005) Test Methods for Air Curtain Units
AMCA 300  (2014) Reverberant Room Method for Sound Testing of Fans
AMCA 301  (2014) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D (2012) Laboratory Methods of Testing Dampers for Rating

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 410  (2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils
AHRI 440  (2008) Room Fan-Coils and Unit Ventilators
AHRI 880 I-P (2011) Performance Rating of Air Terminals
AHRI 885  (2008; Addendum 2011) Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
AHRI Guideline D  (1996) Application and Installation of Central Station Air-Handling Units

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11  (2014) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9  (1990; ERTA 2012; S 2013) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


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


ASHRAE 70  (2006; R 2011) Method of Testing for Rating the Performance of Air Outlets and Inlets


ASME INTERNATIONAL (ASME)

ASME A13.1  (2007; R 2013) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)


ASTM D1654 (2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D3359 (2009; E 2010; R 2010) Measuring Adhesion by Tape Test

ASTM D520 (2000; R 2011) Zinc Dust Pigment


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2014) Motors and Generators


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code


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


U.S. DEPARTMENT OF DEFENSE (DOD)


U.S. DEPARTMENT OF ENERGY (DOE)

Procurement Requirements

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)


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

40 CFR 82 Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 181 (2013) Factory-Made Air Ducts and Air Connectors
UL 555 (2006; Reprint May 2014) Standard for Fire Dampers
UL 555S (2014) Smoke Dampers
UL 586 (2009; Reprint Sep 2014) Standard for High-Efficiency Particulate, Air Filter Units
UL 6 (2007; Reprint Nov 2014) Electrical Rigid Metal Conduit-Steel
UL 705 (2004; Reprint Dec 2013) Standard for Power Ventilators
UL 723 (2008; Reprint Aug 2013) Test for Surface Burning Characteristics of Building Materials
UL 900 (2015) Standard for Air Filter Units

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 ductwork, and all fittings, and other components, required to install the work as indicated and specified.

Provide air handling units, fans, terminal units, fan coil units, diffusers, registers, grilles, canopy hoods, filter sections, ductwork systems and accessories. Submit operation and maintenance data in accordance with Section 01 78 23, Operation and Maintenance Data in three
separate packages.

1.2.1 Mechanical Equipment Identification

The number of charts and diagrams shall be equal to or greater than the number of mechanical equipment rooms. Where more than one chart or diagram per space is required, mount these in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees.

1.2.1.1 Charts

Provide chart listing of equipment by designation numbers and capacities such as flow rates, pressure and temperature differences, heating and cooling capacities, horsepower, pipe sizes, and voltage and current characteristics, for each air handling unit and fan.

1.2.1.2 Diagrams

Submit proposed diagrams, at least 2 weeks prior to start of related testing. Provide neat mechanical drawings or inlaminated plastic, system diagrams that show the layout of equipment, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system. After approval, post these items where directed.

1.2.2 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Provide label for each item of equipment scheduled in accordance with the typical examples below:

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>LABEL AND TAG DESIGNATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air handling unit Number</td>
<td>AHU - (insert drawing tag)</td>
</tr>
<tr>
<td>Air Conditioner</td>
<td>AC-insert drawing tag</td>
</tr>
<tr>
<td>Exhaust Fan Number</td>
<td>EP - (insert Drawing Tag)</td>
</tr>
<tr>
<td>VAV Box Number</td>
<td>VAV - (insert drawing tag)</td>
</tr>
<tr>
<td>Fan Coil Unit Number</td>
<td>FC - (insert drawing tag)</td>
</tr>
<tr>
<td>Terminal Unit Number</td>
<td>TU - (insert drawing tag)</td>
</tr>
<tr>
<td>Cabinet Unit Heater</td>
<td>UH-(insert drawing tag)</td>
</tr>
</tbody>
</table>

1.2.3 Color Coding

Color coding of all piping systems shall be in accordance with ASME A13.1 MIL-STD-101. Refer to Section 23 64 26, Chilled and Hot Water Piping Systems for Piping Identification requirements.
1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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

Shop Drawings; G
Coordination Drawings; G

SD-03 Product Data

For equipment, product data shall include factory certified illustrations of equipment plan layouts, elevations, and include assembly and installation details. Drawings shall include information required to demonstrate compliance with the performance characteristics, electrical characteristics and dimensional allowances indicated on the Contract Drawings. The submitted equipment shall be coordinated with the design intent to enable proper function. Highlight submittal data to show model, size, options, etc., that are intended for consideration. Submittal data shall be tagged with equipment marks correlating to equipment schedules. Provide in accordance with Division 23 Section BASIC MECHANICAL MATERIALS AND METHODS. Product data shall include:

a. Capacities of equipment correlating to Contract Drawing equipment schedules.
b. Equipment features indicating compliance with specified characteristics.
c. Equipment dimensions including dimensions to ductwork and piping connections.
d. Equipment layouts which identify assembly and installation details.
e. Physical separation.
f. Motor sizes and voltage characteristics.
g. Electrical motor connection diagrams.
h. Fan curve for each fan with operating point clearly identified; speed, efficiency, static pressure and air quantity.
i. UVC lights; kW, voltage, lamp quantity and UVC accessories for each AHU.
j. Plans and elevations to indicate manufacturer recommended clearances required for operation and maintenance.
k. For equipment with factory-wired electrical components, provide a detailed wiring diagram for each unit indicating all system accessories and point to point wiring connections.
l. For floor mounted equipment, foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations.
m. For suspended equipment drawings indicating dimensions to suspension points and types of connections required.
n. Details, if equipment is to be supported other than as indicated; include loadings and type of frames, brackets, stanchions, or other supports.

Metallic Flexible Duct; G
Insulated Nonmetallic Flexible Duct; G
Register Plenums; G
Duct Access Doors; G
Fire Dampers; G
Manual Balancing Dampers; G
Combination Smoke-Fire Dampers; G
Sound Attenuation Equipment; G
Diffusers; G
Registers and Grilles; G
Utility Vent Centrifugal Fans; G
Air Vents and Goosenecks; G

In-Line Centrifugal Fans; G
Axial Flow Fans; G

Air-Curtain Fans; G
Air Handling Units; G
Room Fan-Coil Units; G
Variable Volume, Single Duct Terminal Units; G
Filter sections; G
Filters; G
Humidifiers; G
Mechanical identification materials; G
Test Procedures; G
Charts and Diagrams; G

SD-06 Test Reports

Performance Tests
Damper Acceptance Test

SD-07 Certificates

Bolts

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions
Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G
Fire Dampers; G
Manual Balancing Dampers; G
Combination Smoke-Fire Dampers; G
Utility Vent Centrifugal Fans; G
In-Line Centrifugal Fans; G
Axial Flow Fans; G

Air-Curtain Fans; G
Air Handling Units; G
Variable Volume, Single Duct Terminal Units; G
Humidifiers; G
Filter sections; G

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.

e. Conduct a pre-installation meeting and subsequent follow up meetings to coordinate the work of this section with the metal stud installation for partitions indicated in Section 09 22 00 METAL SUPPORT FRAMING ASSEMBLIES, and masonry openings in 04 20 00, MASONRY. Verify that framed openings are provided for duct penetrations through partitions constructed with metal studs, and that masonry wall openings are provided for duct penetrations.

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. Provide written certification from the bolt manufacturer that the bolts furnished comply with the requirements of this specification. Include illustrations of product markings, and the number of each type of bolt to be furnished in the certification.

1.4.2 Asbestos Prohibition
Do not use asbestos and asbestos-containing products.

1.4.3 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.

1.4.4 Shop 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. Provide drawings illustrating ductwork systems, ductwork sizes, elevations of ductwork,
ductwork hanger details, gauge reinforcement, reinforcement spacing, rigidity classification, and static pressure and seal classifications. Provide a duct material and reinforcement schedule indicating each ductwork system; schedule shall indicate pressure class, duct reinforcement methodology proposed, reinforcement spacing interval and material gages. Drawings shall include information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Drawings shall consist of:

a. Equipment layouts which identify ductwork connections.
b. Ductwork layouts which identify all dampers and fittings.
c. Plans and elevations which identify clearances required for maintenance and operation.
d. Details, if ductwork and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.

Submit dimensioned shop drawings indicating ductwork and equipment showing both the accurately scaled elements and relationship to space enclosure. The drawings shall utilize the building floor plans. Provide in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, and as modified by this section. SUBMITTED DUCTWORK SHOP DRAWINGS SHALL INDICATE DUCTWORK WHICH HAS BEEN COORDINATED WITH, OR ADEQUATE SPACE ALLOWANCE MADE FOR WORK OF TRADES ADJACENT TO DUCTWORK. Illustration shall be drawn to a minimum scale of 1/4 inch equals one foot. Drawings shall indicate dimensions to ductwork from building structural elements and elevations above finished floor. Provide illustrations including sections to clarify elevations of equipment, equipment connections, space allowance for piping, and piping accessories. Drawings shall conform to standard drafting industry procedures. Include Contractors name, project title, date and phone number in title block. Coordinate ductwork and equipment layout with work of other trades. Include as a minimum the following:

a. Ductwork systems
b. Air handling units
c. Fans
d. Filter sections
e. Air Terminal units
f. Hoods/canopies
g. Sound Attenuators
h. Diffusers/registers/grilles
i. Louvers
j. Dampers
k. Airflow measuring stations

Include a ductwork construction and duct air leakage testing schedule indicating criteria for each duct system. Include materials, duct pressure class, duct seal and duct leakage class.

1.4.5 Coordination Drawings

Shop Drawings may be used as a basis to develop coordination drawings. For additional requirements regarding coordination drawings refer to Division 23 Section BASIC MECHANICAL MATERIALS AND METHODS.
1.4.6 Test Procedures

Submit proposed test procedures and test schedules for the ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

1.5 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 seal all open duct ends during construction.

After diffusers, registers and grilles are installed, cover and seal each with minimum 3 mil plastic sheething including sealed perimeters to prevent the entry of duct during construction. Remove plastic sheeting only when construction areas have been cleaned to a point acceptable to the Contracting Officer.

Equipment and ductwork shall be delivered and stored with protective crating and weatherproof wrapping to provide protection from the weather, humidity, temperature variations, dirt and dust or other contaminants.

1.6 COORDINATION OF TRADES

Contract Drawings indicate an engineering solution and design intent. Through the installer coordination effort, it may be required to re-position or shift ductwork and duct system accessories to facilitate the installation of the ductwork system and adjacent trade materials. Provide ductwork, offsets, fittings, and accessories as required to provide a complete installation and to eliminate interference with other construction. Coordinate duct locations with space required for trades in the adjacent installation area.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.7.2 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. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

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 in conformance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph ENERGY EFFICIENT EQUIPMENT that the following products meet energy efficiency requirements as outlined in this section:

a. Centrifugal Fans
b. In-Line Centrifugal Fans
c. Axial Flow Fans
d. Utility Vent Centrifugal Fans
e. Air-Curtain Fans
f. Air Handling Units

2.1.2 Reduce Volatile Organic Compounds (VOC) for sealants, coatings or adhesives

Low or no VOC's and no added urea formaldehyde for duct sealants, coatings or adhesives, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS (VOC).

2.1.3 Ozone Depleting Substances for Refrigerants

Do not use any Ozone Depleting Substances (ODS) as Refrigerants per requirements in 01 33 29 SUSTAINABILITY REPORTING paragraph OZONE DEPLETING SUBSTANCES.

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 STANDARD PRODUCTS

Except for the fabricated duct, plenums and casings specified in paragraphs "Duct Systems" provide components and equipment that are standard products of manufacturers regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. This requirement applies to all equipment indicated under SD-03, Product Data. All energy consuming HVAC equipment must be Energy Star or Federal Energy management Program (FEMP) designated efficiency in conformance to Section 01 33 29 SUSTAINABILITY REPORTING paragraph ENERGY EFFICIENT EQUIPMENT.

a. Standard products are defined as components and equipment that have been in satisfactory commercial or industrial use in similar applications of similar size for at least two years before bid opening.

b. Prior to this two year period, these standard products shall have been sold on the commercial market using advertisements in manufacturers'
catalogs or brochures. These manufacturers' catalogs, or brochures shall have been copyrighted documents or have been identified with a manufacturer's document number.

c. Provide equipment items that are supported by a service organization. In product categories covered by Energy Star or the Federal Energy Management Program, provide equipment that is listed on the Energy Star Qualified Products List or that meets or exceeds the FEMP-designated Efficiency Requirements.

2.4 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.

2.5 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. The requirements for catwalks, operating platforms, ladders, and guardrails are specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

2.6 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. Motors indicated for operation with variable frequency drive motor starters shall additionally be certified for inverter duty.

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. Provide variable frequency drives for motors as specified in Section 26 29 23 VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS.

2.7 ANCHOR BOLTS

Provide anchor bolts for equipment placed into concrete equipment pads or 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.

2.8 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Protect and preserve factory paint coatings during construction. Field retouch only if approved by Contracting Officer. Otherwise, return equipment to the factory for refinishing.

2.9 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.10 DUCT SYSTEMS

2.10.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification.

a. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.

b. Provide ductwork that meets the requirements of Seal Class indicated. Provide ductwork in VAV systems upstream of the VAV boxes 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 and round 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.

e. Ductwork shall be suspended using galvanized steel straps hangers or galvanized steel trapeze angles with galvanized steel threaded rods. Cable type hanger systems are not permitted. For ductwork supported from floor, provide galvanized steel angle supports.

f. Provide duct reinforcing through metal gage, joint type and external reinforcing methods. Internal duct tie-rod reinforcing is not acceptable.

2.10.1.1 Insulated Nonmetallic Flexible Duct Runouts

Use flexible duct runouts only where indicated. Runout length is indicated on the drawings, and is not to exceed 5 feet. Provide runouts that are preinsulated, factory fabricated, and that comply with NFPA 90A and UL 181. Provide either field or factory applied vapor barrier. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene. Where coil induction or high velocity units are supplied with vertical air inlets, use a streamlined, vaned and mitered elbow transition piece for connection to the flexible duct or hose. Provide a die-stamped elbow and not a flexible connector as the last elbow to these units other than the vertical air inlet type. Insulated flexible connectors are allowed as runouts. Provide insulated material and vapor barrier that conform to the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Do not expose the insulation material surface to the air stream.

2.10.1.2 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.

2.10.1.3 Corrosion Resisting (Stainless) Steel Sheets

ASTM A167
2.10.2 Ducts of Pressure Classes Greater than 2 Inches W.G.

Unless noted otherwise, provide galvanized sheet steel, lock forming quality, coating designation G90 for general ductwork and duct fitting applications. Provide stainless sheet steel materials, lock forming quality, Type 304, ASTM A167 for duct systems indicated to be constructed of stainless steel, including duct fittings. Duct construction, metal gages, and hangers and support reinforcements shall conform with the SMACNA DCS; and as modified herein. Ducts shall not pulsate or vibrate when in operation. Pressure sensitive tape shall not be used as a primary sealant on ductwork. Air leakage shall be as specified for duct air leakage testing (DALT) but no less than one percent of the system capacity. Curved elbows shall have a centerline radius not less than 1 1/2 times the width of ducts. For circular and flat oval duct shapes indicated, factory fabricated circular and flat-oval ductwork with spiral or lockseam construction or welded longitudinal seam construction with all joints and connections sealed. Construct ductwork with reinforcement at maximum 5 feet center to center.

2.10.2.1 Round and Flat Oval Ducts

SMACNA DCS, Section 3 and as modified by this section. Provide factory fabricated duct construction. Provide continuous longitudinal welded or spiral lockseam construction. Make joints between sections of duct and fittings with mating angle rings, beaded sleeve joints or slide-on gasketed flange connections. Slide-on gasketed flange joints shall consist of two mating flange rings. The flanges shall be fabricated with an integral mastic to make them self-sealing. The flanges shall be joined to the duct with spot-welds or self-tapping screws. A neoprene gasket shall be used between the flanges. Final joining of the slide-on flange connection shall be made with four bolts for flat-oval ducts. A single-bolt closure ring shall be used to complete the round slide-on flange connection. Select duct gage for size and pressure class as recommended in SMACNA DCS, Section 3. Note that longitudinal snap-lock ductwork is not acceptable.

2.10.2.2 Ducts of Pressure Classes 2 Inches w.g. and Less

Unless noted otherwise, provide galvanized sheet steel, lock forming quality, coating designation G90 for general ductwork and duct fitting applications. Provide stainless sheet steel materials, lock forming quality, type 304, ASTM A167 for duct systems indicated to be constructed of stainless steel, including duct fittings. Construction, metal gage, hangers and supports, and reinforcements shall conform with SMACNA DCS; and as modified herein. Ductwork shall be airtight and shall not vibrate or pulsate when system is in operation. Pressure sensitive tape shall not be used as a primary sealant on ductwork. Construct ductwork of galvanized steel with all joints and seams sealed. Construct ductwork with reinforcement at 5 feet center to center. Provide spiral lockseam construction for round and flat oval ductwork. Note that longitudinal snap-lock ductwork is not acceptable.

2.10.2.3 Fittings

Square elbows, rectangular elbows, round elbows, fittings, branch take-offs, turning vanes, transitions, splitters, duct volume dampers, fire dampers, flexible connections, and access doors shall conform as a minimum with the SMACNA DCS, Section 2, but shall also comply with details indicated on Contract Drawings. Note that turning vanes are not
acceptable for use in duct where radius elbows are indicated.

2.10.2.4 Test Holes

Provide airtight and noncorrosive test holes with nipple to clear insulation, screw cap and gasket. Test holes for stainless steel duct systems shall be constructed of type 304 ASTM A167 stainless steel.

2.10.2.5 Curved Elbows

Make a centerline radius not less than 1 1/2 times the width or diameter of the duct. Duct elbows and accessories for stainless steel duct systems shall be constructed of type 304 ASTM A167 stainless steel. Note that curved elbows with square or rectangular heels are not acceptable.

2.10.2.6 Laps

Make laps at joints in the direction of air flow. Space bolt-connection in standing seams at fixed centers not greater than 6 inches.

2.10.2.7 Flexible Duct Connectors

Provide flexible duct runouts only where indicated. Runout length is indicated on the drawings, and is not to exceed 5 feet. Provide flexible duct joints at connections to equipment and elsewhere as indicated.

2.10.2.8 Insulated Metallic Flexible Duct Connectors

a. Provide duct that conforms to UL 181 and NFPA 90A with factory-applied insulation, vapor barrier, and end connections. Provide duct assembly that does not exceed 25 for flame spread and 50 for smoke developed. Proved ducts designed for working pressures of two inches water gauge positive and 1.5 inches water gauge positive. Provide flexible round duct length that does not exceed five feet. Secure connections by applying adhesive for two inches over rigid duct, apply flexible duct two inches over rigid duct, apply metal clamp, and provide minimum of three No. 8 sheet metal screws through clamp and rigid duct.

b. Inner duct core: Provide interlocking spiral or helically corrugated flexible core constructed of stainless steel.

c. Insulation: Provide mineral fiber blanket type flexible insulation on connector exterior; minimum of one inch thick. Provide insulation covered on exterior with manufacturer's standard fire retardant vapor barrier jacket for flexible round duct.

2.10.2.9 Insulated Nonmetallic Flexible Duct Connectors

Provide runouts that are preinsulated, factory fabricated, and that comply with NFPA 90A and UL 181. Connectors shall be constructed of helical metallic zinc coated steel ribbing with mylar jacketing adhered to the ribbing. Provide mineral fiber blanket type flexible insulation on connector exterior; minimum of one inch thick. Provide insulation covered on exterior with manufacturer's standard fire retardant vapor barrier jacket for flexible round duct.

2.10.2.10 Flexible Duct Joints

Provide a flexible duct connector minimum 6 inches in length where sheet
metal connections are made to fans and where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector system that complies with UL 214 and is classified as "flame-retarded fabrics" in UL Building Materials Directory.

2.10.3 Duct Liner

Unless otherwise specified, ductliner is not permitted.

2.10.4 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and plenums where indicated and at all air flow measuring stations, motor actuated, fire dampers, combination fire/smoke dampers, coils, thermostats, smoke detectors, sensors, and other apparatus. Provide access doors upstream and downstream of air flow measuring stations and heating and cooling coils. Provide doors that are a minimum 15 by 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 by 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

Provide doors with continuous hinge on one side. Where hinged operation is impeded by work of other trades or adjacent ducts, provide cam-lock hardware with removable doors and metal chain secured to door frame and door. Access doors in systems designed for pressures greater than 2 inches w.g. shall be two piece, double-wall insulated, oval configuration with spring compression twist-lock latching. Access doors shall be constructed of materials typical of the related duct system.

2.10.5 Fire Dampers

Use 1.5 hour rated fire dampers unless otherwise indicated. Provide fire dampers that conform to the requirements of NFPA 90A and UL 555. Perform the fire damper test as outlined in NFPA 90A. Provide automatic operating fire dampers with a dynamic rating suitable for the maximum air velocity and pressure differential to which it is subjected. Provide fire dampers approved for the specific application, and install according to their listing. Equip fire dampers with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, does not impair the operation of the damper. Equip sleeves or frames with perimeter mounting angles attached on both sides of the wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies in conformance with UL Fire Resistance. Provide curtain type with damper blades out of the air stream. Install dampers that do not reduce the duct or the air transfer opening cross-sectional area. Install dampers so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, comply with the installation details given in SMACNA 1819 and in manufacturer's instructions for fire dampers. Perform acceptance testing of each fire damper according to paragraph Fire Damper Acceptance Test and NFPA 90A.
2.10.6 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators. Install dampers that are 2 gauges heavier than the duct in which installed. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.10.7 Manual Balancing Dampers

a. Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators.

b. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide access doors or panels in hard ceilings, partitions and walls for access to all concealed damper operators and damper locking setscrews. Coordinate location of doors or panels with other affected contractors.

c. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.10.7.1 Square or Rectangular Dampers

2.10.7.1.1 Duct Size 12 x 12 inches and Less

2.10.7.1.1.1 Frames

<table>
<thead>
<tr>
<th>Width</th>
<th>Height</th>
<th>Galvanized Steel Thickness</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum 12 inches</td>
<td>Maximum 12 inches</td>
<td>Minimum 20 gauge</td>
<td>Minimum 3 inches</td>
</tr>
</tbody>
</table>

2.10.7.1.1.2 Single Leaf Blades

<table>
<thead>
<tr>
<th>Width</th>
<th>Height</th>
<th>Galvanized Steel Thickness</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum 12 inches</td>
<td>Maximum 12 inches</td>
<td>Minimum 20 gauge</td>
<td>Minimum 3 inches</td>
</tr>
</tbody>
</table>
2.10.7.1.3 Blade Axles

To support the blades of round dampers, provide galvanized steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.

<table>
<thead>
<tr>
<th>Width</th>
<th>Height</th>
<th>Material</th>
<th>Shaft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum 12 inches</td>
<td>Maximum 12 inches</td>
<td>Galvanized Steel</td>
<td>Minimum 3/8 inch</td>
</tr>
</tbody>
</table>

2.10.7.1.4 Axle Bearings

Support the shaft on each end at the frames with shaft bearings. Shaft bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

<table>
<thead>
<tr>
<th>Width</th>
<th>Height</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum 12 inches</td>
<td>Maximum 12 inches</td>
<td>solid nylon, or equivalent solid plastic, or oil-impregnated bronze</td>
</tr>
</tbody>
</table>

2.10.7.1.5 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Stand-off distance shall be a minimum of 2 inches off the metal duct surface. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.10.7.1.6 Finish

Mill Galvanized, unless noted otherwise.

2.10.7.1.2 Duct Size Greater than 12 x 12 inches

2.10.7.1.2.1 Dampers

Provide dampers with multi-leaf opposed-type blades.

2.10.7.1.2.2 Frames

Maximum 48 inches in height; maximum 48 inches in width; minimum of 16 gauge galvanized steel, minimum of 5 inches long.

2.10.7.1.2.3 Blades

Minimum of 16 gauge galvanized steel; 6 inch nominal width.
2.10.7.1.2.4 Blade Axles

To support the blades of dampers, provide minimum 1/2 inch diameter galvanized square steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.

2.10.7.1.2.5 Axle Bearings

Support the shaft on each end at the frames with shaft bearings constructed of oil-impregnated bronze, or solid nylon, or a solid plastic equivalent to nylon. Shaft bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

2.10.7.1.2.6 Blade Actuator

Minimum 1/2 inch diameter galvanized steel.

2.10.7.1.2.7 Blade Actuator Linkage

Mill Galvanized steel bar and crank plate with stainless steel pivots.

2.10.7.1.2.8 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Stand-off distance shall be a minimum of 2 inches off the metal duct surface. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.10.7.1.2.9 Finish

Mill Galvanized, unless otherwise noted.

2.10.7.2 Round Dampers

2.10.7.2.1 Frames

<table>
<thead>
<tr>
<th>Size</th>
<th>Galvanized Steel Thickness</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 to 20 inches</td>
<td>Minimum 20 gauge</td>
<td>Minimum 6 inches</td>
</tr>
</tbody>
</table>

2.10.7.2.2 Blades

<table>
<thead>
<tr>
<th>Size</th>
<th>Galvanized Steel Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 to 20 inches</td>
<td>Minimum 20 gauge</td>
</tr>
</tbody>
</table>

2.10.7.2.3 Blade Axles

To support the blades of round dampers, provide galvanized steel shafts supporting the blade the entire duct diameter frame-to-frame. Axle shafts shall extend through standoff bracket and hand quadrant.
2.10.7.2.4 Axle Bearings

Support the shaft on each end at the frames with shaft bearings constructed of oil-impregnated bronze, or solid nylon, or a solid plastic equivalent to nylon. Shaft bearings configuration shall be a pressed fit to provide a tight joint between blade shaft and damper frame.

<table>
<thead>
<tr>
<th>Size</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 to 20 inches</td>
<td>solid nylon, or equivalent solid plastic, or oil-impregnated bronze</td>
</tr>
</tbody>
</table>

2.10.7.2.5 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Stand-off distance shall be a minimum of 2 inches off the metal duct surface. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.10.7.2.6 Finish

Mill Galvanized, unless noted otherwise.

2.10.7.3 Manual Balancing Dampers in Stainless Steel Duct Systems

Provide dampers constructed of Type 304 stainless steel unless noted otherwise. Stainless steel gages for damper frames and blades, stainless steel blade axle and axle bearings materials shall be as indicated for manual balancing dampers with “Duct Size Greater than 12 x 12 inches”.

2.10.7.4 Remote Operators for Manual Balancing Dampers

Where indicated, equip manual dampers with remote mechanical actuators. The actuator assembly shall include a concealed damper actuator; galvanized steel housing with internal wrench nut, cover plate with color and finish to match adjacent construction, secured with recessed stainless steel screws, configured for recessed ceiling mounting. The operator shall connect to the damper linkage through a remote cable; external helically wound galvanized steel with inner stainless steel wire. Furnish for actuator a worm gear control plate with integral cable clamp. Furnish for the damper axle a stand-off bracket with cable casing nuts and damper shaft hub with integral wire stop.
2.10.8 Automatic Balancing Dampers

Provide dampers as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS.

2.10.9 Combination Smoke-Fire Dampers

Multiple blade type, 180 degrees F fusible fire damper link; smoke damper assembly to include 120V electric damper operator with field installed end switch to indicate damper open position. Unless noted otherwise, provide damper actuator and accessories configured for 120v electrical power. UL 555 as a 1.5 hour rated fire damper; further qualified under UL 555S as a leakage rated damper. Provide a leakage rating under UL 555S that is no higher than Class II or III at an elevated temperature Category B (250 degrees F for 30 minutes). Ensure that pressure drop in the damper open position does not exceed 0.1 inch water gauge with average duct velocities of 2500 fpm. Provide end switches as work of Section 23 09 23.13 20 BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

2.10.10 Air Supply And Exhaust Air Dampers

Where outdoor air supply and exhaust air dampers are required they shall have a maximum leakage rate when tested in accordance with AMCA 500-D as required by ASHRAE 90.1 - IP, including maximum Damper Leakage for:

a. Maximum damper leakage at 1.0 inch w.g. for motorized dampers is 4 cfm per square foot of damper area and non-motorized dampers are not allowed.

2.10.11 Air Deflectors and Branch Connections

Provide air deflectors at all duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections are allowed in lieu of deflectors for branch connections. Furnish all air deflectors, except those installed in 90 degree elbows, with an approved means of adjustment. Provide easily accessible means for adjustment inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, provide external adjustments with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Provide factory-fabricated air deflectors consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Provide factory or field assembled air deflectors. Make adjustment from the face of the diffuser or by position adjustment and lock external to the duct. Provide stand-off brackets on insulated ducts as described herein. Provide fixed air deflectors, also called turning vanes, in 90 degree elbows. Air deflectors shall be constructed of materials typical of the related duct system.

2.10.12 Diffusers, Registers, and Grilles

Provide factory-fabricated units of steel stainless steel or aluminum as indicated that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area.
Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide sound power level as indicated. Provide diffusers and registers with interior volume damper with accessible operator, unless otherwise indicated. Provide opposed blade type volume dampers for all diffusers and registers, except linear slot diffusers. Provide linear slot diffusers with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A. Units indicated to be constructed of stainless steel shall be fabricated completely of stainless steel including dampers, fasteners and accessories.

2.10.12.1 Ceiling Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air straightening vanes in throat. Diffuser cores shall consist of four or more concentric elements in the face, designed to deliver air in a radial pattern evenly from the center of the face. Diffuser core dimensions shall extend to the perimeter frame dimensions scheduled; reduced core dimension units are not acceptable. Install ceiling mounted units with rims tight against ceiling. Provide sponge rubber gaskets between ceiling and surface mounted diffusers for air leakage control. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller.

2.10.12.2 Registers and Grilles

Provide units that are four-way directional-control type, except provide return and exhaust registers that are fixed horizontal or vertical louver type similar in appearance to the supply register face. Furnish registers with sponge-rubber gasket between flanges and wall or ceiling. Install wall supply registers at least 6 inches below the ceiling unless otherwise indicated. Locate return and exhaust registers 6 inches above the floor unless otherwise indicated. Achieve four-way directional control by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Provide grilles as specified for registers, without volume control damper.

2.10.12.3 Registers

Double-deflection supply registers. Provide manufacturer-furnished volume dampers. Provide volume dampers of the group-operated, opposed-blade type and key adjustable by inserting key through face of register. Operating mechanism shall not project through any part of the register face. Provide exhaust and return registers as specified for supply registers, except provide exhaust and return registers that have a single set of nondirectional face bars or vanes having the same appearance as the supply registers. Set face bars or vanes at 30 degrees.

2.10.12.4 Ceiling Return Registers

Provide factory fabricated perforated face registers with single key opposed blade volume damper in throat. Faceplate shall not sag or deflect when operating under design conditions. Provide frames for lay-in (acoustic tile) or gypsum board (hard) ceilings as indicated. Coordinate frames with reflective ceiling plans. Provide sponge rubber gasket
between flange and ceiling for surface mounted types. Register core dimensions shall extend to the perimeter frame dimensions scheduled; reduced core dimension units are not acceptable. Provide registers with neck sizes the same as the register face size for use with the indicated Register Plenums, unless noted otherwise.

2.10.12.5 Ceiling Exhaust Registers

Provide factory fabricated perforated face registers with single key opposed blade volume damper in throat. Faceplate shall not sag or deflect when operating under design conditions. Provide frames for lay-in (acoustic tile) or gypsum board (hard) ceilings as indicated. Coordinate frames with reflective ceiling plans. Provide sponge rubber gasket between flange and ceiling for surface mounted types. Register core dimensions shall extend to the perimeter frame dimensions scheduled; reduced core dimension units are not acceptable. Provide registers with neck sizes the same as the register face size for use with the indicated register plenum, unless noted otherwise.

2.10.12.6 Sidewall Registers

Provide double deflection blade pattern; front blades parallel with register height, rear blades parallel with register width. Provide single key operated opposed blade manual volume damper in throat. Provide similar registers for return, exhaust, and transfer air as specified for supply, except that return, exhaust and transfer registers shall have a single set of blades parallel with register width. Provide sponge rubber gasket between flanges and wall. Where indicated, provide units constructed of type 304 stainless steel.

2.10.12.7 Grilles

Construct and finish as specified above for registers, except that volume dampers shall be omitted.

2.10.12.8 Linear Slot Diffusers

Construct of high grade extruded aluminum. Outer frame members of extruded aluminum shall be mechanically interlocked to extruded aluminum inner frame webs to produce rigid, straight, blemish free sectional lengths. Furnish concealed mounting system of hanger brackets and leveling screws. Furnish auxiliary diffuser sub-frame to suit adjacent general construction; flush, plaster, gypboard or ceiling tile (lay-in). Furnish satin finish. Joints between diffuser sections shall appear as hairline cracks. Provide alignment slots for insertion of key strips or other concealed means to align exposed butt edges of diffusers. Equip with plaster frames when mounted in plaster ceiling. Do not use screws and bolts in exposed face of frames or flanges. Frames and flanges exposed below ceiling shall be metal-filled and ground smooth. Furnish indicated type G90 galvanized steel sheetmetal plenum with separate pivoted or hinged adjustable air-volume-damper.

2.10.13 Louvers

Provide sheetmetal plenum or stainless steel sheet metal plenum and duct connections to louvers for installation in exterior walls that are associated with the air systems; louvers are specified in Section 08 91 00 METAL WALL AND DOOR LOUVERS. Provide materials of the related duct system.
2.10.14 Air Vents and Goosenecks

Fabricate air vents and goosenecks from galvanized steel or stainless steel sheets with galvanized or stainless steel structural shapes. Provide sheet metal thickness, reinforcement, and fabrication that conform to SMACNA 1966. Accurately fit and secure louver blades to frames. Fold or bead edges of louver blades for rigidity and baffle these edges to exclude driving rain. Provide air vents and goosenecks with bird screen. Provide air vent and gooseneck materials typical of associated duct system materials.

2.10.15 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.

2.10.16 Miscellaneous Sheet Metal

Provide Type G-90 galvanized sheet steel for louver plenums, auxiliary drain pans and louver interior blank-off plates. Equip plenums and blank-off plates with galvanized steel reinforcing angles.

2.11 AIR SYSTEMS EQUIPMENT

2.11.1 Fans

Test and rate fans according to AMCA 210. The sound power level of the fans shall not exceed the values scheduled on Contract Drawings when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Unless noted otherwise, fan wheels and housings shall be constructed of carbon steel with welded joints unless noted otherwise. Motors shall be premium efficiency with open dripproof housings unless noted otherwise. Connect fans to the motors either directly or indirectly with V-belt drive as indicated. Use V-belt drives designed for not less than 150 percent of the connected driving capacity. Provide variable pitch motor sheaves for 15 hp and below, and fixed pitch as defined by AHRI Guideline D (A fixed-pitch sheave is provided on both the fan shaft and the motor shaft. This is a non-adjustable speed drive.). Select variable pitch sheaves to drive the fan at a speed which can produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, provide replacement sheaves when needed to achieve system air balance; size as determined by TABs. Provide motors for V-belt drives with adjustable rails or bases. Provide removable metal guards for all exposed V-belt drives, and provide speed-test openings at the center of all rotating shafts. Provide fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Provide standard AMCA arrangement, rotation, and discharge as indicated. Provide power ventilators that conform to UL 705 and have a UL label. Equip fans with lubricated bearings sized for a L-50 Life (200,000 hours at maximum horsepower and operating speed).
Where indicated, provide fans with explosion proof construction; motors, non-sparking wheels and bearings. Where installed duct connections to fans differ from that indicated in the Contract Drawings, include additional motor horsepower to acquire the air delivery to devices indicated on Contract Drawings. Calculate system effect in accordance with AMCA 201. Fans and housings shall be factory painted.

2.11.1.1 Utility Vent Centrifugal Fans

Provide fully enclosed, single-width single-inlet, with AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Provide impeller wheels that are rigidly constructed and accurately balanced both statically and dynamically. Provide backward-inclined design fan blades. Provide fan wheels over 36 inches in diameter with overhung pulleys and a bearing on each side of the wheel. Provide fan wheels 36 inches or less in diameter with one or more extra long bearings between the fan wheel and the drive. Provide sleeve type, self-aligning and self-oiling bearings with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings. Connect grease fittings to tubing for serviceability from a single accessible point. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide steel, accurately finished fan shafts, with key seats and keys for impeller hubs and fan pulleys. Provide fan outlets of ample proportions, designed for the attachment of angles and bolts for attaching flexible connections. Unless otherwise indicated, provide motors that do not exceed 1800 rpm and have dripproof enclosures. Provide units with removable, ventilated motor and drive enclosure.

2.11.1.2 In-Line Centrifugal Fans

Provide in-line fans with centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Mount fans in a welded tubular casing. Provide a fan that axially flows the air in and out. Streamline inlets with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Enclose and isolate fan bearings and drive shafts from the air stream. Provide precision, self aligning ball or roller type fan bearings that are sealed against dust and dirt and are permanently lubricated. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Unless otherwise indicated, provide motors with dripproof enclosure.

2.11.1.3 Axial Flow Fans

Provide axial flow fans complete with drive components and belt guard, with steel housing, cast fan wheel, cast or welded steel diffusers, fan shaft, bearings, and mounting frame as a factory-assembled unit. Provide fan wheels that are dynamically balanced and keyed to the fan shaft, with radially projecting blades of airfoil cross-section. Enclose and isolate fan bearings and drive shafts from the air stream. Permanently lubricate fan bearings or provide them with accessible grease fittings. Provide precision self-aligning ball or roller type fan bearings that are sealed against dust and dirt. Provide fan bearings that have a L50 rated bearing life at not less than 200,000 hours of operation as defined by ABMA 9 and ABMA 11. Provide fan inlets with an aerodynamically shaped bell and an inlet cone. Install diffuser or straightening vanes at the fan discharge to minimize turbulence and provide smooth discharge air flow. Furnish fan unit with inlet and outlet flanges, automatic operation adjustable inlet.
vanes. Unless otherwise indicated, provide motors that do not exceed 1800 rpm and have drip-proof enclosure.

2.11.1.4 Air-Curtain Fans

Provide fans that conform to AMCA 220 with AMCA seal. Furnish air curtains with a weatherproof housing constructed of high impact plastic or minimum 18 gauge rigid welded steel. Provide backward curved, non-overloading, centrifugal type fan wheels, accurately balanced statically and dynamically. Provide motors with totally enclosed fan cooled enclosures. Provide remote manual type motor starters with weather-resistant enclosure actuated when the doorway served is open. Provide air curtains that attain the air velocities specified within 2 seconds following activation. Provide bird screens at air intake and discharge openings. Provide air curtain unit or a multiple unit installation that is at least as wide as the opening to be protected. Provide the air discharge openings to permit outward adjustment of the discharge air. Place installation and adjust according to the manufacturer's written recommendation. Furnish directional controls on air curtains for service windows for easy clean or convenient removal. Design air curtains to prevent the adjustment of the air velocities specified. Make the interior surfaces of the air curtain units accessible for cleaning. Provide certified test data indicating that the fan can provide the air velocities required when fan is mounted as indicated. Provide air curtains designed as fly fans unless otherwise indicated. Provide air curtains designed for use in service entranceways that develop an air curtain not less than 3 inches thick at the discharge nozzle. Provide air velocity that is not less than 1600 fpm across the entire entryway when measured 3 feet above the floor. Provide air curtains designed for use on customer entranceways that develop an air curtain not less than 8 inches thick at the discharge opening. Provide velocity that is not less than 600 fpm across the entire entryway when measured 3 feet above the floor. Equip recirculating type air curtains with readily removable filters, or design the filters for in-position cleaning. Provide readily accessible and easily cleanable air capture compartment or design for in-position cleaning. Provide air curtains designed for use on service windows that develop an air curtain not less than 8 inches thick at the discharge opening. Provide air velocity that is not less than 600 fpm across the entire opening of the service window measured 3 feet below the air discharge opening. Equip air curtain units with factory installed heating coils and minimum Merv 8 inlet filters where indicated. Coils shall comply with the Section.

2.11.2 Coils

Unless noted otherwise, provide fin-and-tube type coils constructed of seamless copper tubes and aluminum fins mechanically bonded to the tubes. Provide copper tube wall thickness that is a minimum of 0.016 inches. Provide aluminum fins that are 0.0055 inch minimum thickness. Provide casing and tube support sheets that are not lighter than 16 gauge galvanized steel or Type 304 stainless steel as indicated, formed to provide structural strength. When required, provide multiple tube supports to prevent tube sag. Test each coil at the factory under water at not less than 325 psi air pressure and construct suitable for 200 psi working pressure and 300 degrees F operating temperature unless otherwise stated. Pipe coils for counterflow service. Rate and certify coils to meet the requirements of AHRI 410.
2.11.2.1 Water Coils

Install water coils with a pitch of not less than 1/8 inch/foot of the tube length toward the drain end. Use headers constructed of cast iron, welded steel or copper. Furnish each coil with a plugged vent and drain connection extending through the unit casing. Provide chilled water coils with externally insulated Type 304 stainless steel drain pans.

2.11.2.2 Corrosion Protection for Coastal Installations

Where stipulated in equipment specifications of this Section, coat finned tube coils of the affected equipment as specified below. Apply coating at the premises of a company specializing in such work. Degrease and prepare for coating in accordance with the coating applicator's procedures for the type of metals involved. Completed coating shall show no evidence of softening, blistering, cracking, crazing, flaking, loss of adhesion, or "bridging" between the fins. Factory applied coatings shall certified by the National Coil Coating Association.

2.11.2.2.1 Phenolic Coating

Provide a resin base thermosetting phenolic coating. Apply coating by electrolytic immersion dipping of the entire coil. Provide a minimum of two coats. Bake or heat dry coils following immersions. After final immersion and prior to final baking, spray entire coil with particular emphasis given to building up coating on sheared edges. Total dry film thickness shall be 2.5 to 3.0 mils.

2.11.2.2.2 Chemical Conversion Coating with Polyelastomer Finish Coat

Dip coils in a chemical conversion solution to molecularly deposit a corrosion resistant coating by electrolysis action. Chemical conversion coatings shall conform to MIL-DTL-5541, Class 1A. Cure conversion coating at a temperature of 110 to 140 degrees F for a minimum of 3 hours. Coat coil surfaces with a complex polymer primer with a dry film thickness of 1 mil. Cure primer coat for a minimum of 1 hour. Using dip tank method, provide three coats of a complex polyelastomer finish coat. After each of the first two finish coats, cure the coils for 1 hour. Following the third coat, spray a fog coat of an inert sealer on the coil surfaces. Total dry film thickness shall be 2.5 to 3.0 mils. Cure finish coat for a minimum of 3 hours. Coating materials shall have 300 percent flexibility, operate in temperatures of minus 50 to plus 220 degrees F, and protect against atmospheres of a pH range of 1 to 14.

2.11.3 Air Filters

List air filters according to requirements of UL 900, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of UL 586. Provide physical sizes and quantities, and gross media areas scheduled on Contract Drawings.

2.11.3.1 Extended Surface Pleated Panel Filters

Provide 2 or 4 inch depth as indicated, sectional, disposable type filters of the size indicated with a MERV of 8 when tested according to ASHRAE 52.2. Provide UL Class 2 filters, and nonwoven cotton and synthetic fiber mat media. Attach a wire support grid bonded to the media to a moisture resistant fiberboard frame. Bond all four edges of the filter media to
the inside of the frame to prevent air bypass and increase rigidity. Install filters in factory fabricated side-access housing or in air handling unit filter frames as indicated.

2.11.3.2 Cartridge Type Filters

Provide 12 inch depth, sectional, replaceable dry media type filters of the size indicated with a MERV of 14 when tested according to ASHRAE 52.2. Provide UL class 1 filters, and pleated microglass paper media with corrugated aluminum separators, sealed inside the filter cell to form a totally rigid filter assembly. Fluctuations in filter face velocity or turbulent airflow have no effect on filter integrity or performance. Install each filter in a factory fabricated side access housing, in air handling unit filter frames.

2.11.3.3 Filter Gauges

Provide dial type filter gauges, diaphragm actuated draft for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Gauges shall be at least 3-7/8 inches in diameter, with white dials with black figures, and graduations graduated in 0.01 inch of water, with a minimum range of 1 inch of water beyond the specified final resistance for the filter bank on which each gauge is applied. Provide each gauge with a screw operated zero adjustment and two static pressure tips with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter vinyl tubing, and all hardware and accessories for gauge mounting.

2.11.3.4 Side-Access Filter Housing

Where indicated for ductwork applications, provide factory fabricated side access type filter housings. Minimum thickness, 14 gage type G90 galvanized steel with baked painted finish inside and out. Hardware shall be stainless steel. Joints shall be continuously welded. Interior of cabinet shall have a heavy duty lever action bar to position filter in place against a flange which contains a fixed air sealing gasket. The fixed air sealing gasket shall be hollow cross section, closed cell rubber or resilient neoprene, suitable for repetitive reuse. Cabinets shall have flanged ends for connection to adjacent ducts and hinged access doors on both cabinet sides. Provide access doors with fixed air sealing gaskets to be airtight at the static pressure expected in service. Provide two 1/4 inch Society of Automotive Engineers (SAE) flare connection test ports complete with seal cap, one on each side of the filter. Weld test ports into each filter cabinet or plenum. Test port shall not penetrate to filter frame or media.

2.11.3.5 Replacement Media

Provide three sets of filter media for each air handling unit filter section and each side-access filter housing; one for use during construction, a second for use during TABs, commissioning, and the third for use by Owner. Store third filter set at location directed by Contracting Officer.

2.11.3.6 Humidifiers

Unit shall be self-contained electric-electrode steam generation type and include steam generator section, steam distribution hose and grid.
distribution tube; within air stream.

a. Steam Generator: Self-contained, factory-assembled and wired unit equipped with a non-metallic disposable pressure vessel, microprocessor based controller, power contactors, operating controls, low voltage control transformer and accessories. Pressure vessel shall include electrodes for steam generation and shall be configured with a side chamber housing a float operated high water level sensor. Pressure vessel shall be configured to enable disassembly for internal inspection. Entire pressure vessel shall be easily removable from the unit for replacement.

b. Dispersion Tube and Hose: Furnish a stainless steel steam dispersion tubes to provide uniform steam distribution over the entire tube length; dimension of tube to extend a minimum of 75 percent of the duct width to which it's indicated to be installed. Furnish length of insulated, reinforced synthetic rubber hose for delivery of the generated steam to the dispersion tube. For air handling unit applications, delivery hose shall connect to a stainless steel dispersion grid factory installed to unit. Air handling unit grid arrays and configuration shall be coordinated with humidifier manufacturer to ensure operational compatibility.

c. Controls: Furnish humidifier with a digital display in cabinet face to monitor and display unit amperage draw, humidistat demand percentage, steam output (as a percentage) and system diagnostic codes. The display mode shall be user selectable. Furnish auxiliary pilot lights to indicate system motor actuated fill and drain valve(s) operation, tank off, high water and display mode selected. The humidifier shall monitor the pressure vessel indicate on the display when it is soiled. Drain cycle shall be regulated through the microprocessor controller both in frequency and duration to maximize pressure vessel life and minimize energy waste. The drain cycle shall automatically control mineral buildup taking into consideration water conductivity, humidity demand history and steam output rate. Drain water shall be tempered by automatically opening the fill valve during blowdown operations. Humidifier shall include programmed diagnostics to display input and output circuit status. Humidifier shall have continuous self-diagnostics checking to monitor the operation of the unit; controls shall shut down the pressure vessel (current to electrodes) to prevent unsafe operation and the visual display code will indicate cause of failure. Provide failure status display for drain solenoid malfunction, fill solenoid malfunction and overcurrent malfunction. Humidifier shall be factory equipped with modulating control capable of command from the facility Direct Digital Control System to provide an operating range of 10 percent to 100 percent capacity; automatically regulated through DDC system command.

d. Piping Connections: Furnish with system a solenoid on the make-up water line and an additional solenoid at the drain location. Furnish unit with an auxiliary manual drain valve. The humidifier fill water line(s) shall have an integral air gap to prevent backflow (siphoning) of contaminated water into the water supply system. Mount humidifiers to enable discharge of humidifier drains into the facility drainage system.
e. Electrical: Humidifier electrical power shall be factory wired to a single point power connection. Include terminal strip interior to unit casing for connections to facility control system, duct high-limit humidistat, AHU fan interlock proof switch, and system alarm.

f. Cabinet: Humidifier shall have all internal components contained internal to a steel cabinet with a key-locked hinged door to prevent unauthorized access.

g. Auxiliaries: Furnish a high limit humidistat and airflow proof switch for duct mounting, compatible with the humidifier system.

2.12 AIR HANDLING UNITS

Single-zone type, factory assembled air handling units with capacity characteristics, sound power levels, and static pressures, as indicated. Include intake, return and discharge plenum sections, filter sections, heating coil sections (where indicated), humidifier sections, cooling coil sections, UV light arrays, access sections, and supply fan sections. Internal components such as filters, filter rack, coils, and fans must be completely removable from the unit without having to dismantle the unit or adjacent equipment; internal components shall not provide casing structural support. Provide units with dual path component configurations indicated and dimensions not to exceed those indicated on contract drawings. Provide components at locations indicated on Contract Drawings. Unit manufacturer shall provide certified ratings conforming to the latest edition of AMCA 210, 310, 500 and AHRI 410. Units shall be UL or ETL listed.

2.12.1 General Assembly

Units shall be completely factory assembled. Sections shall be assembled on a single structural steel base rail skid unless indicated to be, or manufacturer restricted to be constructed with multiple skid sections for field assembly. Units with manufacturer required demount seams or contract drawing indicated demount seams shall be furnished with sufficient gaskets between sections and bolts for reassembly in the field by the contractor.

2.12.2 Unit Base / Internal Frame / Floor

Units shall be assembled using a welded tube steel internal frame and structural steel skid base. Alternatively, units may be designed using the casing design for unit structural support, mounted on a structural steel skid base. The air handling unit base frame system shall include structural C-channel shapes along the unit long axis and additional cross support members at multiple points along the short axis. Internal tube steel frames shall be fabricated of minimum 14-gauge carbon steel, welded to form a unitized assembly for support of all internal components including welding the frame to the base frame. Base and internal frames shall be factory painted with primer and a gray phenolic or epoxy corrosion inhibitive painting system. Base frame shall be fitted with lifting lugs and anchor bolt holes at the corner of each section. Provide integrated to the base frame, a "double wall internally insulated" floor consisting of minimum 20 gauge G-90 galvanized outer skin and minimum 10 gauge stainless steel continuous tread-plate inner walking surface. The "double wall" floor shall be thermally broken from the base frame. All floor seams shall either be gasketed, caulked and sealed, or welded water
and airtight. Insulation in base shall comply with paragraph "insulation" hereinafter. The unit base and floor shall be designed so that deflection is limited to no more than L/240 or span dimension at the casing design pressure indicated in the Section.

2.12.3 Exterior Panels

The exterior wall and roof panels shall be minimum 2 inch thick, "double wall internally insulated" configuration fabricated from minimum 20 gage solid sheet or type 304 stainless steel interior skin and minimum 16 gage type G90 galvanized steel outer skin. Casing shall be thermally broken through gasketing or include insulation thickness and fastener configuration to prevent exterior surface condensation at the criteria indicated. For units without internal tube steel frames, provide metal gages, insulation materials and casing interior reinforcing necessary to limit casing deflection to 1/200 of the narrowest panel dimension. Side casing bottom surfaces shall be shaped to interlock to the floor and roof panels, thermally broken and mechanically attached. Casing seams shall be gasketed and secured with hex head, zinc plated fasteners and neoprene washers. All panel seams shall be caulked and sealed for an airtight unit at the static pressure indicated in this Section. For units indicated to be located outdoors, provide roof casing panels similar to the wall panels except with exterior 16 gage steel skin crossbroken or pitched for drainage to an integral gutter system running along the unit long axis.

2.12.4 Casing Thermal Performance

Casings shall not be structurally dependent upon any of the air handling unit internal components such as filter racks, coil casings, or fan system components. Casing floor, walls and roof shall be "double-wall internally insulated". Casing composition anchorages and attachments shall eliminate air handling unit exterior skin condensation from forming with coil supply air temperatures down to 48 degrees F and exterior ambient air at 79 degrees F WB or higher. The manufacturer shall certify that these conditions will be met under these circumstances.

2.12.5 Casing Insulation

Factory insulate air handling unit floors wall and roof casing panels with either non-compressed fiberglass insulation or injected polyurethane foam. The insulation shall have a minimum effective R value of 16.6 and a noise reduction coefficient (NRC) of 0.70 / per inch thick (based on a type "A" mounting). Fiberglass insulation materials where used shall meet or exceed a 3.0 P.C.F. density rating. Insulation shall be rated for a fire hazard classification of 25/50 (per ASTM E84 and UL 723. All insulation surfaces shall be encapsulated within the double wall casing panels.

2.12.6 Access Doors

The units shall each be equipped with double wall insulated, hinged access doors at locations shown on the plans. Fabricate doors of minimum 16 gage type G90 galvanized steel exterior skin with minimum 20 gage type 304 stainless steel solid interior liner. Access doors shall fabricated using the same insulation and shall be of the same thickness as the casing. Provide extruded aluminum perimeter door frames with a built in thermal break barrier and full perimeter gasket. Where indicated, equip access doors with vision panels constructed of reinforced glass in an extruded aluminum frame. Unless noted otherwise, access doors shall be minimum 18
inches wide except fan section access doors shall be minimum 24 inches wide and access door height shall be minimum 72 inches. Door hinge assemblies shall be die cast zinc or full piano style. Die cast hinges shall include a stainless steel pivot mechanism with field adjustable pitch. Provide a minimum of two heavy duty cast steel or high strength vinyl composite handles per door. All access doors shall open against air pressure. Provide ETL, UL 1995, and CAL-OSHA approved tool operated safety latch on all fan section access doors including electrical dead-man fan interlock. Include latch with dry type electrical contacts on access doors to sections containing UVC emitters to disable emitter when door is opened. Access doors and frame assemblies shall eliminate air handling unit exterior skin condensation from forming with coil supply air temperatures down to 48 degrees F and exterior ambient air at 79 degrees F WB or higher. Equip each access door with an IP-4 test port similar to Dura Dyne or Ventlok #699.

2.12.7 Supply Fans

Plug type, minimum Class II. Fans shall deliver performance specified in the air handling unit schedule and shall be AMCA certified type. Fan wheels shall operate to pressurize a discharge plenum to provide uniform discharge velocity profiles and to allow even face velocities across and through the AHU casing. Unless noted otherwise, fans shall be direct drive.

a. Fan wheel diameters shall be in accordance with the standard sizes adopted by AMCA. Inlets shall be fully streamlined. Blades shall be welded to backplate and welded to wheel cone. Wheels shall be statically balanced prior to assembly and dynamically balanced as an assembly at the factory at design RPM prior to shipment. Fans shall be balanced at design RPM to a total displacement of less than 1 mil measured at each bearing pad prior to shipment.

b. Shafts shall be solid steel machined to standard diameters and tolerances for turned, ground and polished shafts. Center shall be provided at one end of shaft for tachometer reading. Fan shaft shall be designed to be a minimum of 29 percent below critical speed at design RPM. Fan wheels and drive sheaves shall be key-seated to fan shaft.

c. Fans shall be direct driven unless scheduled to be belt driven. Furnish TEFC, premium efficiency motor for each fan. Shaft and bearings shall be configured and sized to accommodate the fan impeller and drive style.

d. Each fan assembly, complete with motor, shall be mounted on a galvanized or welded steel frame. Furnish base with a minimum of four open spring vibration isolators; minimum 2 inches deflection. Isolators shall each be capable of 30% over-travel before contact. Fan frame mounts shall be either welded or mechanically connected to the casing floor structure.

e. For fans scheduled as belt drive, fan bearings shall be spherical fallen type adjusted in self-aligning pillow blocks. Bearings shall be selected for a minimum L-50 life (400,000) hours at maximum horsepower and operating speed for the classification.

f. Solid steel shaft with center punch for tachometer.
g. Equip each fan with a steel tapered venturi inlet.

h. Equip each fan inlet with a reinforced neoprene coated canvas flexible connection. Where recommended by the manufacturer, provide spring compression thrust restraint vibration isolators, threaded rods and clip anchorages located at a minimum of two places; both sides of the fan.

i. Provide fan inlet safety screen.

j. Provide fan discharge side safety screen.

k. Where indicated to be equipped with airflow measuring stations, equip each fan with an inlet side piezometer flow sensor array with transducer.

l. Equip each fan inlet side with an aluminum backdraft damper.

m. Equip fan section with a structural steel I-beam above motors to enable motor removal; extend beam to access door and include an extension to casing exterior.

n. Fans and fan bases not constructed of galvanized steel shall be factory painted with primer and gray phenolic or epoxy corrosion inhibitive paint system.

2.12.8 Water Coils

Provide in accordance with paragraph "Water Coils" and this paragraph. Coils shall be constructed with type 304 stainless steel frames and be assembled to permit coils to slide out individually from the unit. Enclose coil headers and return bends fully within casing, located over drain pans. Coils shall be plate fin type with 5/8 inch O.D. seamless wall copper tubes mechanically expanded into aluminum fins. Headers shall be seamless copper with die formed tube holes. Pipe connections to coil headers shall be male pipe thread (MPT) Schedule 40 Red Brass with 1/4 inch vent and ¾ inch drain provided for complete coil drainage. Intermediate tube supports shall be provided on coils which exceed 44 inches finned length with an additional support every 42 inches multiple thereafter. Connection nipples shall extend minimum 5 inches from casing exterior. Vent and drain connections shall be piped to casing exterior. Fin spacing shall not exceed 11 fins per inch width. Coils shall be factory treated with corrosion protection for coastal installations, where indicated.

2.12.9 Condensate Drain Pans

Construct drain pans from minimum 16 gauge type 304 stainless steel, welded seams with cross break and double sloping pitch to drain connection. Provide drain pans under each cooling coil. Coils shall be integrated to the floor panels above the base frame so that the condensate connection occurs above the base C-channel system.

a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.

b. Depth: A minimum of 2 inches deep.
c. Drain connection centerline shall not exceed a distance of 3 inches below the top of the base rail. Drain connections that protrude through the base rail are not acceptable.

d. Provide a minimum 1 inch NPS type 304 stainless steel nipple on one end of pan. Where drain connections are indicated to be on both sides of the unit, provide drain pans pitched at the center and sloped to each nipple.

e. Provide minimum 2 inch thickness of polyurethane foam insulation surrounding exterior surfaces of drain pan.

f. Units with stacked coils shall have intermediate drain pans below each coil with factory installed drain piping from the top to the bottom pan.

2.12.10 Interior Lighting

Provide marine type LED lights interior to casings with metal guard on each where indicated. Provide switches mounted on unit exterior for lighting control in each section independently; both sides of unit where indicated. Furnish unit with factory installed wiring to light switches, terminating at a single point power connection.

2.12.11 Leak and Sound Testing

For the air handling unit, assembled casing sections upstream of fan sections shall be tested at 10 inches W.G.; negative pressure. Assembled casing sections downstream of fan sections shall be tested at 10 inches W.G.; positive pressure. Leakage rates not to exceed one percent of that scheduled air flow. The unit shall also be equal to or less than the sound power levels indicated on the Contract Drawings.

2.12.12 Inertia Base Frames

Where fans are indicated to be equipped with inertia base frames, the entire fan and motor assembly shall be installed within the perimeter of the inertia base frame. Inertia base frame and vibration isolators shall be constructed of galvanized steel, or carbon steel with primer and gray phenolic or epoxy corrosion resisting paint system. Base shall be equipped with a minimum of four 3 inch diameter housed spring compression vibration isolators with 2 inch nominal deflection spring vibration isolators internally mounted at the factory. Frames shall include reinforcing steel and be configured for field installed concrete infill.

2.12.13 Filter Sections

Provide in accordance with paragraph "Air Filters" and this paragraph. Provide front loading or side loading non-angled air handling filter racks in additional casing sections where indicated. Holding frames shall be fabricated of type 304 stainless steel. Side loading filter systems shall be equipped with a compression lever locking assembly. Front loading filters shall be equipped with compression filter restraint device at each filter. Provide visible identification on media frames showing filter model numbers required and the air-flow direction. Provide sealed galvanized steel baffle plates at each filter bank perimeter to prevent bypass of unfiltered air. Provide filter gage on each filter section; factory piped to filter section up and downstream. Gages shall be located accessible for viewing adjacent to unit.
a. Filter section leakage at rated airflow, upstream to downstream of filter holding frame, and slide mechanism shall be less than 1% at 3 inch w.g. differential.

b. Leakage into housing frame ambient atmosphere at rated airflow shall be less than 0.5% at 3 inch w.g. negative.

c. Manufacturer shall certify filter frame leakage rates as part of the Product Data submittal.

2.12.14 Access Sections, Humidifier Sections and Plenum Sections

Additional air handling unit sections shall be provided where indicated and shall be equipped with access doors as shown. All supplemental unit sections shall be constructed in a manner identical to the remainder of the unit walls, floor and roof. At plenum sections, provide duct connections at locations and of sizes indicated on the Contract Drawings. Humidifier sections shall be equipped with a drain pan similar to that indicated in "Condensate Drain Pan" paragraph.

2.12.15 UVC Emitters

Provide bank of UVC emitting lamps at the downstream side of each cooling coil face. Lamp banks shall be factory wired to the UVC control panel. Control panel shall be configured to receive a single point power connection. Provide UVC control panel with system pilot light, failure pilot light, analog lamp intensity contacts and disconnect switch at unit exterior. All wiring internal to AHU shall be provided with coated rubber grommets where passing through metal junction boxes and control panels.

a. Irradiation - Emitters and fixtures are to be installed in sufficient quantity and in such an arrangement so as to provide an equal distribution of UVC energy on the coil and in the cooling coil drain pan. To maintain energy efficiency, the UVC energy produced shall be of the lowest possible reflected losses and shadowed losses. Provide array with multiple rows of lamps; number defined by coil height. A single row of lamps will not be acceptable.

b. Intensity - The minimal UVC energy striking the leading edge of all coil fins shall not be less than 1500 mW/cm² (4.754 MBH/ft²) at the closest point and through placement, not less than 70 percent of that value at the farthest point. This therefore sets the minimum quantity of fixtures to be installed and their placement. Additionally, equal amounts are to strike the drain, either directly or indirectly through reflection.

c. Installation - Emitters and fixtures shall be installed at right angles to the conforming lines of the coil fins, such that through incident angle reflection, UVC energy bathes all surfaces of the coil and drain pan as well as all of the line of sight airstream.

d. Installation - Emitters and fixtures shall be installed at right angles to the conforming lines of the coil fins, such that through incident angle reflection, UVC energy bathes all surfaces of the coil and drain pan as well as all of the line of sight airstream.

e. Supports shall be type 304 stainless steel with wiring devices and
raceways.

f. Reflectors shall be constructed of high spectral finished aluminum alloy with a minimum 85 percent reflectance of 254 nm UVC radiance.

g. UVC lamp banks shall operate at electrical voltage indicated. They shall be UL class P2 type capable of igniting each Emitter at temperatures from 32-165 degrees F in airflow velocities to 1000 fpm. Their conversion efficiency shall not be less than 70% and they shall be designed so as to enhance plasma vapor pressure for maximum photon production in cold airstreams. They shall be equipped with RF and line noise suppression.

h. Emitter tubes shall be of the high output, hot cathode, T5 (15mm) diameter, medium bi-pin type. They shall produce 95 percent of their energy at 254 nm and be capable of producing the specified output at airflow velocities to 1000 fpm at temperatures of 32-165 degrees F. They shall produce no ozone or other secondary contamination.

i. Provide each UVC array with a radiometric sensing and output device configured with 0-10 VDC or 4-zone output for use by the facility DDC system. System shall enable interrogation of dynamic UVC light intensity.

2.12.16 Electronic Airflow Measuring Stations

Where indicated, provide airflow measuring stations at supply fan inlets. Units shall be factory installed at fan suction locations. Each station shall contain an array of velocity sensing elements designed in a frame for insertion to a fan vortex inlet. The velocity sensing elements shall be of the RTD or thermistor type, with linearizing means. Pitot type airflow measuring stations will not be acceptable. The sensing elements shall be distributed across the duct or opening cross section in the quantity and pattern set forth for measurements and instruments of ASHRAE-03 and SMACNA-07 for the traversing of ducted air flows. Station construction shall be suitable for operation at airflows of up to 5000 feet per minute over a temperature range of -20 to 160 degrees F, and accuracy shall be plus or minus 3 percent over a range of 0 to 5000 feet per minute; scaled to volume. Equip airflow measurement stations with transmitters compatible with control system specified in Section 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

2.12.17 Electrical

Provide factory installed and wired electrical components interior to unit. Factory installed and field installed components shall comply with NFPA 70 and the requirements of this Section. Provide wiring in metallic raceway to each motor, disconnect switch, lighting, UVC light arrays, switches, and where indicated; service receptacles. Furnish factory installed wiring in metallic raceways for all factory installed electrical components at AHU interior. Terminate power wiring for AHU lighting/receptacles, UVC emitters, and fans (each separate) at a junction boxes on AHU exterior.

2.12.18 Filter Gauges

Provide in accordance with paragraph "Filter Gages".
2.13 TERMINAL UNITS

2.13.1 Room Fan-Coil Units

Provide base units that include galvanized coil casing, cooling and heating coils assembly drain pan, air filter, fans, motor, fan drive, motor switch, an enclosure for cabinet models and casing for concealed models, and sound power levels as indicated. Obtain sound power level data or values for these units according to test procedures based on AHRI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models are acceptable for concealed models without separate test provided there is no variation between models as to the coil configuration, blowers, motor speeds, or relative arrangement of parts. Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Suspend each unit securely to the building structure. Provide units with capacity indicated. Provide room fan-coil units that are certified as complying with AHRI 440, and meet the requirements of UL 1995.

2.13.1.1 Enclosures

Fabricate enclosures from not lighter than 18 gauge steel, reinforced and braced. Provide enclosures with front panels that are removable and have 1/4 inch closed cell insulation or 1/2 inch thick dual density foil faced fibrous glass insulation. Make the exposed side of a high density, erosion-proof material suitable for use in air streams with velocities up to 4,500 fpm. Provide galvanized or factory finished ferrous metal surfaces with corrosion resistant enamel, and access doors or removable panels for piping and control compartments, plus easy access for filter replacement. Provide duct discharge collar for ducted units.

2.13.1.2 Fans

Provide steel or aluminum, multiblade, centrifugal type fans. Dynamically and statically balance the fans. Provide accessible assemblies for maintenance. Disassemble and reassemble by means of mechanical fastening devices and not by epoxies or cements.

2.13.1.3 Coils

Provide in accordance with Paragraph, "Coils", and this paragraph. Fabricate coils from not less than 3/8 inch outside diameter seamless copper tubing, with copper or aluminum fins mechanically bonded or soldered to the tubes. Provide coils with not less than 1/2 inch outside diameter sweat connectors, accessory piping package with thermal connections suitable for connection to the type of control valve supplied, and manual air vent. Provide coils suitable for 200 psi working pressure. Make provisions and coordinate access space for coil removal.

2.13.1.4 Drain Pans

Size and locate drain and drip pans to collect all water condensed on and dripping from any item within the unit enclosure or casing. Provide condensate drain pans designed for self-drainage to preclude the buildup of microbial slime and thermally insulated to prevent condensation and constructed of not lighter than 21 gauge type 304 stainless steel or noncorrosive ABS plastic. Provide insulation with a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke
developed rating no higher than 50, and of a waterproof type or coated with a waterproofing material. Design drain pans so as to allow no standing water and pitch to drain. Provide minimum 3/4 inch NPT or 5/8 inch OD drain connection in drain pan. Provide plastic or metal auxiliary drain pans to catch drips from control and piping packages. Provide galvanized steel auxiliary pans below horizontal units where indicated.

2.13.1.5 Filters

Provide one inch thick Merv 8 disposable type filter that complies with ASHRAE 52.2. Filters in each unit shall be removable without the use of tools.

2.13.1.6 Motors

Provide motors of the permanent split-capacitor type with built-in thermal overload protection, directly connected to unit fans. Provide motor switch with three speeds and off, manually operated, and mounted on an identified plate adjacent to the room thermostat. Provide motors with permanently-lubricated or oilable sleeve-type or combination ball and sleeve-type bearings with vibration isolating mountings suitable for continuous duty. Provide a motor power consumption, shown in watts, at the fan operating speed selected to meet the specified capacity that does not exceed the following values:

<table>
<thead>
<tr>
<th>Unit Capacity (cfm)</th>
<th>Maximum Power Consumption (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>115V</td>
</tr>
<tr>
<td>200</td>
<td>70</td>
</tr>
<tr>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>400</td>
<td>170</td>
</tr>
<tr>
<td>600</td>
<td>180</td>
</tr>
<tr>
<td>800</td>
<td>240</td>
</tr>
<tr>
<td>1000</td>
<td>310</td>
</tr>
<tr>
<td>1200</td>
<td>440</td>
</tr>
</tbody>
</table>

High Static Motors

<table>
<thead>
<tr>
<th>Unit Capacity (cfm)</th>
<th>Maximum Power Consumption (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>145</td>
</tr>
</tbody>
</table>
### High Static Motors

<table>
<thead>
<tr>
<th>Unit Capacity (cfm)</th>
<th>Maximum Power Consumption (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>145</td>
</tr>
<tr>
<td>400</td>
<td>210</td>
</tr>
<tr>
<td>600</td>
<td>320</td>
</tr>
<tr>
<td>800</td>
<td>320</td>
</tr>
<tr>
<td>1000</td>
<td>530</td>
</tr>
<tr>
<td>1200</td>
<td>530</td>
</tr>
</tbody>
</table>

**2.13.2 Variable Air Volume (VAV) and Air Terminal Units**

ARI 880; capacities, static pressures, and other operating conditions as indicated. Include variable-volume dampers, and other items for system operation. Furnish units with hot water heating coil in discharge where indicated. Equip units with integral electric motor actuated air-volume control dampers. Maximum air-leak rate of casing shall be less than one percent at 1 (one) inches water gage. Heating coils shall conform to paragraph "Air Systems Equipment."

Attach a flow chart to each unit. Base acoustic performance of the terminal units upon units tested according to AHRI 880 I-P with the calculations prepared in accordance with AHRI 885. Provide sound power level as indicated.

a. Provide enclosures that are constructed of galvanized steel not lighter than 22 gauge or aluminum sheet not lighter than 18 gauge. Units with flow limiters are not acceptable. Provide unit air volume that is factory preset and readily field adjustable without special tools. Provide reheat coils as indicated.

**2.13.2.1 Casing**

Minimum 22 gage galvanized steel or equivalent thickness aluminum. Provide removable access panels for inspection of unit interior, adjustment, and maintenance without disconnecting ducts. Provide minimum one inch thick double wall steel housings with insulation between; internal surfaces of air stream shall be galvanized steel. Provide double wall insulated access door into air terminal valve casing. Door shall permit access to damper, linkage, and coils. Furnish access doors with gasketing and latches to meet casing leakage criteria. Note that tape products applied to casing exterior are not acceptable sealing methodology.

**2.13.2.2 Insulation**

NFPA 90A and UL Classified for 2 hour fire-rated classification with minimum 1 inch thick 1 1/2 lb. glass fiber per cubic foot density. Provide thermal break construction of casing to prevent condensation on exterior of casing when ambient conditions are 80 degree F WB with 50 degrees F supply air.
2.13.2.3 Controls

Provide factory installed direct digital controller in accordance with Section 23 09 23 13 20, BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

2.13.2.4 Flow Sensors

Sensor shall be ring or cross type with minimum of one pitot port per one and one-half lineal inches of ring/cross length, which average the velocity across the inlet. Flow measurement shall be within plus or minus 5 percent of rated airflow with 1.5 diameters of straight duct upstream of unit and inlet static variation of 0.5 to 5.0 inches W.G. Flow measuring taps and calibration flow chart shall be supplied with each unit for field balancing airflows. Furnish flow sensor at each unit inlet.

2.13.2.5 VAV Damper or Valve

Galvanized steel butterfly style damper blade shall close against gasket inside unit. Connect damper to operating shaft with a positive mechanical connection. Provide nylon bearings for damper shaft. Damper or valve leakage at shutoff shall not exceed 1 percent of capacity at 3 inch W.G. pressure.

a. Attach a flow chart to each unit. Base acoustic performance of the terminal units upon units tested according to AHRI 880 I-P with the calculations prepared in accordance with AHRI 885. Provide sound power level as indicated. Show discharge sound power for minimum and 1-1/2 inches water gauge inlet static pressure.

2.13.2.6 Variable Volume, Single Duct Terminal Units

Provide variable volume, single duct, terminal units with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Provide units that control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 to 6 inch water gauge. Provide units with an internal resistance not exceeding 0.4 inch water gauge at maximum flow range. Provide external differential pressure taps separate from the control pressure taps for air flow measurement with a 0 to 1 inch water gauge range.

2.13.2.7 Reheat Units

2.13.2.7.1 Hot Water Coils

Provide in accordance with Paragraph, "Coils" fin-and-tube type hot-water coils constructed of seamless copper tubes and copper or aluminum fins mechanically bonded or soldered to the tubes. Provide headers that are constructed of cast iron, welded steel or copper. Provide casing and tube support sheets that are 16 gauge, galvanized steel, formed to provide structural strength. Provide tubes that are correctly circuited for proper water velocity without excessive pressure drop and are drainable where required or indicated. Install drainable coils in the air handling units with a pitch of not less than 1/8 inch per foot of tube length toward the drain end. Coils shall conform to the provisions of AHRI 410.
2.14 VIBRATION ISOLATORS

Comply with Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC AND PLUMBING PIPING AND EQUIPMENT.

2.15 ROOF CURBS

Factory-fabricated sheet-steel structural members. Provide minimum 2 inches by 4 inches factory-installed wood nailers, and fully mitered end sections. Provide welded 18 gage galvanized steel shell, 2 inch thick rigid fiberglass insulation interior liner, base plate, and counterflushing and provide stiffness required to eliminating deflection. Furnish to suit roof slopes so that supported equipment installed rests dead level. Provide curbs in configurations indicated. Furnish curbs with integral double wall galvanized steel insulated sound absorbing baffles in curb throat where indicated to be sound curbs.

2.15.1 Roof Equipment Supports

Factory fabricated construction typical of roof curb except insulation is not required. Furnish lengths, sizes and configurations indicated.

2.16 MECHANICAL IDENTIFICATION MATERIALS

General: Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.16.1 Painted Identification Materials

Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4 inch high letters for ductwork and not less than 3/4 inch high letters for access door signs and similar operational instructions.

a. Stencil Paint: standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.


2.16.2 Engraved Plastic Laminate Signs

Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black and white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.16.3 Plastic Equipment Markers

Provide manufacturer's standard laminate plastic, color coded equipment markers. Include terminology matching equipment schedules as closely as
possible. Provide approximately 2 inches x 4 inches markers for control devices, and 4 inches x 6 inches for equipment.

2.16.4 Plasticized Tags

Provide pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3 x 6 inches, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.16.5 Lettering and Graphics

Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; AHU No. 3, EF No.2).

2.17 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 3000 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.

2.18 SUPPLEMENTAL COMPONENTS/SERVICES

2.18.1 Chilled, Hot Water Piping

The requirements for chilled, condenser, or dual service water piping and accessories are specified in Section 23 64 26 CHILLED, AND HOT WATER PIPING SYSTEMS

2.18.2 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate in accordance with Section 22 00 70 PLUMBING, GENERAL PURPOSE except as modified herein.

2.18.3 Insulation

The requirements for shop and field applied insulation are specified in
Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Unless otherwise noted, duct liner is not permitted.

2.18.4 Controls

The requirements for controls are specified in Section 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

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 33 29 SUSTAINABILITY REPORTING paragraph INDOOR AIR QUALITY DURING CONSTRUCTION.

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 - GENERAL

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 machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of 3 feet. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices).

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 air handling units. Provide a depth of each seal as indicated. Provide pipe caps or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.3.2 Equipment and Installation

Provide concrete pads for air handling units, fans, plenums and other similar items. Floor mount air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 4 inch concrete pads or curbs doweled in place unless otherwise indicated. Make concrete foundations heavy enough to minimize the intensity of the
vibrations transmitted to the piping, duct work and the surrounding structure, as recommended in writing by the equipment manufacturer. Submit foundation drawings as specified in paragraph SHOP DRAWINGS. Provide concrete for foundations as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.3.3 Access Panels

Install access panels in gypsum ceilings for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.3.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

3.3.5 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Anchor risers on high velocity ducts in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.3.6 Ductwork Installation - General

Provide duct sizes and configurations (rectangular, flat oval, round) indicated on Contract Drawings. Conform to NFPA 90A, SMACNA DCS and details on Contract Drawings. Provide mounting and supporting of ductwork and accessories including, but not limited to, structural supports, hangers, vibration isolators, stands, clamps and brackets, access doors, and dampers. Provide dielectric isolation between dissimilar metals. Dielectric isolation may be fluorinated elastomers or sponge-rubber gaskets. Install ductwork accessories as indicated and as recommended by manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service. Seal all ductwork joints with topically applied mastic sealant; airtight. Factory injected duct sealant systems are not acceptable.

3.3.6.1 Ductwork Reinforcement

Conform to SMACNA DCS, details on Contract Drawings and the requirements of this Section. Air distribution systems shall operate with no chatter or vibration. Selection of ductwork joint methods shall assist in ductwork reinforcement. Provide supplemental galvanized steel angle framing at ductwork exterior. The use of duct-internal tie-rods is prohibited.
3.3.6.2 Ductwork Transitions

Duct transition sections shall be constructed to provide a gradual taper between 15 and 30 degrees. Transitions greater than 30 degrees may be used only when approved by the Contracting Officer. Provide both concentric and eccentric duct transition where indicated.

3.3.6.3 Changes to Ductwork

Provide duct configurations, types and sizes indicated on Contract Drawings. The Contract Drawings indicate an engineered solution and design intent for each ductwork system. If through pre-installation or field coordination it is required to shift ductwork from the locations indicated to enable the installation of adjacent trades, the materials required to coordinate the final locations shall be provided as work of this Section. Any changes to the ductwork locations indicated on the Contract Drawings shall be clearly indicated in the "Shop Drawing" submittal. If reconfiguring duct aspect ratios are required as part of coordination, the maximum aspect ratio shall not exceed 4:1. The substitution of rectangular and/or square ductwork for round and flat oval duct sizes indicated is prohibited. The installation of reconfigured ductwork is prohibited without approval by the Contracting Officer.

3.3.6.4 Dampers

When installed on ducts to be thermally insulated, equip each damper operator with stand-off mounting brackets, bases, or adapters to provide clearance between the duct and operator not less than the thickness of insulation. Stand-off mounting items shall be integral with the operator or standard accessory of damper manufacturer.

3.3.6.5 Turning Vanes

Provide in rectangular and square elbows.

3.3.6.6 Fire Dampers and Combination Fire / Smoke Dampers

Install in accordance with manufacturer's instructions and details on the Contract Drawings. Fire damper installation shall comply with UL 555. Combination fire/smoke damper installation shall comply with UL 555S. Locate dampers at rated wall and floor locations indicated and provide surface penetration sleeves. Provide field installed end switch at each combination fire/smoke damper. Switches shall be provided as work of Section 23 09 23.13 20, "BACnet Direct Digital Control Systems for HVAC. Provide duct access door at each fire damper and combination fire/smoke damper at location accessible for visual observation and maintenance.

3.3.6.7 Duct Access Doors

Provide where indicated on Contract Drawings, and elsewhere required for motor actuated dampers, manual volume dampers, fire dampers, combination fire/smoke dampers, smoke detectors, coils, sensors, thermostats and other concealed apparatus requiring service and inspection in the duct systems.

3.3.6.8 Duct Hangers and Supports

SMACNA DCS, Section 4 and as indicated in this Section. Provide type G90 galvanized steel strap hangers. Trapeze hanger systems may be provided;
construct of galvanized steel angles and galvanized steel threaded rods with nuts and fender washers. Cable-style duct hanging systems are not acceptable. Attach supports only to structural building framing members and metal deck-free concrete slabs. Do not attach hangers to metal deck systems that are not equipped with concrete. Where supports are required between structural framing members, provide auxiliary intermediate metal framing attached to structural building framing. Provide retainer clips where C clamps are used. Support ductwork passing through floor slabs and roof decks with type G90 galvanized steel angles attached to ductwork. Coordinate locations of vertical duct support angles with shaftwall construction to maintain shaftwalls free of duct supports.

3.3.6.9 Flexible Duct Connectors

Support flexible ducts by hangers every 3 feet, unless supported by ceiling construction. Stretch flexible air ducts to smooth out corrugations and long radius elbows. Flexible duct compression at hangers and elsewhere shall not exceed 4 percent. Provide mechanical threaded stainless steel clamps and rigid insulation spacers at connections between flexible duct connectors and rigid metallic duct, diffusers, registers and grilles. Do not exceed maximum flexible duct length indicated.

3.3.6.10 Inspection Test Holes

Provide in ductwork and casings for all balance measurements. If possible, test holes should be located at least 7.5 times diameters downstream from a fitting. Provide plastic closure cap at each hole.

3.3.6.11 Exposed Ductwork at Fume Hoods and Canopy Hoods

Exposed ductwork shall be fabricated from minimum 18 gauge, Type 304L, stainless steel with continuously welded joints and seams. Ducts shall be pitched to drain at hoods and low points indicated.

3.3.6.12 Concealed Ducts at Fume Hoods and Canopy Hoods

Ducts conveying moisture laden air shall be fabricated from minimum 18 gauge, Type 304 series, stainless steel. Joints shall be continuously welded, brazed, or soldered to be liquid tight. Duct shall be pitched to drain at points indicated.

3.3.6.13 Dust Control

Cap all open duct ends with 6 mil plastic sheeting and tape at end of each work day. Wipe ductwork sections clean as installation progresses. Remove all construction debris, dust and dirt from ducts; interior and exterior and wipe clean. Before installing air outlets, vacuum the duct interior with a brush attachment to remove and residual dust.

3.3.7 Concealed Ducts Conveying Moisture Laden Air

3.3.7.1 Exposed Ductwork

Provide exposed ductwork that is fabricated from minimum 18 gauge, Type 304L or 316L, stainless steel with continuously welded joints and seams. Pitch ducts to drain at hoods and low points indicated. Match surface finish to hoods.
3.3.8 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.

3.3.9 Ductwork Leak Test

Ductwork leak test is specified in Section 23 05 93, TESTING, ADJUSTING AND BALANCING FOR HVAC. DALT shall be performed for the ductwork systems as scheduled on contract drawings. Ductwork leak test shall be completed with satisfactory results prior to applying insulation to ductwork exterior. The work of this Section includes the provision of temporary duct caps, blank off plates and sealing materials to facilitate leak testing of duct systems individually. Ductwork installer shall cooperate with TABs to ensure DALT is conducted as specified; coordinate and schedule with TABs, each section of ductwork to receive DALT. The test rig for DALT may be furnished as work of this Section, only if approved and certified by TABs.

3.3.10 Insulation

Provide thickness and application of insulation materials for ductwork and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Externally insulate ducts and plenums. Note that internal duct liner materials are not acceptable.

3.3.11 Equipment Installation

Install air distribution equipment as indicated and in accordance with the manufacturer's instructions. Provide clearance for inspection, repair, replacement, and service. Electrical work shall conform to NFPA 70 and Division 26, "Electrical." Provide overload protection in the operating disconnect switches and motor starters sized for the operating load. Locate air intake of air handling equipment at a minimum of 30 feet from industrial stacks, bathroom vents, and sanitary risers. Prevailing wind direction shall not be used as justification for placing air intake closer than 25 feet of exhaust stacks.

3.3.11.1 Floor Mounted Fans

Provide reinforced concrete pads for floor mounted fans to the dimensions indicated and if not shown, to conform to the floor mount shape of the equipment, with a minimum 8 inch distance from the equipment anchor bolt location to the outside edge of the pad, but no less than 3 inches from the equipment mounting base to the outside edge of the pad. Anchor fans and vibration devices to the concrete pad. Allow reinforced concrete to cure a minimum of 14 days before being loaded. Install with vibration isolators, flexible electrical leads, and flexible connections between fan inlet and discharge ductwork.

3.3.11.2 Suspended Fans and Fan Coil Units

Install with spring compression vibration isolators, galvanized hanger rods with chrome plated steel adjustment turnbuckles, flexible electrical feeds, and flexible connections between fan inlet and discharge ductwork. Attach galvanized steel threaded rods to building structure.
supports are required between structural building framing members, provide auxiliary intermediate metal framing attached to structural building framing.

3.3.11.3 Air Handling Units

Install assembled units on vibration isolation pads under structural base rails. Provide pads between AHU base rails and reinforced concrete pads, spaced evenly, not to exceed 8 feet center to center. Provide supplemental pads at each structural connection or joint in the AHU base rails. Provide reinforced concrete pads for floor mounted AHU's to the dimensions indicated and if not shown, to conform to the floor mount shape of the equipment, with a minimum 8 inch distance from the equipment anchor bolt location to the outside edge of the pad, but no less than 3 inches from the equipment mounting base to the outside edge of the pad. Anchor air handling units to the concrete pad. Allow reinforced concrete to cure a minimum of 14 days before being loaded. Bolt loose AHU sections together. Maintain interior of AHU's free of construction dust and debris. Restore/repair any AHU coil fins which are misshapen due to construction activity. Replace any portions of AHU casings which are bent, deformed or otherwise misshapen as a result of construction activity or shipping. Start-up AHU's in the presence of an AHU manufacturer factory trained representative.

a. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

b. Examine rough-in for hydronic and condensate drainage piping and electrical to verify actual locations of connections prior to installation. Do not proceed until unsatisfactory conditions have been corrected.

c. Install equipment level and plumb, in accordance with manufacturer's written instructions.

d. Secure units with anchor bolts. Adjust vibration isolation devices on fans to allow equipment to float freely. Replace improperly loaded vibration isolator spring units which result in metal and vibration conductance. Provide reinforced concrete infill of air handling spring isolated inertia base frames.

e. Assemble knocked-down (disassembled) air handling units where required for rigging. Assembly shall be conducted as recommended by AHU factory authorized representatives. All AHU casing and component seams shall be sealed airtight with materials recommended by AHU representatives. Failed or damaged components shall be placed with original factory components by the installer.

3.3.12 Piping Installation Requirements

Hydronic piping systems are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:

a. Arrange piping installations adjacent to units to allow unit servicing and maintenance.

b. Connection piping to air-handling units with flexible connectors.
c. Connect condensate drain pans; extend to the nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction. Provide traps and drain piping on both sides of each AHU.

3.3.13 Installation of Room Pressure Monitors

Install system in accordance with manufacturer's requirements. Wiring and pneumatic sensing tubing shall conform to Section, "DIRECT BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC." Coordinate all interlocks and setpoints.

3.3.14 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer's maximum allowable range of misalignment. Provide one set of replacement sheaves (fan and motor) for each v-belt drive fan. Provide sizes of replacement sheaves as determined by TAB's. After final adjustment, provide on spare set of belts for each v-belt drive.

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 14 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 ductwork 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. 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

For ductwork that is exposed to view, where ductwork passes through metal stud partitions or masonry walls, provide closure collars for each duct penetration. Coordinate the provision of framed openings in building studwork with work of Section 09 22 00, METAL SUPPORT FRAMING ASSEMBLIES;
locate each duct penetration through metal stud partitions including dimensions from columns and other fixed points, including elevations so that each penetration may be anticipated and framed prior to stud partition erection. Provide similar coordination for ductwork passing through masonry walls. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Unless required to be sealed with Division 07 Firestopping or Acoustic Sealant, pack spaces between opening and duct or duct insulation with mineral fiber conforming with ASTM C 553, Type 1, Class B-2. 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.

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 and combination fire/smoke dampers, which are exposed to unconditioned air.

3.7.4 Closure Collars

Provide closure collars of a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20 gauge galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with minimum dimension over 15 inches from 18 gauge galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20 gauge galvanized steel. Install collars with fasteners a maximum of 6 inches on center. Attach to collars a minimum of 4 fasteners where the opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less.

3.7.5 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

Where field painting is required, 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 Temperatures between 120 and 400 degrees F

Apply two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of two mils to metal surfaces subject to temperatures between 120 and 400 degrees F.

3.8.3 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.

3.8.4 Color Coding Scheme for Locating Hidden Utility Components

Use scheme in buildings having suspended grid ceilings. Provide color coding scheme that identifies points of access for maintenance and operation of components and equipment that are not visible from the finished space and are accessible from the ceiling grid, consisting of a color code board and colored metal disks. Make each colored metal disk approximately 3/8 inch diameter and secure to removable ceiling panels with fasteners. Insert each fastener into the ceiling panel so as to be concealed from view. Provide fasteners that are manually removable without the use of tools and that do not separate from the ceiling panels when the panels are dropped from ceiling height. Make installation of colored metal disks follow completion of the finished surface on which the disks are to be fastened. Provide color code board that is approximately 3 foot wide, 30 inches high, and 1/2 inches thick. Make the board of wood fiberboard and frame under glass or 1/16 inch transparent plastic cover. Make the color code symbols approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. Mount the color code board where indicated. Make the color code system as indicated below:
3.9 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.10 IDENTIFICATION OF PIPING, EQUIPMENT AND PHYSICAL HAZARDS

Identify equipment, system accessories and physical hazards in accordance with 29 CFR 1910.144, 29 CFR 1910.144, ASME A13.1, ANSI Z535.1 and as modified herein. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment. Identify each piping system and item of equipment indicated on contract drawings. HVAC air outlets and inlets do not require identification.

3.10.1 Mechanical Equipment

Install engraved plastic laminate sign or plastic equipment marker on or near each item of mechanical equipment and each operational device. Provide minimum 1/4 inch high lettering for name of unit where viewing distance is less than 36 inches, 1/2 inch high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering. In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.10.1.1 Access Doors

Provide painted stencil identification of all ductwork access doors to fire dampers, fire/smoke dampers, and motor operated control dampers. Label "fire damper access," "control damper access," etc.

3.11 DAMPER ACCEPTANCE TEST

Submit the proposed schedule, at least 2 weeks prior to the start of test. Operate all fire dampers and combination fire/smoke dampers under normal operating conditions, prior to the occupancy of a building to determine that they function properly. Test each fire damper equipped with fusible link by having the fusible link cut in place. Test dynamic fire dampers with the air handling and distribution system running. Reset all fire dampers with the fusible links replaced after acceptance testing. To ensure optimum operation and performance, install the damper so it is square and free from racking.
3.12 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of performance tests. Tuning of HVAC system controllers shall be performed prior to or simultaneous with HVAC system balancing. The contractor shall tune the control system components provided under this section after all air system and hydronic system balancing has been completed, minimum damper positions set and a report has been issued.

a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).

b. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

3.12.1 System Calibration and Adjustments

System calibration shall be performed for each air handling system. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform calibration and testing of the HVAC control system with Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. All instrumentation and controls shall be calibrated and the specified accuracy shall be verified using test equipment with calibration traceable to NIST standards. Wiring shall be tested for continuity and for ground, open, and short circuits. Mechanical control devices shall be adjusted to operate as specified. Controllers shall be pretested off-site as a functioning assembly ready for field connections, calibration and adjustment of the operational system. Control parameters and logic (virtual) points including control loop setpoints, gain constants, and integral constraints, shall be adjusted before the system is placed on line. Communications requirements shall be as indicated.

Written notification of any planned calibration and testing of the systems shall be given to the Government at least 14 calendar days in advance. Prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the air handling systems prior to the commissioning work specified in Section 23 08 02.00 50 COMMISSIONING OF HVAC, according to the process specified. At minimum, the plan shall include for type of equipment specified in this section:

a. System name.

b. List of devices.

c. Step-by-step procedures for testing each component after installation, including the process of verifying proper hardware and wiring installation, and the process of performing operational checks of each component.

d. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and clearly indicate when the equipment has "passed" and is operating within the
contract parameters.

e. A description of the instrumentation required for testing.

f. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the TAB contractor for this determination.

3.13 PERFORMANCE TESTS

After testing, adjusting, and balancing is complete as specified, test each system as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Record the testing during the applicable season. Make corrections and adjustments as necessary to produce the conditions indicated or specified. Conduct capacity tests and general operating tests by an experienced engineer. Provide tests that cover a period of not less than days for each system and demonstrate that each 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.

3.14 CLEANING AND ADJUSTING

Clean interior and exterior surfaces of fan coil units, unit heaters, air handling units, fans, air terminal units and ductwork systems. Thoroughly clean ducts, plenums, and casing of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and install new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.15 SYSTEM OPERATION DURING CONSTRUCTION

Air handling units and fans may be operated during building construction only when approved by the Contracting Officer. Return and exhaust fans are not permitted to be operated. If air handling units are operated to "dry-out" the facility during construction, they shall be used with the return air ductwork disconnected to avoid AHU and ductwork fouling from the building construction conditions. If it is elected and approved that the units may be used, provide the following:
a. Each air handling unit shall be equipped with the specified construction filters in the permanent AHU filter frames.

b. The AHU inlet connection shall be blanked off with sheet metal and sealed, the suction-side access door(s) shall be opened and configured with a temporary, galvanized steel framing rack, to enable the securing of low efficiency blanket type filter media to the rack. The rack dimensions and configuration shall allow the resulting blanket filter media coverage to not exceed a 500 feet per minute face velocity through the blanket filter media at the scheduled AHU air quantity; the media shall be sealed with temporary metal clips to prevent bypass air. The AHU's shall receive air to the suction side through the louvers to the space.

c. The AHU's shall not be operated when outdoor ambient temperature conditions are at 35 degrees F or less. If the AHU's in the temporary-use state are shut down at the end of the day, the louver shall be blanked off to create a barrier between the mechanical space and the facility exterior.

d. When conditions on the construction site are acceptable to the Contracting Officer, the temporary AHU access door filter rack may be removed and the permanent inlet-side AHU duct condition installed.

e. For the initial two weeks of AHU operation to the permanent duct systems; supply and return air, provide temporary low efficiency replaceable filter media over all return registers and continue to use low efficiency blanket filter media over the permanent AHU filter racks as described above. Secure in place with tape at filter perimeter; seal. Change each register filter when visibly soiled or at a minimum; weekly. The installer of this Section shall schedule observation of the temporary filter media with the Contracting Officer. The Government expects to acquire clean AHU's and ductwork when the installation is completed. If ductwork and AHU is soiled with dust during construction, charges for cleaning the duct system and AHU, to the satisfaction of the Contracting Officer; including coils, prior to building occupancy, will be borne by this section.

3.16 COMMISSIONING

Provide the services of a supervisory level technician in responsible charge of the work in this section, and factory authorized start-up and service technicians; for each major component or system in this section, to participate in the work specified in Section 23 08 02.00 50 COMMISSIONING OF HVAC and Section 01 91 13.00 50, GENERAL COMMISSIONING REQUIREMENTS.

3.17 OPERATION AND MAINTENANCE

3.17.1 Operation and Maintenance Manuals

Submit a minimum of six manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data

3.17.2 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 8 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.

3.18 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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)


INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2014) Motors and Generators


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

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

Shop Drawings; G

Coordination Drawings; G
SD-11 Closeout Submittals

Energy Efficient Equipment for Motors; S
Reduce Volatile Organic Compounds (VOC) for paint/coatings; S
Waste Management (LEED); 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 Shop Drawings

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

Prior to installation, prepare coordination drawings in two separate categories to ensure field coordination prior to installation. The first category shall include items required for an above ceiling coordination effort; including ceiling materials and heights. The second category shall include building surface penetrations, sleeves, framed studwork opening, openings in masonry and concrete walls and penetrations through floors. Drawings shall be drawn to a minimum scale of 1/4 inch equals one foot or larger, and include the floor plan and building structural elements in the backgrounds. The drawings shall demonstrate a pre-installation coordination effort.

Category 1 Submittal: Drawings shall define building surface penetrations; locations of piping floor penetrations, piping masonry and concrete wall penetrations including pre-cast panels, ductwork floor penetrations, ductwork masonry and concrete wall penetrations including structural lintels, ductwork partition penetrations including framed openings in studwork. Penetrations shall be dimensioned from fixed building elements such as structural columns and be provided with elevations above finished floor slabs and roof decks.

Category 2 Submittal: Drawings shall define the proposed locations of ductwork, fire protection piping, plumbing piping, medical gas piping, HVAC piping, mechanical equipment, electrical raceway paths, electrical pull boxes, auxiliary structures to support ceiling mounted items such as exam/surgery lights, and system accessories in relationship with the building structure and reflected ceiling plan. Illustration shall be plotted in colors which enable the clear differentiation of each type of element on the drawing. Indicate space for equipment maintenance access; distance to access equipment control panels and electrical devices, HVAC coil connection spaces, and items of plumbing access such as cleanouts. Include the reflected ceiling plans to coordinate and integrate air outlets and inlets, light fixtures, communication systems components, sprinkler heads, fire alarm system devices, and other ceiling-mounted items.
1.4.2 Coordination Drawings

Coordinate ductwork, piping and equipment with pathways necessary to accommodate electrical conduit/raceways, cable trays, and pull boxes. Ensure clearances have been anticipated and will be maintained during installation to provide the required clearance in front of and above electrical distribution equipment/panels. The Contract Drawings indicate an engineered solution and design intent for each ductwork and piping system. If through the coordination effort it is required to shift ductwork or piping from the locations indicated to enable the installation of adjacent trades, the materials required to coordinate the final locations shall be provided as work of each individual ductwork and piping Section.

Include the following:

a. Clearances for servicing and maintaining equipment, including coil removal, tube removal, filter removal, valve trains at equipment and space necessary for equipment disassembly required for periodic maintenance.

b. Suspended equipment support details.

c. Pipe anchorages.

d. Clearances to fire rated and fire/smoke rated walls, shafts and partitions.

e. Valve stem movement space.

f. Text descriptions to define movement, and positioning of large equipment into the building during construction.

g. Clearances necessary for installing and maintaining insulation.

h. Framed openings in stud partitions, openings in masonry walls and shaft penetrations.

i. Sleeves with waterstops.

j. Fire-rated and smoke rated wall and floor penetrations.

k. Valve stem movement space.

Shop drawing submittals specified in Divisions 21, 22 and 23 may be used to initiate the Coordination Drawing effort.

Conduct a pre-installation meeting at a minimum of four weeks prior to the installation of components; respectively for both the Category 1 and Category 2 submittal. Coordination drawings shall be modified as construction progresses to suit field changes. Periodic meetings; during installation, at a minimum of two week intervals shall follow the initial meeting. The periodic meetings shall include representatives from each respective installation discipline with progressed and/or completed coordination drawings. The purpose of the meetings is to facilitate the correct installation of components, facilitate the shop-fabrication of components prior to materials being fabricated and shipped to the site, and to facilitate field changes required enable the installation.

1.4.3 Material and Equipment Qualifications

Unless otherwise noted, 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.

1.4.4 Alternative Qualifications

Unless otherwise noted, 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.

1.4.5 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. Reasonably convenient is defined as being able to provide a trained service technician to the site to correct the deficiency within 24 hours of the request.

1.4.6 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.

1.4.7 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.

1.4.7.1 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."

1.4.7.2 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.

a. Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Pipe and tubing shipped to the site shall be equipped with factory applied plastic end-caps. During pipe and duct installation, temporarily cap or plug all pipes and ducts to eliminate the intrusion of construction dust and debris until installation is complete.

b. Equipment shall be delivered and stored with protective crating and weatherproof wrapping to enable protection from the weather, humidity, temperature variations, dirt and dust or other contaminants.

c. Ductwork, if stored one day past delivery shall be protected with secure tarpaulins and shall have ends sealed with plastic wrapping. Maintain all materials in-storage on dunnage above grade and/or slab level.

d. After diffusers, registers and grilles are installed, cover and temporarily seal each with minimum 3 mil plastic sheeting including sealed perimeters to prevent the entry of duct during construction. Remove plastic sheeting only when construction areas have been cleaned to a point acceptable to the Contracting Officer.

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 exceed the wiring and electrical distribution characteristics indicated on the electrical contract drawings, provide any required change to the Electrical System; 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 ELECTRICAL INSTALLATION REQUIREMENTS

Electrical installations must conform to IEEE C2, NFPA 70, and requirements specified herein.

1.7.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters (except starters/controllers which are indicated as part of a motor control center), control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control
wiring and conduit to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors are not to be permitted. Variable frequency drive motor starters shall conform to Division 26. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits must be provided under Division 26, except internal wiring for components of package equipment must be provided as an integral part of the equipment. When motors and equipment furnished exceed the wiring and electrical distribution characteristics indicated on the electrical contract drawings, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.7.2 High Efficiency Motors

1.7.2.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors must be high efficiency types corresponding to the applications listed in NEMA MG 11. Single phase motors shall be equipped with built-in thermal overload protection.

1.7.2.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors must be as a minimum selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings must meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1. Where additionally indicated, in Division 23 sections, provide premium efficiency motors.

1.7.3 Three-Phase Motor Protection

Provide controllers for motors rated one 1 horsepower and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors 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.

1.9 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 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 for Motors

Provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph ENERGY EFFICIENT EQUIPMENT that the motors meet energy efficiency requirements as outlined in this section.

2.1.2 Reduce Volatile Organic Compounds (VOC) for paint/coatings

Low or no VOC's and no added urea formaldehyde for paints or coatings, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS (VOC).

2.1.3 Waste Management (LEED)

LEED documentation relative to waste management credit in accordance with LEED Reference Guide. Include in LEED Documentation Notebook.

Separate waste materials for reuse or recycling in accordance with the Waste Management Plan. See Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for reuse and recycling of waste material 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 3000 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 may be the manufacturer's standard color 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.

3.2 WASTE MANAGEMENT

Separate offcuts and waste materials and reuse or recycle in accordance with the Waste Management Plan. Identify manufacturer's policy for collection or return of construction scrap, unused material, demolition scrap, and/or packaging material.

3.3 COMMISSIONING

Divisions 21, 22, and 23 will be responsible to carry out the commissioning requirements specified in Section 01 91 13.00 50, COMMISSIONING REQUIREMENTS. The general contractor and sub-contractors shall become thoroughly knowledgeable of the requirements of the Commissioning Plan, all project specifications, the completed project coordination drawings, and shall schedule completion of the work of all trades to enable commissioning.

-- End of Section --
SECTION 23 05 48.00 40
VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT
08/15

PART 1   GENERAL

This section applies to systems and equipment provided under Division 22 and Division 23 of this specification. Provide vibration isolation products as work of this section unless products are specified otherwise in individual sections.

1.1 REFERENCES

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

ACOUSTICAL SOCIETY OF AMERICA (ASA)


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


NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB PROCEDURAL STANDARDS (2005) Procedural Standards for TAB (Testing, Adjusting and Balancing) Environmental Systems

1.2 ADMINISTRATIVE REQUIREMENTS

Within 60 working days of Contract Award, submit equipment and performance data for vibration isolator systems including equipment base design; inertia-block mass relative to support equipment weight; spring loads and free, operating, and solid heights of spring; spring diameters; nonmetallic isolator loading and deflection; disturbing frequency; natural frequency of mounts; deflection of working member; and anticipated amount of physical movement at the reference points. Coordinate mountings, bases, isolators and anchorages for equipment, piping and ductwork with details and schedules on contract drawings. This section applies to Division 22, Plumbing and Division 23 Heating Ventilating and Air Conditioning of this project specification unless indicated otherwise.

Ensure the data includes information on the following:

a. Mountings
b. Bases
c. Isolators
d. Floor-Mounted Piping
e. Vertical Piping

Five working days prior to commencement of installation, submit installation drawings for vibration isolator systems including equipment and performance requirements.

Indicate within outline drawings for vibration isolator systems, overall physical features, dimensions, ratings, service requirements, and weights of equipment.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Installation Drawings; G

Submit installation drawings and outline drawings in accordance with paragraph "Administrative Requirements" of this section.

SD-03 Product Data

Mountings; G
Isolators; G
Bases; G

Submit product data in accordance with paragraph "Administrative Requirements" of this section.

SD-06 Test Reports

Type of Mounting; G
Type of Base; G
Type of Isolator; G
Allowable Deflection; G
Measured Deflection; G

1.4 QUALITY CONTROL

Ensure all vibration-control apparatus is the product of a single manufacturing source, where possible. Human exposure levels should be considered using ASA S2.71 and NEBB PROCEDURAL STANDARDS.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Scheduled isolation mounting is in inches and is a minimum static
deflection.

Spans referred to in paragraph EQUIPMENT, means longest bay dimension.

Determine exact mounting sizes and number of isolators by the isolator manufacturer based on equipment that will be installed. Check equipment revolutions per minute (rpm) and spring deflections to verify that resonance cannot occur.

2.1.1 Design Requirements

Unless indicated otherwise design for vibration isolation using NEBB PROCEDURAL STANDARDS ASHRAE HVAC APP IP HDBK, Chapter 48, as applicable to the following sections, but no less than the quantities and types schedule on the contract drawings.

2.1.1.1 Mountings

Provide the following mountings:

Type A: Composite pad, with 0.25-inch thick elastomer top and bottom layers, molded to contain a pattern with nonslip characteristics in all horizontal directions. Elastomer loading is not to exceed 40 pounds per square inch (psi). Ensure minimum overall thickness is 1 inch. Maximum deflections up to 0.25-inch are allowed.

Type B: Double rubber-in-shear compression isolators with molded-in steel reinforcement in top and bottom. Maximum deflections up to 0.50-inch are allowed.

Type C: Free-standing laterally stable open-spring type compression isolators for deflections over 0.50-inch, with built-in bearing and leveling provisions, 0.25-inch thick Type A base elastomer pads, and accessories. Ensure outside diameter of each spring is equal to or greater than 0.9 times the operating height of the spring under rated load.

Type D: Partially housed type compression isolators, containing one or more vertically restrained springs with at least 0.50-inch clearance maintained around springs, with adjustable limit stops, 0.25-inch thick Type A base elastomer pads, and accessories.

Type E: Pendulum-suspension configuration with free-standing stable spring with resilient horizontal and vertical restraints to allow maximum movements of 0.25-inch in each direction, 0.25-inch thick Type A base elastomer pads.

Type F: Elastomer-in-shear steel framed for hanger-rod mounting, with minimum total static deflection of 1-inch.

2.1.1.2 Bases

Provide the following bases:

Type U: Unit isolators without rails, structural-steel bases, or inertia blocks.

Type R: Rails, connected mill-rolled structural steel, of sufficient dimension to preclude deflection at midpoint of unsupported span in
excess of 1/1,440th of the span between isolators, power transmission, component misalignment, and any overhanging weight. Where Type R bases are specified and the equipment proposed requires additional base support, use a Type S base.

Type S: Structural-steel bases common to a supported assembly, made from welded-joint mill-rolled structural steel with closed-perimeter configuration, isolators attached to outrigger supports.

Ensure height of steel members is sufficient to provide stiffness required to maintain equipment manufacturer's recommended alignment and duty efficiency of power-transmission components. Ensure height of steel member does not result in member deflection at midpoint of unsupported span of more than 1/1,440th of the span between isolators. Minimum height is 5-inches.

Type CIB: Provide concrete inertia blocks common to the entire assembly, with welded-joint construction, mill-rolled structural-steel perimeters, welded-in No. 4 reinforcing bars 8-inches on center each way near the bottom of the block, outrigger-isolator mounting provisions, anchor bolts. Fill with 3,000 psi cured-strength concrete.

Configure rectangular inertia bases to accommodate equipment supported.

Ensure minimum thickness of inertia base, in addition to providing suitable mass, is sufficient to provide stiffness to maintain equipment manufacturer's recommended alignment and duty efficiency of power-transmission components, and is sufficient to result in base deflection at midpoint of unsupported span of not more than 1/1,440th of the span between isolators. Verify minimum thickness, the preceding requirements not withstanding, is 8 percent of the longest base dimension.

Ensure pumps with flexible couplings do not have inertia base less than 6-inches thick, and the minimum mass of concrete inertia block is equal in weight to supported equipment.

2.2 EQUIPMENT

Vibration isolation design per NEBB PROCEDURAL STANDARDS ASHRAE HVAC IP HDBK, Chapter 37, but no less than the quantities and types scheduled on the contract drawings.

2.2.1 Pipe And Duct Vibration Isolation

Type G: Provide isolators with in-series contained steel springs and preformed fibrous-glass or chloroprene-elastomer elements for connecting to building-structure attachments. Load devices by supported system during operating conditions to produce a minimum spring and elastomer static deflection of 1-inch and 3/8-inch, respectively.

Type H: Provide isolators with contained chloroprene-elastomer elements for connecting to building-structure attachments. Load devices by supported system during operating conditions to produce a minimum elastomer static deflection of 3/8-inch.

Type J: Provide isolators with elastomers mounted on floor-supported columns or directly on the floor. Load devices by supported system
during operating conditions to produce a minimum elastomer static deflection of 3/8-inch.

2.2.1.1 Floor-Mounted Piping

Type K: Provide isolators with springs mounted on floor-supported columns or directly on the floor. Load devices by supported system during operating conditions to produce a minimum spring static deflection of 1-inch.

2.3 MATERIALS

Ensure rubber is natural rubber and elastomer is chloroprene. Shore A durometer measurement of both materials and range between 40 and 60.

Inorganic materials such as precompressed, high-density, fibrous glass encased in a resilient moisture-impervious membrane may be used in lieu of specified natural rubber and elastomers. Where this substitution is made, ensure specified deflections are modified by the manufacturing source to accommodate physical characteristics of inorganic materials and to provide equal or better vibration isolation.

Ensure weather-exposed metal vibration-isolator parts are corrosion protected. Chloroprene coat springs.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

Submit test reports for testing vibration isolation for each type of isolator and each type of base. Meet referenced standards contained within this section. Include in test reports allowable deflection and measured deflection also meeting referenced standards within this section.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment in accordance with manufacturer's recommendations. Anchor isolation devices to equipment and reinforced concrete pads and/or roof equipment supports as applicable.

Ensure rails, structural steel bases, and concrete inertia blocks are raised not less than 1-inch above the reinforced concrete housekeeping pad or support structure, and are level when equipment supported is under operating load.

Ensure vibration-isolation installation and deflection testing after equipment start-up is directed by a competent representative of the manufacturer.

3.2 FIELD QUALITY CONTROL

3.2.1 Tests and Reports

Ensure vibration-isolation devices are deflection tested. Submit test reports substantiating that all equipment has been isolated as specified
3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1 GENERAL

1.1 REFERENCES

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

ACOUSTICAL SOCIETY OF AMERICA (ASA)


ASA S1.4 (1983; Amendment 1985; R 2006) Specification for Sound Level Meters (ASA 47)

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 203 (1990; R 2011) Field Performance Measurements of Fan Systems

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


ASSOCIATED AIR BALANCE COUNCIL (AABC)


AABC MN-4 (1996) Test and Balance Procedures

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)


NEBB PROCEDURAL STANDARDS (2005) Procedural Standards for TAB (Testing, Adjusting and Balancing) Environmental Systems
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 duct leakage testing scheduled on contract drawings." 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.

<table>
<thead>
<tr>
<th>SIMILAR TERMS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contract Term</strong></td>
</tr>
<tr>
<td>TAB Specialist</td>
</tr>
<tr>
<td>Systems Readiness Check</td>
</tr>
</tbody>
</table>

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 and water distribution systems and plumbing potable water systems including equipment and performance data, ducts, dampers valves and piping which are located within, on, under, between, and adjacent to buildings.

Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association that approved the TAB Agency'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
Conduct DALT and TAB of the indicated 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 Water Distribution Systems

TAB systems in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to water distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. At Contractor's option and with Contracting Officer's written approval, the piping systems may be insulated before systems are TAB'd.

Terminate piping insulation immediately adjacent to each flow control valve, automatic control valve, or device. Seal the ends of pipe insulation and the space between ends of pipe insulation and piping, with waterproof vapor barrier coating.

After completion of work under this section, insulate the flow control valves and devices as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.3 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings, based on the equipment and system accessories submitted and provided for the project:

1. A unique number or mark for each piece of equipment or terminal, correlating to contract drawing equipment and terminal tag's.
2. Air quantities at air terminal units, diffusers, registers and grilles.
3. Air quantities and temperatures for air handling units.
4. Air quantities for supply and exhaust fans.
5. Water quantities and temperatures for thermal energy transfer equipment.
7. Water quantities and temperatures for boilers, water chillers and potable water heaters.
8. Water flow measurements at flow meters and manualbalancing fittings.
9. 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.
10. Electrical motor characteristics.

The Testing, Adjusting, and Balancing (TAB) Specialist must review the Contract Plans and Specifications, the completed coordination drawings and advise the Contracting Officer of any deficiencies that would prevent the effective and accurate TAB of the system, 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 30 days after the coordination drawings are complete.

1.3.4 Related Requirements

Specific requirements relating to Reliability Centered Maintenance (RCM) principals and Predictive Testing and Inspection (PTI), by the construction contractor to detect latent manufacturing and installation defects must be followed as part of the Contractor's Quality Control program. Refer to the paragraph titled "Sustainability" for detailed requirements.

Requirements for price breakdown of HVAC TAB work are specified in Section 01 20 00.00 20 PRICE AND PAYMENT PROCEDURE.

Requirements for construction scheduling related to HVAC TAB work are specified in Section 01 32 17.00 20 COST LOADED NETWORK ANALYSIS SCHEDULES (NAS).

1.4 SUBMITTALS

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

SD-01 Preconstruction Submittals
   Independent TAB Agency and Personnel Qualifications; G
   TAB Design Review Report; G
   TAB Agency; G
   Designation of TAB Team Assistants; G
   Designation of TAB Team Engineer; G or TAB Specialist; G
   Designation of TAB Team Field Leader; G

SD-02 Shop Drawings
   TAB Schematic Drawings and Report Forms; G

SD-03 Product Data
   Equipment and Performance Data; G
TAB Related HVAC Submittals; G
A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB team engineer and assistant.

TAB Procedures; G
Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration; G
Systems Readiness Check; G
TAB Execution; G
TAB Verification; G

SD-06 Test Reports
Completed Pre-Final DALT Report; G
Certified Final DALT Report; G
Prerequisite HVAC Work Checkout List For Proportional Balancing; G
Certified Final TAB Report for Proportional Balancing; G
Prerequisite HVAC Work Checkout List For Season 1; G
Certified Final TAB Report for Season 1; G
Prerequisite HVAC Work Checkout List For Season 2; G
Certified Final TAB Report for Season 2; G
Tab Design Review Report; G
TAB report for Season 1; G
TAB report for Season 2; G

SD-07 Certificates
Independent TAB Agency and Personnel Qualifications; G
DALT and TAB Submittal and Work Schedule; G
TAB Pre-Field Engineering Report; G
Instrument Calibration Certificates; G
DALT and TAB Procedures Summary; G
Completed Pre-Final DALT Work Checklist; G
Advance Notice of Pre-Final DALT Field Work; G
Advance Notice of TAB Field Work for Proportional Balancing; G
Advance Notice of TAB Field Work for Season 1; G
Advance Notice of TAB Field Work for Season 2; G
TAB Agency; G
Design Review Report; G
Pre-field DALT Preliminary Notification; G
Advanced notice for Season 1 TAB Field Work; G
Prerequisite HVAC Work Check Out List For Season 1; G
Advanced notice for Season 2 TAB field work; G
Prerequisite HVAC Work Check Out List For Season 2; G

1.5 QUALITY ASSURANCE

1.5.1 Independent TAB Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to Contracting Officer for approval:

a. Independent AABC or NEBB or TABB TAB agency:

   TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

   TAB team supervisor: Name and copy of AABC or NEBB or TABB TAB supervisor certificate and expiration date of current certification.

   TAB team field leader: Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

   TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

   Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.
b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

1.5.1.1 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 Agency 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.

1.5.1.2 Qualifications

a. TAB Agency

The TAB Agency 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 Agency loses subject certification during this period, the Contractor must immediately notify the Contracting Officer and submit another TAB Agency for approval. Any agency that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Agency will be considered invalid if the TAB Agency 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 Agency 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. The TAB Agency shall not be affiliated with any company participating in any other phase of this contract including design, furnishing equipment, construction or commissioning.

b. TAB Specialist

The TAB Specialist must be either a member of AABC, an experienced technician of the Agency 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.

c. 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.

1.5.1.3 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.

1.5.2 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 the paragraph TAB SUBMITTAL AND WORK SCHEDULE.

1.5.2.1 Contractor

a. TAB personnel: Ensure that the DALT work and the TAB work is accomplished by a group meeting the requirements specified in the paragraph TAB PERSONNEL QUALIFICATION REQUIREMENTS.

b. Pre-DALT/TAB meeting: Attend the meeting with the TAB Supervisor, and ensure that a representative is present for the sheetmetal contractor, mechanical contractor, electrical contractor, and automatic temperature controls contractor.
c. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB agency:

(1) Contract drawings and specifications
(2) Approved submittal data for equipment
(3) Approved coordination drawings
(4) Construction work schedule
(5) Up-to-date contract document and equipment 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 the paragraph TAB SUBMITTAL AND WORK SCHEDULE is met.

e. Coordination of supporting personnel:

Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the DALT and the TAB field measurement work.

Provide equipment mechanics to operate HVAC equipment and ductwork mechanics to provide the field designated test ports to enable TAB field team to accomplish the DALT and the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the DALT and the TAB field work.

Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the controls check out.

f. Deficiencies: Ensure that the TAB Agency supervisor submits all Design/Construction deficiency notifications directly to the Contracting officer within 3 days after the deficiency is encountered. Further, ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.

g. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as prerequisite work items, the deficiencies pointed out by the TAB team supervisor in the design review report.

h. Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. Do not allow the TAB team to commence TAB field work until all of the following are completed:

(1) HVAC system installations are fully complete to the satisfaction of the Contracting Officer.

(2) HVAC prerequisite checkout work lists specified in the paragraph
PRE-FIELD TAB ENGINEERING REPORT are completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved prerequisite HVAC work checklist.

(3) DALT field checks for all systems are completed.

(4) HVAC system filters are clean for both Season 1 and Season 2 TAB field work.

i. Advance notice: Furnish to the Contracting Officer with advance written notice for the commencement of the DALT field work and for the commencement of the TAB field work.

j. Insulation work: For required DALT work, ensure that insulation is not installed on ducts to be DALT’d until DALT work on the subject ducts is complete. Later, ensure that openings in duct and machinery insulation coverings for TAB test ports are marked, closed and sealed.

1.5.2.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of the paragraph INDEPENDENT TAB AGENCY PERSONNEL QUALIFICATIONS. The work to be performed by the TAB agency is limited to testing, adjusting, and balancing of HVAC and Plumbing, air and water systems to satisfy the requirements of this specification section.

1.5.2.3 TAB Team Supervisor

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.

b. Pre-DALT/TAB meeting: Attend meeting with Contractor.

c. Design review report: Review project specifications, accompanying drawings, and contractor-prepared coordination 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, flow meters, manual balancing valves, motor actuated valves and dampers 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, specifications, and contractor-prepared coordination drawings, approved submittal data for
equipment, up-to-date revisions and change orders; prepare this report.

g. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field engineering report is submitted.

h. Technical assistance for DALT work.
   (1) Technical assistance: Provide immediate technical assistance to TAB field team.
   (2) DALT field visit: Near the end of the DALT field work effort, visit the contract site to inspect the HVAC installation and the progress of the DALT field work. Conduct a site visit to the extent necessary to verify correct procedures are being implemented and to confirm the accuracy of the Pre-final DALT Report data which has been reported. Also, perform sufficient evaluation to allow the TAB supervisor to issue certification of the final report. Conduct site visits for the quantity of DALT intervals determined by the Contractor.

i. Final DALT report: Certify the DALT report. This certification includes the following work:
   (1) Review: Review the Pre-final DALT report data. From these field reports, prepare the Certified Final DALT report.
   (2) TAB Verification: Verify adherence, by the TAB field team, to the procedures specified in this section.

j. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.
   (1) TAB field visit: At the midpoint of the Season 1 and Season 2 TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workdays duration.
   (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 workdays duration. Review the TAB final report data and certify the TAB final report.

k. Certified TAB report: Certify the TAB report. This certification includes the following work:
   (1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.
   (2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.

l. Design/Construction deficiencies: Within 3 working days after the TAB Agency has encountered any design or construction deficiencies, the TAB Supervisor must submit written notification directly to the Contracting Officer, with a separate copy to the Contractor, of all such deficiencies. Provide in this submittal a complete explanation,
including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB, the TAB Agency must issue notice and request direction in the notification submittal.

m. TAB Field Check: The TAB team supervisor must attend and supervise Season 1 and Season 2 TAB field check.

1.5.2.4 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.

1.5.3 Sequencing and Scheduling

1.5.3.1 DALT and TAB Submittal and Work Schedule

Comply with additional requirements specified in Appendix C: DALT AND TAB SUBMITTAL AND WORK SCHEDULE included at the end of this section.

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-DALT/TAB Meeting: Within 30 calendar days after the date of approval of the TAB agency and personnel, meet with the COTR.

Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.

Pre-Field DALT Preliminary Notification: On completion of the duct installation for each system, notify the Contracting Officer in writing within 5 days after completion.

Ductwork Selected for DALT: Within 7 calendar days of Pre-Field DALT Preliminary Notification, the COTR will select which of the project ductwork must be DALT'd.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected.

Submit Pre-final DALT Report: Within one working day after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final
DALT reports may be submitted to allow phased testing from system to system.

DALT Work Field Check: Upon approval of the Pre-final DALT Report, schedule the COTR's DALT field check work with the Contracting Officer.

Submit Final DALT Report: Within 15 calendar days after completion of successful DALT Work Field Check, submit Season 1 TAB report.

Pre-Field TAB Engineering Report: Within 30 calendar days after approval of the TAB agency Personnel Qualifications, submit the Pre-Field TAB Engineering Report.

Prerequisite HVAC Work Check Out List For Season 1 and Advanced Notice For Season 1 TAB Field Work: At a minimum of 115 calendar days prior to CCD, submit Season 1 prerequisite HVAC work check out list certified as complete, and submit advance notice of commencement of Season 1 TAB field work.

Season 1 TAB Field Work: At a minimum of 90 calendar days prior to CCD, and when the ambient temperature is within Season 1 limits, accomplish Season 1 TAB field work.

Submit Season 1 TAB Report: Within 15 calendar days after completion of Season 1 TAB field work, submit Season 1 TAB report.

Season 1 TAB Field Check: 30 calendar days after Season 1 TAB report is approved by the Contracting Officer, conduct Season 1 field check.

Complete Season 1 TAB Work: Prior to CCD, complete all TAB work except Season 2 TAB work.

Prerequisite HVAC Work Check Out List For Season 2 and Advanced Notice For Season 2 TAB Field Work: Within 150 calendar days after date of the commencement of the Season 1 TAB field work, submit the Season 2 prerequisite HVAC work check out list certified as complete and submit advance notice of commencement of Season 2 TAB field work.

Season 2 TAB Field Work: Within 180 calendar days after date of commencement of the Season 1 TAB field work and when the ambient temperature is within Season 2 limits, accomplish Season 2 TAB field work.

Submit Season 2 TAB Report: Within 15 calendar days after completion of Season 2 TAB field work, submit Season 2 TAB report.

Season 2 TAB Field Check: 30 calendar days after the Season 2 TAB report is approved by the Contracting Officer, conduct Season 2 field check.

Complete Season 2 TAB Work: Within 15 calendar days after the completion of Season 2 TAB field data check, complete all TAB work.

a. TAB Design Review Report

Submit typed report describing omissions and deficiencies in the HVAC system's design or contractor coordination effort 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.

b. Pre-Field DALT Preliminary Notification

Notification: On completion of the installation of each duct system indicated to be DALT'd, notify the Contracting Officer in writing within 7 calendar days after completion.

1.5.3.2 TAB Pre-Field 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 contractor coordination drawings 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) Hydronic and Potable Water System Diagrams: Use the coordination drawings to provide hydronic and potable water system diagrams in the report showing the location of all balancing devices and flow meters. Use a key numbering system on the diagrams which identifies each balancing device contained in the waterflow report sheets.

(4) 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.

1.5.4 Subcontractor Special Requirements

Perform all work in this section in accordance with the paragraph SUBCONTRACTOR SPECIAL REQUIREMENTS in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS, stating that all contract requirements of this section must be accomplished directly by a first tier subcontractor. No work may be performed by a second tier subcontractor.

1.5.5 Instrument Calibration Certificates

It is the responsibility of the TAB firm to provide instrumentation that meets the minimum requirements of the standard under which the TAB Firm's qualifications are approved for use on a project. Instrumentation must be in proper operating condition and must be applied in accordance with the instrumentation's manufacturer recommendations.

All instrumentation must bear a valid NIST traceable calibration certificate during field work and during government acceptance testing. All instrumentation must be calibrated within no later than one year of the date of TAB work or government acceptance testing field work.

1.5.6 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.
1.5.7 Sustainability

Contractor must submit the following as part of the Quality Control Plan for acceptance testing:

a. List all test equipment to be used, including its manufacturer, model number, calibration date, and serial number.

b. Certificates of test personnel qualifications and certifications. Provide certification of compliance with 40 CFR 82.

c. Proof of equivalency if the contractor desires to substitute a test requirement.

1.5.8 Test Reports

1.5.8.1 Data from DALT Field Work

Report the data for the Pre-final DALT Report and Certified Final DALT Report in compliance with 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.

1.5.8.2 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:

(1) LAB X-ray or RAD rooms.

(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 Season I and Season 2 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.

d. Static Pressure Profiles: Report static pressure profiles for air duct systems including each air handling unit; per component and each exhaust fan. Report static pressure data for all supply, return, exhaust and outside air ducts for the systems listed. Include the following in the static pressure report data, in addition to AABC/NEBB/TABB required data:

(1) Report supply fan, and exhaust fan inlet and discharge static pressures.

(2) Report static pressure drop across chilled water coils, and hot water coils, installed in air handling units or the system ductwork.

(3) Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and two-position, installed in air handling units.

(4) Report static pressure drop across air filters, air flow measuring stations or other pressure drop producing specialty items installed in the air handling unit, or in the system ductwork. Examples of these specialty items are smoke detectors, security bars, and duct mounted humidifiers.

Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

(5) Report static pressure drop across outside air and exhaust air louvers.

(6) Report static pressure readings of supply air, return air,
exhaust air, and outside air in duct at the point where these ducts connect to each air handling unit and also at the following locations:

**Main Supply, Return and Exhaust Duct:** Take readings at four locations along the full length of the main duct, 25 percent, 50 percent, 75 percent, and 100 percent of the total duct length.

**VAV Terminals:** Take readings at inlet static pressure at VAV terminal unit inlet ducts.

e. **Duct Traverses:** Report duct traverses for main supply, return, exhaust, and outside air ducts. This includes all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency must evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pilot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

f. **Instruments:** List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings must provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

g. **Certification:** Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

h. **Performance Curves:** The TAB Supervisor must include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job. Identify the prime mover impeller type and diameter for each.

i. **Calibration Curves:** The TAB Supervisor must include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturi's and flow orifices TAB'd on the job.

1.6 **Warranty**

Furnish workmanship and performance warranty for the DALT and TAB system work performed for a period not less than 2 years from the date of Government acceptance of the work; issued directly to the Government. Include provisions that if within the warranty period the system shows evidence of major performance deterioration, or is significantly out of tolerance, resulting from defective TAB or DALT workmanship, the corrective repair or replacement of the defective materials and correction of the defective workmanship is the responsibility of the TAB Agency. Perform corrective action that becomes necessary because of defective materials and workmanship while system TAB and DALT is under warranty 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the TAB Agency.
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 PRE-DALT/TAB MEETING

Meet with the Contracting Officer's technical representative (COTR) and the designing engineer of the HVAC systems to develop a mutual understanding relative to the details of the DALT work and TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

3.3 DALT PROCEDURES

3.3.1 Instruments, Consumables and Personnel

Provide instruments, consumables and personnel required to accomplish the DALT field work. Follow the same basic procedure specified below for TAB Field Work, including maintenance and calibration of instruments, accuracy of measurements, preliminary procedures, field work, workmanship and treatment of deficiencies. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

3.3.2 Advance Notice of Pre-Final DALT Field Work

On completion of the installation of each duct system indicated to be DALT’d, notify the Contracting Officer in writing prior to the COTR's duct selection field visit.

3.3.3 Ductwork To Be DALT'd

Leak test the HVAC air ducts and sections of each system based on criteria scheduled on the Contract Drawings. Accomplish leak tests in accordance with SMACNA HVACADLTM, except as modified by this section. Use the duct class, seal class, leakage class and the leak test pressure data indicated, to comply with the procedures specified in SMACNA HVACADLTM. Provide testing fan, calibrated flow meter, instruments and consumables required to accomplish the DALT field work. Follow the same basic, procedure specified below in paragraph "TAB Field Work," including maintenance of and calibration of instruments, accuracy of measurements, preliminary procedures, field work, workmanship and treatment of deficiencies. DALT field work shall be monitored by the Contractor QC representative and the TAB team supervisor. If any of the duct sections exceed the leakage class during testing repairs shall be conducted. Provide retesting of ductwork until leakage rate is brought into compliance. Charges for retesting and observation of retesting shall be borne by the ductwork installer.
3.3.4 DALT Testing

Use the duct class, seal class, leakage class and the leak test pressure data indicated on the drawings, to comply with the procedures specified in SMACNA 1972 CD.

In spite of specifications of SMACNA 1972 CD to the contrary, DALT ductwork of construction class of 3-inch water gauge static pressure and below is required if scheduled on the contract drawings to be DALT’d. Separately conduct DALT work for large duct systems to enable the DALT work to be completed.

3.3.5 Completed Pre-Final DALT Report

After completion of the DALT work, prepare a Pre-final DALT Report meeting the additional requirements specified in Appendix B REPORTS - DALT and TAB. Data required by those data report forms shall be furnished by the TAB team. Prepare the report neatly and legibly; the Pre-final DALT report shall provide the basis for the Final DALT Report.

TAB supervisor shall review, approve and sign the Pre-Final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the COTR that the field check of the Pre-Final DALT Report data can commence.

3.3.6 Quality Assurance - COTR DALT Field Acceptance Testing

In the presence of the COTR and TAB team field leader, verify for accuracy Pre-final DALT Report data selected by the COTR. For each duct system, this acceptance testing shall be conducted on a maximum of 50 percent of the duct sections DALT’d.

Further, if any data on the Pre-final DALT report form for a given duct section is out-of-tolerance, then field acceptance testing shall be conducted on data for one additional duct section, preferably in the same duct system, in the presence of the COTR.

3.3.7 Additional COTR Field Acceptance Testing

If any of the duct sections checked for a given system are determined to have a leakage rate measured that exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction class and sealant class, terminate data checking for that section. The associated Pre-final DALT Report data for the given duct system will be disapproved. Make the necessary corrections and prepare a revised Pre-final DALT Report. Reschedule a field check of the revised report data with the COTR.

3.3.8 Certified Final DALT Report

On successful completion of all field checks of the Pre-Final DALT Report data for all systems, the TAB Supervisor shall assemble, review, approve, sign and submit the Final DALT Report in compliance with Appendix B REPORTS - DALT and TAB to the Contracting Officer for approval.

3.3.9 Prerequisite for TAB Field Work

Do not commence TAB field work prior to the completion and approval, for all systems, of the Final DALT Report.
3.4 TAB PROCEDURES

3.4.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. That is, comply with the the requirements of AABC MN-1 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.

Unless noted otherwise, test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates indicated on the contract documents. For outdoor air quantities at each air handling unit, TAB tolerance shall be within plus 10% / minus 0% of the air quantity scheduled. For the exhaust fan air quantity summary related to each air handling unit, TAB tolerance shall be within plus 0% / minus 10% of the summary. TAB shall adjust systems and certify that the facility is under a positive air pressure in relation to the outdoors with air handling unit at the full air quantity scheduled, and at VAV turndown.

TAB air system main, sub-main and branch duct dampers, in addition to adjusting prime movers and air terminal units to acquire airflows indicated. Use dampers at diffusers and registers only if performance cannot be detained by means described above. Balance prime movers through sheave and belt adjustment unless prime mover is equipped with direct drive. Balancing of belt-drive prime movers through variable frequency drive adjustment, without sheave and belt changes is not acceptable.

Conduct TAB work, including measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES and NEBB MASV, or SMACNA 1780 (used by TABB) and SMACNA 1858 sound measurement procedures, except as supplemented and modified by this section. The only water flow and air flow reporting which can be deferred until the Season 2 is that data which would be affected in terms of accuracy due to outside ambient conditions.

3.4.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. TAB engineer is to locate, in the field, test ports required for testing. It is the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

3.4.3 TAB Air Distribution Systems

3.4.3.1 Units With Coils

Report heating and cooling performance capacity tests for hot water, and chilled water, coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For air handlers conduct capacity tests in accordance with AABC MN-4,
procedure 3.5, "Coil Capacity Testing."

Do not determine entering and leaving wet and dry bulb temperatures by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For VAV terminal units, and unitary equipment, such as ductless split systems.

Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.3.2 Air Handling Units

Air handling unit systems including fans (air handling unit fans, exhaust fans, coils, ducts, plenums, mixing boxes, variable air volume air terminal units, and diffusers, registers and grilles, fume hoods and exhaust canopies for supply air, return air, and exhaust air.

3.4.3.3 Ductless Split System Fan Coils

Fan coil unit systems including fans, coils.

3.4.3.4 Exhaust Fans

Exhaust fan systems including fans, ducts, plenums, registers, exhaust canopies, and hoods for exhaust air.

3.4.3.5 Unit Heaters

Unit heater systems including fans and coils.

3.4.4 TAB Water Distribution Systems

3.4.4.1 Chilled Water

Chilled water systems including chillers, pumps, coils, manual balancing valves and flow measuring devices.

For water chillers, report data as required by AABC, NEBB and TABB standard procedures, including refrigeration operational data.

3.4.4.2 Heating Hot Water

Heating hot water systems including boilers, pumps, coils, manual balancing valves and flow measuring devices.

3.4.4.3 Potable Water Heating Systems

Potable hot water recirculation systems including pumps and system
3.4.5 Sound Measurement Work

3.4.5.1 Areas To Be Sound Measured

In the following spaces, with equipment operating at peak scheduled conditions, measure and record the sound power level for each octave band listed in ASHRAE HVAC APP IP HDBK Noise Criteria:

a. All HVAC mechanical rooms, including machinery spaces and other spaces containing HVAC power drivers and power driven equipment.
b. All spaces sharing a common barrier with each mechanical room, including rooms overhead, rooms on the other side of side walls, and rooms beneath the mechanical room floor.
c. Each space sharing a common barrier with an audio sound booth.

3.4.5.2 Procedure

Measure sound levels in each room, when unoccupied except for the TAB team, with all HVAC systems that would cause sound readings in the room operating in their noisiest mode. Record the sound level in each octave band. Attempt to mitigate the sound level and bring the level to within the specified ASHRAE HVAC APP IP HDBK noise criteria goals, if such mitigation is within the TAB team’s control. State in the report the ASHRAE HVAC APP IP HDBK noise criteria goals. If sound level cannot be brought into compliance, provide written notice of the deficiency to the Contractor for resolution or correction.

3.4.5.3 Timing

Measure sound levels at times prescribed by AABC or NEBB or TABB.

3.4.5.4 Meters

Measure sound levels with a sound meter complying with ASA S1.4, Type 1 or 2, and an octave band filter set complying with ASA S1.11 PART 1. Use measurement methods for overall sound levels and for octave band sound levels as prescribed by NEBB.

3.4.5.5 Calibration

Calibrate sound levels as prescribed by AABC or NEBB or TABB, except that calibrators emitting a sound pressure level tone of 94 dB at 1000 hertz (Hz) are also acceptable.

3.4.5.6 Background Noise Correction

Determine background noise component of room sound (noise) levels for each (of eight) octave bands as prescribed by AABC or NEBB or TABB.

3.4.6 TAB Work on Performance Tests With Seasonal Limitations

3.4.6.1 Performance Tests

Accomplish proportional balancing TAB work on the air distribution systems and water distribution systems, in other words, accomplish adjusting and
balancing of the air flows and water flows, any time during the duration of this contract, subject to the limitations specified elsewhere in this section. However, accomplish, within the following seasonal limitations, TAB work on HVAC systems which directly transfer thermal energy.

3.4.6.2 Season Of Maximum Load

Visit the contract site for at least two TAB work sessions for Season 1 and Season 2 field measures. Visit the contract site during the season of maximum heating load and visit the contract site during the season of maximum cooling load, the goal being to TAB the operational performance of the heating systems and cooling systems under their respective maximum outdoor environment-caused loading. During the seasonal limitations, TAB the operational performance of the heating systems and cooling systems.

3.4.6.3 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.

3.4.6.4 Sound Measurements

Comply with the paragraph SOUND MEASUREMENT WORK, specifically, the requirement that a room must be operating in its noisiest mode at the time of sound measurements in the room. The maximum noise level measurements could depend on seasonally related heat or cooling transfer equipment.

3.4.7 Water Chillers

Water chillers: For water chillers, report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.8 Refrigeration Units

For refrigeration compressors/condensers/condensing units, report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.9 Coils

Report heating and cooling performance capacity tests for hot water, chilled water, and DX coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For Central station air handlers, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

   Entering and leaving wet and dry bulb temperatures are not determined by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

   Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the
purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For VAV terminal units, and unitary equipment, and ductless split systems.

Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

### 3.4.10 Workmanship

Conduct TAB work on the HVAC systems until measured flow rates are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. This TAB work includes adjustment of balancing valves, balancing dampers, and sheaves. Further, this TAB work includes changing out fan sheaves and pump impellers if required to obtain air and water flow rates specified or indicated. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, contact the Contracting Officer for direction.

### 3.4.11 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 WORKMANSHIP, provide written notice as soon as possible to the Contractor and the Contracting Officer describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

### 3.4.12 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 "Workmanship."

After completion of the TAB work, prepare a pre-final TAB report using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship" of this section.

Prepare the report neatly and legibly; the pre-final TAB report is the
final TAB report minus the TAB supervisor's review and certification. Obtain, at the contract site, the TAB supervisor's review and certification of the TAB report.

3.4.13 Quality Assurance - COTR TAB Field Acceptance Testing

3.4.13.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COTR, random selections of data (water, air quantities, air motion, sound level readings) recorded in the TAB Report. Points and areas for field acceptance testing are to be selected by the COTR. Measurement and test procedures are the same as approved for TAB work for the TAB Report.

Field acceptance testing includes verification of TAB Report data recorded for the following equipment groups:

Group 1: Each chiller, boiler, exhaust fan, and air handling unit, ductless split system and hydronic pump.

Group 2: 25 percent of the VAV air terminal units and associated diffusers and registers.

Group 4: 25 percent of the return registers, and exhaust registers.

Group 5: 25 percent of the supply fans, exhaust fans, and pumps.

Further, if any data on the TAB Report for Groups 2 through 5 is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, additional group data verification is required in the presence of the COTR. Verify TAB Report data for one additional piece of equipment in that group. Continue this additional group data verification until out-of-tolerance data ceases to be found.

3.4.13.2 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.

3.4.13.3 Prerequisite for Approval

Compliance with the field acceptance testing requirements of this section is a prerequisite for the final Contracting Officer approval of the TAB Report submitted.

3.5 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, gauges, splitters, and dampers so that adjustment can be restored if disturbed at any time. Provide permanent markings clearly indicating the settings on the adjustment devices which result in the data reported on the submitted TAB report.
3.6 MARKING OF TEST PORTS

The TAB team is to permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, make these markings on the exterior side of the duct insulation. Show the location of test ports on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

3.7 APPENDICES

Appendix A  WORK DESCRIPTIONS OF PARTICIPANTS
Appendix B  REPORTS - DALT and TAB
Appendix C  DALT AND TAB SUBMITTAL AND WORK SCHEDULE
Appendix 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 Agency, 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 Agency. Provide the TAB Agency copies of contract revisions and modifications as they occur.

   b. Schedules: Ensure the requirements specified under the paragraph "DALT and TAB Schedule" are met.

   c. Pre-DALT and TAB meeting: Arrange and conduct the Pre-DALT and TAB meeting. Ensure that a representative is present for the sheet metal contractor, the mechanical contractor, the electrical contractor, and the automatic temperature controls contractor.

   d. Coordinate Support: Provide and coordinate support personnel required by the TAB Agency in order to accomplish the DALT and TAB field work. Support personnel may include factory representatives, HVAC controls installers, HVAC equipment mechanics, sheet metal workers, pipe fitters, and insulators. Ensure support personnel are present at the work site at the times required.

   e. Correct Deficiencies: Ensure the notifications of Construction Deficiencies are provided as specified herein. Refer to the paragraph CONSTRUCTION DEFICIENCIES. Correct each deficiency as soon as practical with the Contracting Officer, and submit revised schedules and other required documentation.

   f. Pre-TAB Work Checklists: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as pre-TAB work checklist items, the deficiencies pointed out by the TAB team supervisor in the design review report.

      Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's DALT and TAB Work Procedures Summary. Do not allow the TAB team to commence TAB field work until all of the following are completed.

   g. Give Notice of Testing: Submit advance notice of proportional balancing, Season 1, and Season 2 TAB field work accompanied by completed prerequisite HVAC Work List
h. Insulation work: Ensure that no insulation is shall not be installed on ducts to be DALT'd until DALT work on the subject ducts is complete. Ensure the duct and piping systems are properly insulated and vapor sealed upon the successful completion and acceptance of the DALT and TAB work.

2. TAB Team Supervisor
a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.

b. Schedule: Ensure the requirements specified under the paragraph "DALT and TAB Schedule" are met.

c. Submittals: Provide the submittals specified herein.

d. Pre-DALT/TAB meeting: Attend meeting with Contractor. Ensure TAB personnel that will be involved in the TAB work under this contract attend the meeting.

e. Design Review Report: Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

f. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the DALT and TAB Procedures Summary, the during the DALT or TAB field work.

Ensure the Contractor is properly notified and aware of all support personnel needed to perform the TAB work. Maintain communication with the Contractor regarding support personnel throughout the duration of the TAB field work, including the TAB field acceptance testing checking.

Ensure all inspections and verifications for the Pre-Final DALT and Pre-TAB Checklists are completely and successfully conducted before DALT and TAB field work is performed.

g. Advance Notice: Monitor the completion of the duct system installations and provide the Advance Notice for Pre-Final DALT field work as specified herein.

h. Technical Assistance: Provide technical assistance to the DALT and TAB field work.

i. Deficiencies Notification: Ensure the notifications of Construction Deficiencies are provided as specified herein. Comply with requirements of the paragraph CONSTRUCTION DEFICIENCIES. Resolve each deficiency as soon as practical and submit revised schedules and other
required documentation.

j. Procedures: Develop the required TAB procedures for systems or system components not covered in the TAB Standard.

3. TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, EXECUTION.

b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC work list, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.
Appendix B

REPORTS - DALT and TAB

All submitted documentation must be typed, neat, and organized. All reports must have a waterproof front and back cover, a title page, a certification page, sequentially numbered pages throughout, and a table of contents. Tables, lists, and diagrams must be titled. Generate and submit for approval the following documentation:

1. DALT and TAB Work Execution Schedule

Submit a detailed schedule indicating the anticipated calendar date for each submittal and each portion of work required under this section. For each work entry, indicate the support personnel (such as controls provider, HVAC mechanic, etc.) that are needed to accomplish the work. Arrange schedule entries chronologically.

2. DALT and TAB Procedures Summary

Submit a detailed narrative describing all aspects of the DALT and TAB field work to be performed. Clearly distinguish between DALT information and TAB information. Include the following:

a. A list of the intended procedural steps for the DALT and TAB field work from start to finish. Indicate how each type of data measurement will be obtained. Include what Contractor support personnel are required for each step, and the tasks they need to perform.

b. A list of the project's submittals that are needed by the TAB Firm in order to meet this Contract's requirements.

c. The schematic drawings to be used in the required reports, which may include building floor plans, mechanical room plans, duct system plans, and equipment elevations. Indicate intended TAB measurement locations, including where test ports need to be provided by the Contractor.

d. The data presentation forms to be used in the report, with the preliminary information and initial design values filled in.

e. A list of DALT and TAB instruments to be used, edited for this project, to include the instrument name and description, manufacturer, model number, scale range, published accuracy, most recent calibration date, and what the instrument will be used for on this project.

f. A thorough checklist of the work items and inspections that need to be accomplished before DALT field work can be performed. The Contractor must complete, submit, and receive approval of the Completed Pre-Final DALT Work Checklist before DALT field work can be accomplished.

g. A thorough checklist of the work items and inspections that need to be accomplished before the Season 1 TAB field work can be performed. The Contractor must complete, submit, and receive approval of the Completed Season 1 Pre-TAB Work Checklist before the Season 1 TAB field work can be accomplished.

h. A thorough checklist of the work items and inspections that need to be
accomplished before the Season 2 TAB field work can be performed. The Contractor must complete, submit, and receive approval of the Completed Season 2 Pre-TAB Work Checklist before the Season 2 TAB field work can be accomplished.

i. The checklists specified above shall be individually developed and tailored specifically for the work under this contract. Refer to NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under the paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" for examples of items to include in the checklists.

3. Design Review Report

Submit report containing the following information:

a. Review the contract specifications and drawings to verify that the TAB work can be successfully accomplished in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, balancing valves, motor actuated valves and dampers and manual volume dampers.

b. Submit a typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the DALT work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. If no deficiencies are evident, state so in the report.

4. Completed Pre-Final DALT Work Checklist

Report the data for the Pre-Final DALT Report meeting the following requirements:

a. Submit a copy of the approved DALT and TAB Procedures Summary: Provide notations describing how actual field procedures differed from the procedures listed.

b. Report format: Submit a comprehensive report for the DALT field work data using data presentation forms equivalent to the "Air Duct Leakage Test Summary Report Forms" located in the SMACNA 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. Node numbers shall be included in the completed report forms to identify each duct section.

c. Calculations: Include a copy of all calculations prepared in determining the duct surface area of each duct test section. Include in the DALT reports copy(s) of the calibration curve for each of the DALT test orifices used for testing.

d. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument’s unique identification number, calibration date, and calibration expiration date. Instruments are to be calibrated within one year of the date of use in the field; instrument calibration is to be traceable to the measuring standards of the National Institute of Standards and Technology.
e. TAB Supervisor Approval: Include on the submitted report the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

5. Final DALT Report

On successful completion of all COTR field checks of the Pre-final DALT Report data for all systems, the TABS Supervisor shall assemble, review, sign and submit the Final DALT Report to the Contracting Officer for approval.

6. TAB Reports: Submit TAB Report for Proportional Balancing, Season 1, and Season 2 in the following manner:

a. Procedure Summary: Submit a copy of the approved DALT and TAB Procedures Summary. When applicable, provide notations describing how actual field procedures differed from the procedures listed.

b. Report format: Submit the completed data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed, approved and signed by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data shall be typewritten. Handwritten report forms or report data are not acceptable.

c. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as hereinbefore specified:

   (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 Season I TAB Report Season I and Season 2 TAB Report.

d. Air System Diagrams: Provided updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations.

e. Air Static Pressure Profiles: Report static pressure profiles for air duct systems including each air handling unit; per component and each exhaust fan. Report static pressure data for all supply, return,
relief, exhaust and outside air ducts for the systems listed. The static pressure report data shall include, in addition to AABC or NEBB or TABB required data, the following:

(1) Report supply fan, and exhaust fan inlet and discharge static pressures.

(2) Report static pressure drop across chilled water coils, DX coils, hot water coils, installed in air handling units or the system ductwork.

(3) Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and two-position, installed in air handling units.

(4) Report static pressure drop across air filters, air flow measuring stations or other pressure drop producing specialty items installed in the air handling unit, or in the system ductwork. Examples of these specialty items are smoke detectors, security bars, and duct mounted humidifiers.

Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

(5) Report static pressure drop across outside air and exhaust air louvers.

(6) Report static pressure readings of supply air, return air, exhaust air, and outside air in duct at the point where these ducts connect to each air handling unit.

f. Duct Transverses: Report duct traverses for main supply, return, exhaust, and outside air ducts. This shall include all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency shall evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pitot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane".

g. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument’s unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings shall provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

h. Performance Curves: The TAB Supervisor shall include, in the TAB Reports, factory pump curves and fan curves for pumps and fans for both the design and final TAB’d condition.

i. Calibration Curves: The TAB Supervisor shall include, in the TAB Reports, a factory calibration curve for installed flow control
balancing valves, flow venturis and flow orifices TAB'd on the job.

j. Data From TAB Field Work: After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and approval signature, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms shall be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph WORKMANSHIP.
Appendix C

DALT AND TAB SUBMITTAL AND WORK SCHEDULE

Perform the following items of work in the order listed adhering to the dates schedule specified below. Include the major items listed in this schedule in the project network analysis schedule required by Section 01 32 17.00 20 COST-LOADED NETWORK ANALYSIS SCHEDULES (NAS).

Submit TAB Agency and TAB Personnel Qualifications: Within 45 calendar days after date of contract award.

Submit the DALT and TAB Work Execution Schedule: within 14 days after receipt of the TAB agency and TAB personnel qualifications approval. Revise and re-submit this schedule 28 days prior to commencement of DALT work and 28 days prior to the commencement of TAB Season 1 work and TAB Season 2 work.

Submit the DALT and TAB Work Procedures Summary: within 14 days after receipt of the initial approved DALT and TAB Work Execution Schedule.

Meet with the COTR at the Pre-DALT/TAB Meeting: Within 28 calendar days after receipt of the approved initial DALT/TAB Execution Schedule.

Submit Design Review Report: Within 60 calendar days after the receipt of the approved initial DALT and TAB Work Execution Schedule.

Advance Notice of Pre-Final DALT Field Work: After the completed installation of the HVAC duct system to be DALT'd, submit to the Contracting Officer an Advance Notice of Pre-Final DALT Field Work accompanied by the completed Pre-Final DALT Work Checklist for the subject duct system.

Ductwork Selected for DALT: Within 14 calendar days after receiving an acceptable completed Pre-Final DALT Work Checklist, the Contracting Officer's technical representative (COTR) will select the project ductwork sections to be DALT'd.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected project ductwork.

Submit Pre-Final DALT Report: Within two working days after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

Quality Assurance - COTR DALT Field Checks: Upon approval of the Pre-final DALT Report, the COTR's DALT field check work shall be scheduled with the Contracting Officer.

Submit Final DALT Report: Within 15 calendar days after completion of successful DALT Work Field Check, submit Season 1 TAB report.

Advance Notice of Season 1 TAB Field Work: At a minimum of 14 calendar days prior to Season 1 TAB Field Work, submit advance notice of TAB field work accompanied by completed Season 1 Pre-TAB Work Checklist.
Season 1 TAB Field Work: At a minimum of 90 calendar days prior to CCD, and when the ambient temperature is within Season 1 limits, accomplish Season 1 TAB field work.

Submit Season 1 TAB Report: Within 15 calendar days after completion of Season 1 TAB field work, submit initial Season 1 TAB report.

Season 1 Quality Assurance - COTR TAB Field Check: 30 calendar days after initial Season 1 TAB report is approved by the Contracting Officer, conduct Season 1 field check.

Complete Season 1 TAB Work: Prior to CCD, complete all TAB work except Season 2 TAB work and submit final.

Receive the approved TAB report: Within 21 calendar days, receive the report from Contracting Officer approved TAB report.

Advance Notice of Season 2 TAB Field Work: At a minimum of 166 calendar days after CCD, submit advance notice of Season 2 TAB field work accompanied by completed Season 2 Pre-TAB Work Checklist.

Season 2 TAB Field Work: Within 90 calendar days after date of advance notice of Season 2 TAB field work and when the ambient temperature is within Season 2 limits, accomplish Season 2 TAB field work.

Submit Season 2 TAB Report: Within 15 calendar days after completion of Season 2 TAB field work, submit Season 2 TAB report.

Season 2 Quality Assurance - COTR TAB Field Checks: 28 calendar days after the Season 2 TAB report is approved by the Contracting Officer, conduct Season 2 field check.

Complete Season 2 TAB Work: Within 15 calendar days after the completion of Season 2 TAB field data check, complete all TAB work.

Receive the approved TAB report: Within calendar 21 days, receive the report from Contracting Officer.

3.8 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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 A167

ASTM A580/A580M

ASTM B209

ASTM C1136

ASTM C1290
(2011) Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts

ASTM C1710

ASTM C195

ASTM C450

ASTM C534/C534M
Thermal Insulation in Sheet and Tubular Form


ASTM C612 (2014) Mineral Fiber Block and Board Thermal Insulation


ASTM E2231 (2015) Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics


FM GLOBAL (FM)

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. This Section applies to Division 22 Plumbing and Division 23, Heating, Ventilating and Air Conditioning of this project specification, unless specified in the individual section.

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:

<table>
<thead>
<tr>
<th>Material</th>
<th>Recycled Material Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock Wool</td>
<td>75 percent slag of weight</td>
</tr>
<tr>
<td>Fiberglass</td>
<td>20-25 percent glass cullet by weight</td>
</tr>
<tr>
<td>Rigid Foam</td>
<td>9 percent recovered material</td>
</tr>
</tbody>
</table>

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:

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; G
Duct Insulation Systems; G
Equipment Insulation Systems; G

A complete list of materials for each piping, duct and equipment installation requiring insulation, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. Submit a schedule indicating the insulation application, manufacturer's product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each type of pipe, duct and equipment insulation. The product data must be copyright, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section of the specification shall be submitted together in a booklet. Annotate the product data to indicate which MICA plate is applicable.

SD-08 Manufacturer's Instructions

Pipe Insulation Systems; G
Duct Insulation Systems; G
Equipment Insulation Systems; G

Submit a booklet containing manufacturer's published installation instructions for the insulation systems in coordination with the details on the Contract Drawings. Annotate their installation
instructions to indicate which product data plate are applicable. The instructions must be copywrited, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation.

SD-11 Closeout Submittals

Reduce Volatile Organic Compounds (VOC) for Caulking, Sealant and Adhesive Materials; S
Recycled Content for Pipe and Ductwork Insulation Materials; S

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

For products in this section, where applicable and to extent allowed by performance criteria, provide and document the following:

2.1.1 Reduce Volatile Organic Compounds (VOC) for Caulking, Sealant and Adhesive Materials

For interior applications, provide caulking, sealant and adhesive materials meeting the reduced VOC requirements as stated within Section 01 33 29 SUSTAINABILITY REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS (VOC).

2.1.2 Recycled Content for Pipe and Ductwork Insulation Materials

Provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REPORTING that the following products meet the recycled content requirements as outlined in this section:

a. Pipe Insulation Systems
b. Duct Insulation Systems
c. Equipment Insulation Systems
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 SD-02 Submittal.

2.2.1 Insulation System

Provide insulation systems in accordance with the approved MICA National Insulation Standards plates, manufacturer installation recommendations and as supplemented by this specification. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems, HVAC and plumbing piping systems and equipment that are located within, on, under, and adjacent to buildings. 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 indicated and as a minimum 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 cloth 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 0.025 inch thick aluminum 1 by 1 inch shop fabricated. 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 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 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an anti-microbial additive. Note that tape products are not an acceptable substitute for field-applied mastic-imbedded cloth products where cloth product installations are indicated.

2.3.7 Staples

Outward clinching type monel ASTM A167, Type 304 or 316 stainless steel.

2.3.8 Jackets

2.3.8.1 Aluminum Jackets

Aluminum jackets shall be smooth sheet, minimum 0.016 inch nominal thickness; ASTM B209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105. Aluminum jackets shall not be embossed with corrugations or a stippled surface. 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.

2.3.8.2 Vapor Barrier/Vapor Retarder

Apply the following criteria to determine which system is required.

a. On ducts, piping and equipment operating below 60 degrees F or located outside shall be equipped with a vapor barrier.

2.3.9 Vapor Retarder Required

ASTM C921, Type I, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require 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.

2.3.9.1 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.

2.3.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

2.3.9.2.1 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.

2.3.9.2.2 Vapor Retarder

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be 0.013 perms or less at 43 mils dry film thickness as determined according to procedure B of ASTM E96/E96M utilizing apparatus described in ASTM E96/E96M. The coating shall be nonflammable, fire resistant type. To resist mold/mildew, coating shall meet ASTM D5590 with 0 growth rating. Coating shall meet MIL-PRF-19565 Type II (if selected for indoor service) and be Qualified Products Database listed. All other application and service properties shall be in accordance with ASTM C647.

2.3.9.3 Laminated Film Vapor Retarder

 ASTM C1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork; where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable. Vapor retarder shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible Elastomeric exterior foam with factory applied UV Jacket. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and an excellent WVT rate.

2.3.9.4 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 TAPPI T403 OM or ISO 2758. Tensile strength 68 lb/inch width (PSTC-1000). Tape shall be as specified for laminated film vapor barrier above.

2.3.10 Vapor Retarder Not Required

ASTM C921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor
transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Jacket shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.3.11 Wire

Soft annealed ASTM A580/A580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.3.12 Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge aluminum.

2.3.13 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum 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. Comply with EPA requirements for material with recycled content in accordance with Section 01 33 29 SUSTAINABILITY REPORTING, paragraph RECYCLED CONTENT. 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.

2.4.1.3 Mineral Fiber Insulation with Integral Wicking Material (MFIWM)

ASTM C547. Install in accordance with manufacturer's instructions. Do not use in applications exposed to outdoor ambient conditions in climatic zones 1 through 4.
2.4.2 Aboveground Hot Pipeline (Above 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

2.4.2.1 Mineral Fiber

ASTM C547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

2.4.3 Below-ground Pipeline Insulation

For below-ground pipeline insulation, use cellular glass, ASTM C552, type II

2.5 DUCT INSULATION SYSTEMS

2.5.1 Rigid Insulation

Rigid mineral fiber in accordance with ASTM C612, Class 2 (maximum surface temperature 400 degrees F), 3 pcf average, 1-1/2 inch thick, Type IA, IB, II, III, and IV.

2.5.1.1 Blanket Insulation

Blanket flexible mineral fiber insulation conforming to ASTM C553, Type 1, Class B-3, 3/4 pcf nominal, 2.0 inches thick or Type II up to 250 degrees F. Also ASTM C1290 Type III may be used.

2.5.2 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. Provide aluminum stainless steel bands, minimum width of 1/2 inch.

2.6 EQUIPMENT INSULATION SYSTEMS

Insulate equipment and accessories as specified in Tables 5 and 6. 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. 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

Insulation shall only be applied to unheated and uncooled piping, ductwork and equipment. Insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Display Samples

Submit and display, after approval of materials, actual sections of installed systems, properly insulated in accordance with the specification requirements. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Contracting Officer will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

3.1.1.1 Pipe Insulation Display Sections

Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

3.1.1.2 Duct Insulation Display Sections

Display sample sections for rigid and flexible duct insulation used on the job. Use a temporary covering to enclose and protect display sections for duct insulation exposed to weather.

3.1.2 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 as specified and detailed on the control drawings. Insulation shall be terminated beveled at a 45 degree angle at items not to be insulated such as nameplates, manholes, handholes, insulated access doors, factory insulated equipment, pipe terminations at equipment, and similar terminations. Cut bevels neatly and at a uniform angle; cover all raw insulation with white mastic sealer.

3.1.3 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. All other penetrations, such as piping, conduit, and wiring, through firewalls must be protected with a material or system of the same hourly rating that is listed by UL, FM, or a NRTL.

3.1.4 Painting and Finishing

Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.1.5 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 which during installation or operation the surface temperature may exceed 100 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 aluminum jacketing after the adhesive is dry and cured.

3.1.5.1 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.

3.1.5.2 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.

3.1.6 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.
3.1.7 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, and the requirements of this section.

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. Unless noted otherwise, materials used for installation shall be consistent on each piping service throughout the entire project. Cut pieces or scraps abutting each other shall not be used. All insulated piping exterior to building shall be equipped with aluminum jackets, lapped to shed water. 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 and drinking fountain draw shall have the hot water supply and drain, including the trap, insulated where exposed. Refer to section 22 00 70, PLUMBING, HEALTHCARE FACILITIES for insulation materials and installation at these locations.

c. Sanitary drain lines.

d. Air chambers.

e. Adjacent insulation.

f. ASME stamps.

g. Access plates.

h. Cleanouts or handholes.

3.2.1.2 Pipes Passing Through Walls, Roofs, Pipe Portal Roof Curbs and Floors

Where sleeves are indicated pipe insulation shall be continuous through the sleeve. Where sleeves are not indicated, pipe insulation shall be continuous through roof curb or penetration.

Provide an aluminum jacket.

3.2.1.2.1 Penetrate Interior Walls

The aluminum jacket 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 Floors

Extend the aluminum jacket from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

3.2.1.2.3 Penetrating Waterproofed Floors

Extend the aluminum jacket from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

3.2.1.2.4 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.

3.2.1.2.5 Penetrating Roofs

Insulate pipe as required for interior service to a point flush with the top of the flashing and sealed with flashing sealant. Tightly butt the insulation for exterior application to the top of flashing and interior insulation. Extend the exterior aluminum jacket 2 inches down beyond the end of the insulation to form a counter flashing. Seal the flashing and counter flashing underneath with metal jacketing/flashing sealant. Where penetrating roof curb caps, insulation shall be continuous through the roof curb and cap. Provide metal jacketing material, starting at a minimum of 10 inches below the curb cap, and extending continuously to the exterior. All piping insulation exterior to the facility shall be equipped with metal jacketing.

3.2.1.2.6 Hot Water Pipes Supplying Plumbing Fixtures

Terminate the insulation on the backside of the finished wall. Protect the insulation termination with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). Extend the coating out onto the insulation 2 inches and seal the end of the insulation. Overlap glass tape seams 1 inch. Caulk the annular space between the pipe and wall penetration with approved fire stop material. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inches.

3.2.1.2.7 Domestic Cold Water Pipes Supplying Plumbing Fixtures or Other Similar Cold Water Service

Terminate the insulation on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). Protect the insulation with two coats of weather barrier mastic (breather emulsion type weatherproof mastic impermeable to water and permeable to air) with a minimum total thickness of 1/16 inch. Extend the mastic out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and caulk the wall penetration with an approved fire stop material having vapor retarder properties. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inches.
3.2.1.3 Pipes Passing Through Hangers

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 Horizontal Pipes Larger Than 2 Inches at 60 Degrees F and Above

Supported on hangers in accordance with MSS SP-69, Section 22 00 70 PLUMBING, GENERAL PURPOSE, Section 23 23 00, REFRIGERANT PIPING and Section 23 64 26, CHILLED AND HOT WATER PIPING SYSTEMS.

3.2.1.3.2 Horizontal Pipes Larger Than 2 Inches and Below 60 Degrees F

Supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, prefabricated insulation pipe hangers, or perlite above 80 degrees F shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, cork blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the cork blocks or insulation insert. Horizontal piping larger than 2 inches and above 60 degrees F shall be equipped with a Type 39 protection saddle in accordance with MSS SP-69. Provide steel saddles for steel piping systems tack welded to piping. Provide copper saddles for copper piping systems brazed to pipe. Fill voids of the saddles with uniformly shaped strips if the specified piping insulation.

3.2.1.3.3 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. If the insulation material is specified to be other than cellular glass an insulation insert of cellular glass 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, cork 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 cork blocks 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.
3.2.1.3.4 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 Pipes in High Abuse Areas

Unless noted otherwise, in high abuse areas such as mechanical rooms, provide metallic jackets. Pipe insulation to the 6 foot level shall be protected. All insulated piping exposed in the chiller yard and within the level 1.0 mechanical room shall be provided with metal jackets regardless of height. Metal pipe jacketing shall include pipe fittings and valves.

3.2.1.6 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>
<thead>
<tr>
<th>Service</th>
<th>Material</th>
<th>Specification</th>
<th>Type</th>
<th>Class</th>
<th>VR/VB Req’d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water (Supply &amp; Return, 40 F nominal)</td>
<td>Cellular Glass</td>
<td>ASTM C552</td>
<td>II</td>
<td>2</td>
<td>Yes</td>
</tr>
<tr>
<td>Heating Hot Water Supply &amp; Return, (Max 250 F)</td>
<td>Mineral Fiber</td>
<td>ASTM C547</td>
<td>I</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>Cold Domestic Water Piping, Makeup Water Ice Machine Drain Piping &amp; Drinking Fountain Drain Piping</td>
<td>Cellular Glass</td>
<td>ASTM C552</td>
<td>II</td>
<td>2</td>
<td>No</td>
</tr>
</tbody>
</table>
TABLE 1

<table>
<thead>
<tr>
<th>Service</th>
<th>Insulation Material for Piping</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Material</td>
</tr>
<tr>
<td>Flexible Elastomeric Cellular Mineral Fiber with Wicking material</td>
<td>ASTM C547</td>
</tr>
<tr>
<td>Hot Domestic Water ISupply &amp; Recirculating Piping (Max 200 F)</td>
<td>Mineral Fiber</td>
</tr>
<tr>
<td>Refrigerant Suction Piping (35 degrees F nominal)</td>
<td>Flexible Elastomeric Cellular</td>
</tr>
<tr>
<td>Compressed Air Discharge, (201 to 250 Degrees F)</td>
<td>Mineral Fiber</td>
</tr>
<tr>
<td>Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)</td>
<td>Flexible Elastomeric Cellular</td>
</tr>
<tr>
<td></td>
<td>Cellular Glass</td>
</tr>
<tr>
<td>Condensate Drain Located Inside Building and Horizontal (Including underside of drain fitting) Sanitary Piping that collects condensate</td>
<td>Flexible Elastomeric Cellular</td>
</tr>
</tbody>
</table>

Note: VR/VB = Vapor Retarder/Vapor Barrier

TABLE 2

<table>
<thead>
<tr>
<th>Service</th>
<th>Piping Insulation Thickness (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Material</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Chilled Water (Supply &amp; Return, Piping, 40 Degrees F nominal)</td>
<td>Cellular Glass</td>
</tr>
</tbody>
</table>
## TABLE 2

Piping Insulation Thickness (inch)

<table>
<thead>
<tr>
<th>Service</th>
<th>Tube And Pipe Size (inch)</th>
<th>Material</th>
<th>&lt;1</th>
<th>1-&lt;1.5</th>
<th>1.5-&lt;4</th>
<th>4-&lt;8</th>
<th>&gt; or = &gt;8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Flexible Elastomeric Cellular</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Heating Hot Water Supply &amp; Return, (Max 250 F)</td>
<td></td>
<td>Mineral Fiber</td>
<td>1.5</td>
<td>1.5</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Cold Domestic Water Piping, Makeup Water &amp; Drinking Fountain Drain Piping</td>
<td></td>
<td>Mineral Fiber with Wicking</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flexible Elastomeric Cellular</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Hot Domestic Water Supply &amp; Recirculating Piping (Max 200 F)</td>
<td></td>
<td>Mineral Fiber</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Refrigerant Suction Piping (35 degrees F nominal)</td>
<td></td>
<td>Flexible Elastomeric Cellular</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Compressed Air Discharge, (201 to 250 Degrees F)</td>
<td></td>
<td>Mineral Fiber</td>
<td>1.5</td>
<td>1.5</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flexible Elastomeric Cellular</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Exposed Lavatory Drains, Exposed Domestic Water Piping &amp; Drains to Areas for Handicapped Personnel</td>
<td></td>
<td>Cellular Glass</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flexible Elastomeric Cellular</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)</td>
<td></td>
<td>Cellular Glass</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Condensate Drain Located Inside Building and Horizontal (Including underside of drain fitting) Sanitary Piping that collects condensate</td>
<td></td>
<td>Cellular Glass</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* 1.5, 2, 2.5, 3, 3.5
### TABLE 2

<table>
<thead>
<tr>
<th>Piping Insulation Thickness (inch)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Service</th>
<th>Tube And Pipe Size (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;1</td>
</tr>
<tr>
<td>Flexible Elastomeric Cellular</td>
<td>1</td>
</tr>
</tbody>
</table>

#### 3.2.2 Aboveground Cold Pipelines

The following cold pipelines for minus 30 to plus 60 degrees F, shall be insulated in accordance with Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

- a. Make-up water.
- b. Horizontal and vertical portions of interior roof drain systems including drain body and elbows.
- c. Refrigerant suction lines.
- d. Chilled water.
- e. Air conditioner condensate drains, including hub drain body for units above grade level floors.
- f. Domestic cold water.
- g. Ice machine and drinking fountain drains.

#### 3.2.2.1 Factory or Field applied Jacket

Except where indicated to be wicking mineral fiber. Insulation shall be covered with a factory applied vapor retarder jacket/vapor barrier. Insulation inside the building, to be protected with an aluminum jacket. The aluminum 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 mechanical rooms and receiving/logistics, aluminum jacketing shall be provided to the 6 ft level. Provide aluminum jackets on all piping exposed in the chiller yard, and the level 1.0 mechanical room regardless of height. Aluminum jacketing shall be provided continuously at pipe fittings and valves.

#### 3.2.2.2 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.

3.2.2.2.1 Longitudinal Laps of the Jacket Material

Overlap not less than 1-1/2 inches. Provide butt strips 3 inches wide for circumferential joints.

3.2.2.2 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.

3.2.2.2.3 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.

3.2.2.2.4 Staples

Coat all staples, including those used to repair factory self-seal lap systems, with a vapor retarder coating. Coat all seams, except those on factory self-seal systems, with vapor retarder coating.

3.2.2.2.5 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. Extend the patch not less than 1-1/2 inches past the break.

3.2.2.2.6 Penetrations Such as Thermometers

Fill the voids in the insulation and seal with vapor retarder coating.

3.2.2.2.7 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 field applied contact 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.

3.2.2.3 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 field applied contact adhesive.
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 modified by supplemental requirements indicated in this section, plates detailing each insulating system for each pipe, insulating system, after approval of materials and prior to applying insulation. Valves shall be insulated up to the underside of handwheels/actuators.

(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 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 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. Exterior surfaces of insulation shall be marked showing the location of unions, strainers, and check valves and manual balancing valves concealed under the insulation.

f. Provide removable metallic covers for pipeline strainers sizes 2 1/2 inches and larger as indicated on contract drawings.
3.2.2.4 Ice Machine Piping

Insulate drain piping; horizontal and vertical portions including P-trap to the point of the vent connection.

3.2.2.5 Roof Drain and Roof Conductor piping

Roof drain piping interior to buildings shall be insulated continuously from and including the roof drain body including all horizontal portions to the riser location, including the riser portion to a point below the riser elbow turned down. If the roof drain riser is offset horizontally beyond the initial riser elbow, the pipe shall be insulated from a point above the bottom elbow, through all horizontal portions, to a point below the riser turned down. Insulation is not required for horizontal portions of roof drains below the slab on grade.

3.2.3 Aboveground Hot Pipelines

3.2.3.1 General Requirements

All hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated in accordance with Table 2. This includes but is not limited to the following:

a. Domestic hot water supply & re-circulating system.

b. Heating hot water.

c. Compressed air discharge.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required underfloor systems, omit insulation on piping within and below concrete slabs.

3.2.3.2 Insulation for Fittings and Accessories

Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant. Insulation shall be marked showing the location of unions, strainers, check valves and other components that would otherwise be hidden from view by the insulation. Valves shall be insulated up to the underside of handwheel/actuators. Threaded unions do not require insulation.

3.2.3.2.1 Precut or Preformed

Place precut or preformed insulation around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

3.2.3.2.2 Rigid Preformed

Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments
shall conform to MICA Tables 12.20 "Mitered Insulation Elbow", as supplemented by the requirements of this section. Insulation terminations shall be tapered to unions and equipment at a 45 degree angle. Cover all exposed insulation surfaces with white lagging adhesive.

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, provide aluminum jackets lapped to shed water. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION in PART 3.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with 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.

a. Insulation shall be marked to indicate the locations of unions, strainers, check valves and manual balancing valves.

b. Provide removable metallic covers for pipeline strainers sizes 2 1/2 inches and larger as indicated on contract drawings.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above.

3.3 DUCT INSULATION SYSTEMS INSTALLATION

Install duct insulation systems in accordance with the manufacturer's published installation instructions and the requirements of this section. Duct insulation minimum thickness and insulation level must be as listed in Table 4. Provide insulation on ductwork, ductwork system components and accessories including sheet metal plenums, louver blank-of plates and rear surfaces of supply and return registers and diffusers.

Aluminum Corner angles shall be installed on external corners of insulation on ductwork in exposed spaces before covering with jacket.

3.3.1 Duct Insulation Minimum Thickness

Duct insulation minimum thickness in accordance with Table 4.
### Table 4 - Minimum Duct Insulation (inches)

<table>
<thead>
<tr>
<th>Duct Type</th>
<th>Minimum Insulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Air Ducts</td>
<td>2.0</td>
</tr>
<tr>
<td>Return Ducts</td>
<td>1.5</td>
</tr>
<tr>
<td>Outdoor Ducts</td>
<td>2.0</td>
</tr>
</tbody>
</table>

#### 3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Insulation and vapor retarder/vapor barrier shall be provided for the following cold air ducts and associated equipment.

- **a.** Supply ducts.
- **b.** Return air ducts.
- **c.** Outdoor air ducts.
- **d.** Flexible run-outs (field-insulated).
- **e.** Plenums.
- **f.** Duct-mounted filter sections.
- **g.** Rear surfaces of diffusers and registers.
- **h.** Linear diffuser plenums.

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 and smokewall penetrations. Unless noted otherwise, duct insulation terminating at fire dampers and combination fire/smoke dampers, shall be continuous over the damper collar and retaining angle of fire dampers and combination fire/smoke 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. Note that glass cloth and mastic jacket sealing is required without exception. Ductwork located above suspended ceilings is considered to be concealed. All other duct locations are considered to be exposed. Duct insulation shall not be compressed to a thickness of less than specified at corners and reinforcement.
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 cloth as necessary to ensure a secure seal. Staples, cloth and seams shall be coated with a brush coat of vapor retarder coating.

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 cloth and staples. Staples and cloth joints shall be sealed with a brush coat of vapor retarder coating.

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.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or cloth embedded in vapor retarder coating. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches. Mechanical fasteners shall be as corrosion resistant as G90 coated galvanized
steel, and shall indefinitely sustain a 50 lb tensile dead load test perpendicular to the duct wall. Equip longitudinal seams of square and rectangular ducts with metal corner angles.

b. Form duct insulation with minimum jacket seams. Fasten each piece of rigid insulation to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder/barrier jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors.

c. Impale insulation on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.

d. Seal joints in the insulation jacket with a 4 inch wide strip of tape. Seal taped seams with a brush coat of vapor retarder coating.

e. Ribs or standing seams in ductwork shall be covered with the same material as the ductwork.

f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a flashing sealant.

g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

3.3.3 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

3.3.4 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.3.5 Duct Exposed to Weather

3.3.5.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

3.3.5.2 Round Duct

Aluminum jacket with factory applied moisture retarder shall be applied with the joints lapped not less than 3 inches and secured with bands.
located at circumferential laps and at not more than 12 inch intervals throughout. Horizontal joints shall lap down to shed water and located at 4 or 8 o'clock position. Joints shall be sealed with metal jacketing sealant to prevent moisture penetration. Where jacketing abuts an un-insulated surface, joints shall be sealed with metal jacketing sealant.

3.3.5.3 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

3.3.5.4 Rectangular Ducts

Two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 1/16 inch minimum thickness. The exterior shall have an aluminum jacket applied, lapped to shed water.

3.3.5.5 Insulation of Intake and Discharge Air Plenums

Insulate entire plenum to the louver connection. Insulate all outdoor air intake ducts. For exhaust ducts, insulate the duct to the plenum from the point of the duct-installed motor actuated damper.

3.4 EQUIPMENT INSULATION SYSTEMS INSTALLATION

Unless noted otherwise install equipment insulation systems in accordance with the manufacturer's published installation instructions, and the requirements of this section.

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:


b. Boiler manholes.

c. Cleanouts.

d. ASME stamps.

e. Manufacturer's nameplates.

f. Duct Test/Balance Test Holes.

3.4.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Insulation shall be furnished on equipment handling media below 60 degrees F including the following:

a. Chilled water and potable cold water pumps.

b. Water chiller evaporator and accessory parts that are not factory insulated.
c. Floor/hub drain bodies (serving air conditioning condensate drains).

d. Water softeners.

e. Backflow preventers and water meters.

f. Chilled water filters.

g. Roof drain bodies.

h. Air handling equipment parts that are not factory insulated.

i. Expansion and air separation tanks.

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Material and thicknesses shall be as shown in Table 5:

<table>
<thead>
<tr>
<th>Table 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation Thickness for Cold Equipment (inches)</td>
</tr>
<tr>
<td>Equipment handling media at indicated temperature</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 to 60 degrees F</td>
<td></td>
</tr>
<tr>
<td>Cellular Glass</td>
<td>2.0</td>
</tr>
<tr>
<td>Flexible Elastomeric Cellular</td>
<td>1.5</td>
</tr>
<tr>
<td>1 to 34 degrees F</td>
<td></td>
</tr>
<tr>
<td>Cellular Glass</td>
<td>3</td>
</tr>
<tr>
<td>Flexible Elastomeric Cellular</td>
<td>1.5</td>
</tr>
<tr>
<td>Minus 30 to 0 degrees F</td>
<td></td>
</tr>
<tr>
<td>Cellular Glass</td>
<td>3.5</td>
</tr>
<tr>
<td>Flexible Elastomeric Cellular</td>
<td>1.75</td>
</tr>
</tbody>
</table>

3.4.2.2 Pump Insulation

a. Insulate pumps with cellular glass material by forming a galvanized steel or aluminum box around the pump housing internally lined with continuous insulation. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with contact adhesive for flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable. Provide
box with mechanical latches to secure box in closed, vapor tight condition.

b. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Flashing sealant shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

3.4.2.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 12 inch centers except flexible elastomeric cellular which shall be adhered with contact adhesive. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Cellular glass shall be installed in accordance with manufacturer's instructions. Joints and ends shall be sealed with joint sealant, and sealed with a vapor retarder coating.

d. Insulation on mechanically accessible openings on equipment shall be removable. Removable section joints shall be fabricated using a male-female shiplap type joint. The entire surface of the removable section shall be finished by applying two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch.

e. Exposed insulation corners shall be protected with aluminum corner angles.

f. Insulation on equipment with ribs shall be applied over 6 by 6 inches by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 by 2 inches washers or shall be securely banded or wired in place on 12 inch centers.

3.4.2.4 Vapor Retarder/Vapor Barrier

For cellular glass insulation, upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating or vapor barrier jacket shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Flashing sealant or vapor barrier tape shall be applied to parting line between equipment and removable section insulation.

3.4.3 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 60 degrees F including the following:

a. Expansion tanks.
b. Unjacketed areas of boilers and water heaters.

c. Heating system filters.

d. Pumps handling media above 110 degrees F.

e. Air separation tanks.

3.4.3.1 Insulation

Insulation shall be suitable for the temperature encountered. Heat exchangers shall be insulated for the temperature of the shell medium.

Insulation thickness for hot equipment shall be determined using Table 6:

<table>
<thead>
<tr>
<th>Equipment handling media at indicated pressure or temperature limit</th>
<th>Thickness (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td></td>
</tr>
<tr>
<td>15 psig or 250 degrees F</td>
<td>2</td>
</tr>
<tr>
<td>Rigid Mineral Fiber</td>
<td></td>
</tr>
<tr>
<td>200psig or 400 degrees F</td>
<td>3</td>
</tr>
<tr>
<td>Rigid Mineral Fiber</td>
<td></td>
</tr>
</tbody>
</table>

3.4.3.2 Insulation of Pumps

Insulate pumps by forming a galvanized steel or aluminum box around the pump housing internally lined with rigid mineral fiber insulation. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing that does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line of the removable sections and penetrations. Provide box with mechanical latches to secure box in closed and sealed condition.

3.4.3.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 12 inch center. Insulation corners shall be protected under wires and bands with aluminum corner angles.
c. Mineral fiber joints shall be filled with finishing cement.

d. Insulation on mechanically accessible flanged openings on equipment shall be removable. The removable section joint shall be fabricated using a male-female shiplap type joint. Entire surface of the removable section shall be finished as specified.

e. Exposed insulation corners shall be protected with aluminum corner angles.

f. On equipment with ribs, such as boiler flue gas connection, insulation shall be applied over 6 by 6 inch by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 by 2 inch washers or shall be securely banded or wired in place on 12 inch (maximum) centers.

g. On equipment handling media above 600 degrees F, insulation shall be applied in two or more layers with joints staggered.

h. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.4 Equipment Handling Dual Temperature Media

Below and above 60 degrees F: equipment handling dual temperature media shall be insulated as specified for cold equipment.

3.4.5 Equipment Exposed to Weather

3.4.5.1 Installation

Except for factory insulated water chiller evaporators, equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

3.5 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of 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.

U.S. GREEN BUILDING COUNCIL (USGBC)


1.2 SUMMARY

This project will have selected building systems commissioned. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CA) appointed by the Government will direct the commissioning process.

1.2.1 This Section Includes

Requirements for commissioning the HVAC systems, sub-systems and equipment. This Section supplements the general requirements specified in Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS. This section applies to Division 22 Plumbing and Division 23, Heating, Ventilating and Air Conditioning of this project specification.

1.2.2 Commissioning Activities

a. The commissioning activities have been developed to support the United States Green Building Council (USGBC) LEED™ rating program and to support delivery of project performance in accordance with the Contract Documents.

(1) Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" prerequisite of "Fundamental Building Systems Commissioning".
(2) Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" requirements for the "Enhanced Building System Commissioning" credit.
(3) Activities and documentation for the LEED™ section on "Measurement and Verification" requirements for the Measurement and Verification credit.

1.2.3 Related Sections

Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.
1.3 DEFINITIONS

Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.4 COMMISSIONED SYSTEMS

Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS for description of mechanical (HVAC and Plumbing) Systems requiring commissioning.

1.5 SUBMITTALS

a. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the Contracting Officer prior to forwarding to the Contractor. Refer to Section 01 33 00 SUBMITTAL PROCEDURES for further details.

b. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS.

1.6 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN

See Section 01 33 29 LEED(TM) DOCUMENTATION.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 SYSTEMS READINESS CHECKLISTS

The Contractor shall complete Systems Readiness Checklists to verify systems, sub-systems, and equipment installation is complete and systems are ready for Systems Functional Testing. The Commissioning Agent will prepare Systems Readiness Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to Contracting Officer and to the Commissioning Agent for review. The Commissioning Agent shall check the completed checklists. If the Commissioning Agent determines that the checklists are inaccurate, the checklists will be returned to the Contractor for correction and re-submission. Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for System Readiness Checklists, Equipment Startup Reports, and other commissioning documents.

3.2 CONTRACTOR'S TESTS

Contractor tests as required by other sections of Division 23 shall be scheduled and documented. The Commissioning Agent shall witness selected Contractor tests to minimize testing work that would otherwise be repeated. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.
3.3 FUNCTIONAL PERFORMANCE TESTING

The Commissioning Process includes Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Functional Performance Test procedures for review and approval by the Contracting Officer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will direct and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF OWNER PERSONNEL

Training of User's operation and maintenance personnel is required in cooperation with the Contracting Officer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with Contracting Officer after submission and approval of formal training plans. Refer to Section 01 91 13.00 50 GENERAL COMMISSIONING REQUIREMENTS and Division 23 Sections for additional Contractor training requirements.

3.5 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1 REFERENCES

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

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D (2012) Laboratory Methods of Testing Dampers for Rating

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


ASHRAE 135.1 (Errata 1 2015; INT 1 2013; Addenda O 2014) Method of Test for Conformance to BACnet

ARCNET TRADE ASSOCIATION (ATA)

ATA 878.1 (1999) Local Area Network: Token Bus

ASME INTERNATIONAL (ASME)


ASME B31.1 (2014; INT 1-47) Power Piping

ASME B40.100 (2013) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)


CONSUMER ELECTRONICS ASSOCIATION (CEA)


INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


IEEE C62.45 (2002; R 2008) Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)


NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ST 1 (1988; R 1994; R 1997) Specialty Transformers (Except General Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

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


UNDERWRITERS LABORATORIES (UL)

UL 1449 (2014; Reprint Mar 2015) Surge Protective Devices

UL 1778 (2014; Reprint Aug 2015) Uninterruptible Power Systems

UL 506 (2008; Reprint Oct 2013) Specialty Transformers
1.2 DEFINITIONS

1.2.1 ANSI/ASHRAE Standard 135

ANSI/ASHRAE Standard 135: BACnet - A Data Communication Protocol for Building Automation and Control Networks, referred to as "BACnet". ASHRAE developed BACnet to provide a method for diverse building automation devices to communicate and share data over a network.

1.2.2 ARCNET

ATA 878.1 - Attached Resource Computer Network. ARCNET is a deterministic LAN technology; meaning it's possible to determine the maximum delay before a device is able to transmit a message.

1.2.3 BACnet

Building Automation and Control Network; the common name for the communication standard ASHRAE 135. The standard defines methods and protocol for cooperating building automation devices to communicate over a variety of LAN technologies.

1.2.4 BACnet Building Controller (B-BC)

ASHRAE 135 building controller that is the main interface for the building control system.

1.2.5 BACnet/IP

An extension of BACnet, Annex J, defines this mechanism using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number. See also "BACnet Broadcast Management Device".

1.2.6 BACnet Internetwork

Two or more BACnet networks, possibly using different LAN technologies, connected with routers. In a BACnet internetwork, there exists only one message path between devices.

1.2.7 BACnet Network

One or more BACnet segments that have the same network address and are interconnected by bridges at the physical and data link layers.

1.2.8 BACnet Segment

One or more physical segments of BACnet devices on a BACnet network, connected at the physical layer by repeaters.
1.2.9 BBMD

BACnet Broadcast Management Device (BBMD). A communications device, typically combined with a BACnet router. A BBMD forwards BACnet broadcast messages to BACnet/IP devices and other BBMDs connected to the same BACnet/IP network. Every IP subnetwork that is part of a BACnet/IP network must have only one BBMD. See also "BACnet/IP".

1.2.10 BAS

Building Automation Systems, including DDC (Direct Digital Controls) used for facility automation and energy management.

1.2.11 BAS Manufacturer

The regional or local user responsible for managing all aspects of the BAS operation, including: network connections, workstation management, submittal review, technical support, control parameters, and daily operation.

1.2.12 BIBBs

BACnet Interoperability Building Blocks. A collection of BACnet services used to describe supported tasks. BIBBs are often described in terms of "A" (client) and "B" (server) devices. The "A" device uses data provided by the "B" device, or requests an action from the "B" device.

1.2.13 BI

BACnet International, formerly two organizations: the BACnet Manufacturers Association (BMA) and the BACnet Interest Group - North America (BIG-NA).

1.2.14 BI/BTL

BACnet International/BACnet Testing Laboratories (Formerly BMA/BTL). The organization responsible for testing products for compliance with the BACnet standard, operated under the direction of BACnet International.

1.2.15 Bridge

Network hardware that connects two or more network (or BACnet internetwork) segments at the physical and data link layers. A bridge may also filter messages.

1.2.16 Broadcast

A message sent to all devices on a network segment.

1.2.17 Device

Any control system component, usually a digital controller, that contains a BACnet Device Object and uses BACnet to communicate with other devices. See also "Digital Controller".

1.2.18 Device Object

Every BACnet device requires one Device Object, whose properties represent the network visible properties of that device. Every Device Object
requires a unique Object Identifier number on the BACnet internetwork. This number is often referred to as the device instance.

1.2.19 Device Profile

A collection of BIBBs determining minimum BACnet capabilities of a device, defined in ASHRAE Standard 135-2004, Annex L. Standard device profiles include BACnet Operator Workstations (B-OWS), BACnet Building Controllers (B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and BACnet Smart Sensor (B-SS). Each device used in new construction is required to have a PICS statement listing BIBBs supported.

1.2.20 Digital Controller

An electronic controller, usually with internal programming logic and digital and analog input/output capability, which performs control functions. In most cases, synonymous with a BACnet device described in this specification. See also "Device".

1.2.21 Direct Digital Control (DDC)

Digital controllers performing control logic. Usually the controller directly senses physical values, makes control decisions with internal programs, and outputs control signals to directly operate switches, valves, dampers, and motor controllers.

1.2.22 DDC System

A network of digital controllers, communication architecture, and user interfaces. A DDC system may include programming, sensors, actuators, switches, relays, factory controls, operator workstations, and various other devices, components, and attributes.

1.2.23 Ethernet

A family of local-area-network technologies providing high-speed networking features over various media.

1.2.24 Firmware

Software programmed into read only memory (ROM), flash memory, electrically erasable programmable read only memory (EEPROM), or erasable programmable read only memory (EPROM) chips.

1.2.25 Middleware

Communication hardware and software connecting two or more different protocols, similar to human language translators. The Middleware translates one protocol into equivalent concepts for the other protocol. In BACnet applications, a middleware has BACnet on one side and non-BACnet protocols on the other side.

1.2.26 Half Router

A device that participates as one partner in a BACnet point-to-point (PTP) connection. Two half-routers in an active PTP connection combine to form a single router.
1.2.27 Hub

A common connection point for devices on a network.

1.2.28 Internet Protocol (IP, TCP/IP, UDP/IP)

A communication method, the most common use is the World Wide Web. At the lowest level, it is based on Internet Protocol (IP), a method for conveying and routing packets of information over various LAN media. Two common protocols using IP are User Datagram Protocol (UDP) and Transmission Control Protocol (TCP). UDP conveys information to well-known "sockets" without confirmation of receipt. TCP establishes "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

1.2.29 Input/Output (I/O)

Physical inputs and outputs to and from a device. The term also describes binary and analog software, or "virtual" I/O. See also "Points".

1.2.30 I/O Expansion Unit

An I/O expansion unit provides additional point capacity to a digital controller.

1.2.31 IP subnet

Internet protocol (IP) identifies individual devices with a 32-bit number divided into four groups from 0 to 255. Devices are often grouped and share some portion of this number. For example, one device has IP address 209.185.47.68 and another device has IP address 209.185.47.82. These two devices share Class C subnet 209.185.47.00

1.2.32 Local-Area Network (LAN)

A communication network that spans a limited geographic area and uses the same basic communication technology throughout.

1.2.33 LonTalk

CEA-709.1-D. A communication protocol developed by Echelon Corp. LonTalk is an optional physical and data link layer for BACnet.

1.2.34 MAC Address

Media Access Control address. The physical node address that identifies a device on a Local Area Network.

1.2.35 Master-Slave/Token-Passing (MS/TP)

ISO 8802-3. One of the LAN options for BACnet. MSTP uses twisted-pair wiring for relatively low speed and low cost communication (up to 4,000 ft at 76.8K bps).

1.2.36 Native BACnet Device

A device that uses BACnet as its primary, if not only, method of communication with other BACnet devices without intermediary gateways. A system that uses native BACnet devices at all levels is a native BACnet
system.

1.2.37 Network

Communication technology for data communications. BACnet approved network types are BACnet over Internet Protocol (IP), Point to Point (PTP) Ethernet, ARCNET, MS/TP, and LonTalk®.

1.2.38 Network Number

A site-specific number assigned to each network segment to identify for routing. This network number must be unique throughout the BACnet internetwork.

1.2.39 Object

The concept of organizing BACnet information into standard components with various associated properties. Examples include analog input objects and binary output objects.

1.2.40 Object Identifier

An object property used to identify the object, including object type and instance. Object Identifiers must be unique within a device.

1.2.41 Object Properties

Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.

1.2.42 Peer-to-Peer

Peer-to-peer refers to devices where any device can initiate and respond to communication with other devices.

1.2.43 Performance Verification Test (PVT)

The procedure for determining if the installed BAS meets design criteria prior to final acceptance. The PVT is performed after installation, testing, and balancing of mechanical systems. Typically the PVT is performed by the Contractor in the presence of the Government.

1.2.44 PID

Proportional, integral, and derivative control; three parameters used to control modulating equipment to maintain a setpoint. Derivative control is often not required for HVAC systems (leaving "PI" control).

1.2.45 PICS

Protocol Implementation Conformance Statement (PICS), describing the BACnet capabilities of a device. See BACnet, Annex A for the standard format and content of a PICS statement.

1.2.46 Points

Physical and virtual inputs and outputs. See also "Input/Output".
1.2.47 PTP

Point-to-Point protocol connects individual BACnet devices or networks using serial connections like modem-to-modem links.

1.2.48 Repeater

A network component that connects two or more physical segments at the physical layer.

1.2.49 Router/Protocol Gateway

A BACnet router is a component that joins together two or more networks using different LAN technologies and protocols. Examples include joining a BACnet RS485 field bus (serial network) to an IP or Ethernet network.

In the above case the protocol gateway encapsulates BACnet data from the field bus within UDP headers for transport over IP

1.2.50 Stand-Alone Control

Refers to devices performing equipment-specific and small system control without communication to other devices or computers for physical I/O, excluding outside air and other common shared conditions. Devices are located near controlled equipment, with physical input and output points limited to 64 or less per device, except for complex individual equipment or systems. Failure of any single device or communications will not cause other network devices to fail. Internal time clocks and onboard scheduling are required to allow for stand-alone control. BACnet "Smart" actuators (B-SA profile) and sensors (B-SS profile) communicating on a network with a parent device are exempt from stand-alone requirements. Provide stand-alone control routines to provide for energy saving sequences such as free cooling. Provide stand-alone control routines that operate without connection to the BACnet/IP and MS/TP networks during a loss of communication.

1.3 SUBCONTRACTOR SPECIAL REQUIREMENTS

Perform all work in this section in accordance with the paragraph SUBCONTRACTOR SPECIAL REQUIREMENTS in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS. The paragraph specifies that all contract requirements of this section shall be accomplished directly by a first tier subcontractor. No work required shall be accomplished by a second tier subcontractor.

1.4 CRITERIA

The direct digital control subcontractor shall be a primary equipment manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated BAS of similar size, scope and complexity to the system indicated in this Contract. Distributors, manufacturer's representatives and wholesalers will not be acceptable.

1.4.1 Single Source Responsibility of Subcontractor

The controls subcontractor shall be responsible for the complete design, installation, and participating in the commissioning of the system. The controls subcontractor shall be in the business of design, installation
and service of such building automation control systems similar in size
and complexity.

1.4.1.1 Equipment and Materials

Equipment and materials shall be cataloged products of manufacturers
regularly engaged in production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been
tested and proven in actual use.

1.4.1.2 Previous Experience

The controls subcontractor shall provide a list of no less than five
similar projects which have building control systems as specified in this
Section. These projects must be on-line and successfully functional such
that the Department of Defense representative would observe the control
systems in full operation. The controls subcontractor shall have (minimum
of three years) experience in design and installation of building
automation systems similar in performance to those specified in this
Section. Provide evidence of experience by submitting resumes of the
project manager, the local branch manager, project engineer, the
application engineering staff, and the electronic technicians who would be
involved with the supervision, the engineering, and the installation of
the control systems. Training and experience of these personnel shall not
be less than three years. Failure to disclose this information will be a
ground for disqualification of the supplier.

1.4.1.3 Local Representation

The controls subcontractor shall have in-place facility within 50 miles
with technical staff, spare parts inventory, and necessary test and
diagnostic equipment to support the control systems for this project.

1.4.1.4 Project Manager

Provide a competent and experienced Project Manager employed by the
Controls Contractor. The Project Manager shall be supported as necessary
by other Contractor employees in order to provide professional
engineering, technical and management service for the work. The Project
Manager shall attend scheduled Project Meetings as required and shall be
empowered to make technical, scheduling and related decisions on behalf of
the subcontractor.

1.5 Contract Drawings

The "MI" numbered series portion of the Contract Documents indicate an
engineering solution and design intent including graphic layouts of
components, input/output device point lists, sequences of operation and
additional operating parameters for each system. The work of this Section
includes the development and detail of the proposed installation to a
state that this Section's installer field work effort is fully engineered;
system operation determined and defined prior to installer mobilization of
the site. Unless noted otherwise, provide the following:

a. This Section's installer solutions shall be fully composed utilizing
   the equipment and accessory products proposed/submitted for
   installation under this Contract. The submittals under this Section
   shall reflect coordination with connections at the actual Heating
   Ventilating and Air Conditioning equipment purchased for the project.
b. The submittals under this Section shall include lists of materials proposed for each system indicated on the Contract Drawings; each input and output device identified by a model number which correlates to the submitted product data.

c. Indicate control range and set point for each input and output device on the Shop Drawing submittal in this Section.

d. Submit the Product Data and Shop Drawings simultaneously so that correlated review of the both may be conducted.

e. The sequences of operation indicated on the Contract Drawings form an empirical basis for system operation. The work of this Section includes the further definition of operational sequences including the development and incorporation of PID loops, validating HVAC component and equipment interlocks, validating interlocks with systems exclusive of this Section such as the Fire Alarm system, and additional control functions necessary for successful system operation.

f. Direct replication of the Contract Drawing graphics, point lists and/or sequences of operation as part of the Shop Drawing submittal will not be an acceptable substitute for installer engineering and pre-installation planning.

1.6 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC DESCRIPTION

a. Provide new BACnet and merge with existing BACnet DDC systems including associated equipment and accessories. All new devices are accessible using a Web browser interface and communicate using ASHRAE 135 BACnet communications without the use of gateways, unless gateways are shown on the design drawings and specifically requested by the Government. Where gateways are allowed, they must support ASHRAE 135, including all object properties and read-write services shown on Government approved interoperability schedules. Manufacturer's products, including design, materials, fabrication, assembly, inspection, and testing shall be in accordance with ASHRAE 135, ASME B31.1, and NFPA 70, except where indicated otherwise.

1.6.1 Design Requirements

1.6.1.1 Control System Drawings Title Sheet

Provide a title sheet for the control system drawing set. Include the project title, project location, contract number, the controls contractor preparing the drawings, an index of the control drawings in the set, and a legend of the symbols and abbreviations used throughout the control system drawings.

1.6.1.2 List of I/O Points

Also known as a Point Schedule, provide for each input and output point physically connected to a digital controller: point name, point description, point type (Analog Output (AO), Analog Input (AI), Binary Output (BO), Binary Input (BI)), point sensor range, point actuator range, point address, BACnet object, associated BIBBS (where applicable), and point connection terminal number. Provide an individual points list for each digital controller. Provide an individual points list for each item of central station equipment such as air handling units, water chiller...
system, hot water boiler system, reheat water system, and Central Plant ventilation system. Typical schedules are acceptable for terminal equipment such as air terminal valves, fan coil units etc., except where the terminal valves are providing control beyond a typical application.

1.6.1.3 Control System Components List

Provide a complete list of control system components proposed for installation on this project. Include for each controller and device: control system schematic name, control system schematic designation, device description, manufacturer, model, part number, firmware version, serial number, and physical location (e.g. Building 4, room 112 overhead). For sensors, include point name, sensor range, and operating limits. For valves, include body style, Cv, design flow rate, pressure drop, valve characteristic (linear or equal percentage), and pipe connection size. For actuators, include point name, spring or non-spring return, modulating or two-position action, normal (power fail) position, nominal control signal operating range (0-10 volts DC or 4-20 milliamps), and operating limits.

1.6.1.4 Control System Schematics

Provide control system schematics. Typical schematics for multiple identical equipment are allowed unless otherwise requested in design or contract criteria. Include the following:

a. Location of each input and output device
b. Flow diagram for each piece of HVAC equipment
c. Name or symbol for each control system component, such as V-1 for a valve
d. Setpoints, with differential or proportional band values
e. Written sequence of operation for the HVAC equipment
f. Valve and Damper Schedules, with normal (power fail) position

1.6.1.5 HVAC Equipment Electrical Ladder Diagrams

Provide HVAC equipment electrical ladder diagrams. Indicate required electrical interlocks.

1.6.1.6 Component Wiring Diagrams

Provide a wiring diagram for each type of input device and output device. Indicate how each device is wired and powered; showing typical connections at the digital controller and power supply. Show for all field connected devices such as control relays, motor starters, actuators, sensors, and transmitters. Submit a wiring diagram for each motor starter and variable frequency drive installation including auxiliary relays/contactors for DDC System, System Safety Devices, Fire Alarm System and additional interlocks to enable sequence of operation indicated on Contract Drawings.

1.6.1.7 Terminal Strip Diagrams

Provide a diagram of each terminal strip. Indicate the terminal strip
location, termination numbers, and associated point names.

1.6.1.8 BACnet Communication Architecture Schematic

Provide a schematic showing the project's entire BACnet communication network, including Internet Protocol (IP), Media Access Control (MAC), BACnet network, Device ID, field bus address, BBMDs, any devices using BACnet FDR, and Firmware version / Operating System, LAN devices including routers and bridges, gateways, controllers, workstations, and field interface devices. If applicable, show connection to existing networks.

1.7 SUBMITTALS

Submit detailed and annotated manufacturer's data, drawings, and specification sheets for each item listed, that clearly show compliance with the project specifications.

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

SD-02 Shop Drawings

Include the following in the project's control system drawing set:

Control System Drawings Title Sheet; G
List of I/O Points; G
Control System Components List; G
Control System Schematics; G
HVAC Equipment Electrical Ladder Diagrams; G
Component Wiring Diagrams; G
Terminal Strip Diagrams; G
BACnet Communication Architecture Schematic; G

SD-03 Product Data

Direct Digital Controllers; G

Include BACnet PICS for each controller/device type, including smart sensors (B-SS) and smart actuators (B-SA).

BACnet Gateways; G

Include BACnet and workstation display information; bi-directional communication ability; compliance with interoperability schedule; expansion capacity; handling of alarms, events, scheduling and trend data; and single device capability (not depending on multiple devices for exchanging information from either side of the gateway).

BACnet Discovery Tool; G
BACnet Operator Workstation and Notebook Computer Software; G
BACnet Operator Workstation; G
   Include BACnet PICS for Operator Workstation software.
Notebook Computer; G
Sensors and Input Hardware; G
Output Hardware; G
Surge and Transient Protection; G
Indicators; G
Uninterruptible Power Supply (UPS); G

Submit manufacturers' specification sheets for each sensor and input hardware, output hardware, digital controller, workstation computer and system accessory to show compliance with the project specification. For each type of equipment, highlight each compliance item and reference each item to the relevant specification paragraph number. Submit sufficient manufacturer's information to allow verification of compliance by the reviewing authority.

SD-05 Design Data

Performance Verification Testing Plan; G
Pre-Performance Verification Testing Checklist; G
Performance Verification Test Procedures; G

Six copies of the HVAC Control System Performance Verification Test Procedures, in booklet form and indexed, 60 days before the Contractor's scheduled test dates. The performance verification test procedures shall refer to the devices by their unique identifiers as shown, shall explain, step-by-step, the actions and expected results that will demonstrate that the HVAC control system performs in accordance with the sequences of operation, and other contract documents. An HVAC control system performance verification test equipment list shall be included that lists the equipment to be used during performance verification testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

SD-06 Test Reports

Performance Verification Testing Report; G

SD-07 Certificates

Contractor's Qualifications; G

SD-09 Manufacturer's Field Reports
Pre-PVT Checklist; G
Cybersecurity Hygiene Checklist

SD-10 Operation and Maintenance Data

Comply with requirements for data packages in Section 01 78 23 OPERATION AND MAINTENANCE DATA, except as supplemented and modified in this specification.

BACnet Direct Digital Control Systems, Data Package 4; G
Controls System Operators Manuals, Data Package 4; G

SD-11 Closeout Submittals

Training Documentation; G

1.8 QUALITY ASSURANCE

1.8.1 Standard Products

Provide material and equipment that are standard manufacturer's products currently in production and supported by a local service organization.

1.8.2 Delivery, Storage, and Handling

Handle, store, and protect equipment and materials to prevent damage before and during installation according to manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.8.3 Operating Environment

Protect components from humidity and temperature variation, dust, and contaminants. If components are stored before installation, keep them within the manufacturer's limits.

1.8.4 Finish of New Equipment

New equipment finishing shall be factory provided. Manufacturer's standard factory finishing shall be proven to withstand 125 hours in a salt-spray fog test. Equipment located outdoors shall be proven to withstand 500 hours in a salt-spray fog test.

Salt-spray fog test shall be according to ASTM B117, with acceptance criteria as follows: immediately after completion of the test, the finish shall show no signs of degradation or loss of adhesion beyond 0.125 inch on either side of the scratch mark.

1.8.5 Verification of Dimensions

The contractor shall verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing work.

1.8.6 Contractor's Qualifications

Submit documentation certifying the controls Contractor performing the work has completed at least three DDC systems installations of a similar
design to this project, and programmed similar sequences of operation for at least two years.

1.8.7 Modification of References

The advisory provisions in ASME B31.1 and NFPA 70 are mandatory. Substitute "shall" for "should" wherever it appears and interpret all references to the "authority having jurisdiction" and "owner" to mean the Contracting Officer.

1.8.8 Project Sequence

The control system work for this project shall proceed in the following order:

a. Submit and receive approval on the Shop Drawings, Product Data, and Certificates specified under the paragraph SUBMITTALS.

b. Perform the control system installation work, including all field check-outs and tuning.

c. Provide support to TAB personnel as specified under the paragraph TEST AND BALANCE SUPPORT.

d. Submit and receive approval of the Controls System Operators Manual specified under the paragraph CONTROLS SYSTEM OPERATORS MANUALS.

e. Submit and receive approval of the Performance Verification Testing Plan, PVT Procedures and the Pre-PVT Checklist specified under the paragraph PERFORMANCE VERIFICATION TESTING.

f. Perform the Performance Verification Testing.

g. Submit and receive approval on the PVT Report.

h. Submit and receive approval on the Training Documentation specified under the paragraph INSTRUCTION TO GOVERNMENT PERSONNEL. Submit at least 30 days before training.

i. Deliver the final Controls System Operators Manuals.

j. Conduct the Phase I Training.

k. Conduct the Phase II Training.

l. Submit and receive approval of Closeout Submittals.

1.9 PROJECT/SITE CONDITIONS

All products shall be rated for continuous operation under the following conditions:

a. Pressure: Pressure conditions normally encountered in the installed location.

b. Vibration: Vibration conditions normally encountered in the installed location.

c. Temperature
1) Products installed indoors: Ambient temperatures in the range of 32 to 112 degrees F and temperature conditions outside this range normally encountered at the installed location.

2) Products installed outdoors or in unconditioned indoor spaces: Ambient temperatures in the range of -35 to plus 151 degrees F and temperature conditions outside this range normally encountered at the installed location.

d. Humidity: 10 to 95 percent relative humidity, noncondensing and humidity conditions outside this range normally encountered at the installed location.

1.10 MAINTENANCE

1.10.1 General

The HVAC control System Operation and Maintenance (O&M) Instructions shall include:

a. "Manufacturer Data Package 3" as specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA for each piece of control equipment.

b. HVAC control system sequences of operation formatted as submitted; corrected to field installed conditions.

c. Procedures for the HVAC system start-up, operation and shut-down including the manufacturer supplied procedures for each piece of equipment, and procedures for the overall HVAC system.

d. As-built HVAC control system detail drawings formatted as specified.

e. Printouts of configuration settings for all devices.

f. Routine maintenance checklist. The routine maintenance checklist shall be arranged in a columnar format. The first column shall list all installed devices, the second column shall state the maintenance activity or state no maintenance required, the third column shall state the frequency of the maintenance activity, and the fourth column for additional comments or reference.

g. Qualified service organization list.


1.10.2 Maintenance Service

Provide services, materials and equipment as necessary to maintain the entire system in an operational state as specified for a period of one year after successful completion and acceptance of the Performance Verification Test. Minimize impacts on facility operations.

1.10.2.1 Description of Work

The adjustment and repair of the system shall include the manufacturer's required sensor and actuator (including transducer) calibration, span and
range adjustment.

1.10.2.2 Personnel

Use qualified service personnel to accomplish work promptly and satisfactorily. Advise the Government in writing of the name of the designated service representative, and of any changes in personnel.

1.10.2.3 Scheduled Inspections

Perform two inspections at six-month intervals, and all work required shall be performed. Inspections shall be scheduled in July and January. These inspections shall include:

a. Visual checks and operational tests of equipment.

b. Air handling units, fans, pumps, chillers, hot water boiler system, interface to DDC, steam boiler system interface to DDC, computer room unit system interface to the DDC system, interface to the DDC system, air terminal units, fan coil units, room pressure monitors, including all control system equipment.

c. Clean control system equipment including interior and exterior surfaces.

d. Check and calibrate each field device. Check and calibrate 50 percent of the total analog inputs and outputs during the first inspection. Check and calibrate the remaining 50 percent of the analog inputs and outputs during the second major inspection. Certify analog test instrumentation accuracy to be twice the specified accuracy of the device being calibrated. Randomly check at least 25 percent of all digital inputs and outputs for proper operation during the first inspection. Randomly check at least 25 percent of the remaining digital inputs and outputs during the second inspection.

e. Run system software diagnostics and correct diagnosed problems.

f. Resolve any previous outstanding problems.

1.10.2.4 Scheduled Work

This work shall be performed during regular working hours, Monday through Friday, excluding Federal holidays.

1.10.2.5 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel in the direct employ of the control system manufacturer shall be available to provide service to the system. A telephone number where the service supervisor can be reached at all times shall be provided. Service personnel shall be at the site within 24 hours after receiving a request for service. The control system shall be restored to proper operating condition as required in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS.

1.10.2.6 Operation

Scheduled adjustments and repairs shall include verification of the control system operation as demonstrated by the applicable tests of the
performance verification test.

1.10.2.7  Records and Logs

Keep dated records and logs of each task, with cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain initial analog span and zero calibration values and digital points. Complete logs shall be kept and shall be available for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the control system.

1.10.2.8  Work Requests

Record each service call request as received and include its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. Submit a record of the work performed within 5 days after work is accomplished.

PART 2   PRODUCTS

2.1  DDC SYSTEM

a. Provide a networked DDC system for stand-alone control in compliance with the latest revision of the ASHRAE 135 BACnet standard. Include all programming, objects, and services required to meet the sequence of control. Provide BACnet communications between the DDC system and native BACnet devices furnished with HVAC equipment and plant equipment including boilers, chillers, and variable frequency drives. Devices provided shall be certified in the BACnet Testing Laboratories (BTL) Product Listing and in accordance with ASHRAE 135.1 Method of Test for Conformance to BACnet.

b. Provide an operator workstation and new server with complete interface software capable of programming, configuring, and monitoring the digital controllers. Interface the new DDC system with the site's existing server and operator workstation at the hospital and software including graphic creation, scheduling, alarming, and trending. The server and workstation shall be located where indicated on Contract Drawings.

2.1.1  BACnet Building Controller (B-BC)

ASHRAE 135 building controller that is the main interface for the building control system. New equipment finishing shall be factory provided.

2.1.2  Direct Digital Controllers

Direct digital controllers shall be UL 916 rated.

2.1.2.1  I/O Point Limitation

The total number of I/O hardware points used by a single stand-alone digital controller, including I/O expansion units, shall not exceed 64, except for complex individual equipment or systems. Place I/O expansion units in the same cabinet as the digital controller.
2.1.2.2 Environmental Limits

Controllers shall be suitable for, or placed in protective enclosures suitable for the environment (temperature, humidity, dust, and vibration) where they are located.

2.1.2.3 Stand-Alone Controllers

Provide stand-alone direct digital controllers with internal time clocks. Each piece of equipment shall be controlled by a single controller to provide stand-alone control in the event of any building communication failure. All I/O points specified for a piece of equipment shall be integral to its controller and serial connected expansion modules. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

2.1.2.4 Internal Clock

Provide internal clocks and scheduling for all Direct Digital Controllers. Provide controllers with BTL listed profiles for all BACnet Building Controllers (B-BC) and BACnet Advanced Application Controllers (B-AAC) using BACnet time synchronization services. This includes but is not limited to VAV Controllers, Fan Coil controllers, Heat Pump controllers and any terminal controllers. BACnet Application specific controllers (B-ASC) will only be accepted for dedicated small exhaust system control such as restroom and mechanical room exhaust fans. Automatically synchronize system clocks daily from an operator-designated controller. The system shall automatically adjust for daylight saving time.

2.1.2.5 Memory

Provide sufficient memory for each controller to support the required control, communication, trends, alarms, and messages. Protect programs residing in memory with EEPROM, flash memory, or by an uninterruptible power source (battery or uninterruptible power supply). The backup power source shall have capacity to maintain the memory during a 72-hour continuous power outage. Rechargeable power sources shall be constantly charged while the controller is operating under normal line power. Batteries shall be replaceable without soldering. Trend and alarm history collected during normal operation shall not be lost during power outages less than 72 hours long.

2.1.2.6 Immunity to Power Fluctuations

Controllers shall operate at 90 percent to 110 percent nominal voltage rating.

2.1.2.7 Transformer

The controller power supply shall be fused or current limiting and rated at 125 percent power consumption.

2.1.2.8 Wiring Terminations

Use screw terminal wiring terminations for all field-installed controllers. Provide field-removable modular terminal strip or a termination card connected by a ribbon cable for all controllers other than terminal units.
2.1.2.9 Input and Output Interface

Provide hard-wired input and output interface for all controllers as follows:

a. Protection: Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with sources up to 24 volts AC or DC for any duration shall cause no controller damage.

b. Binary Inputs: Binary inputs shall have a toggle switch and monitor on and off contacts from a "dry" remote device without external power, and external 5-24 VDC voltage inputs.

c. Pulse Accumulation Inputs: Pulse accumulation inputs shall conform to binary input requirements and accumulate pulses at a resolution suitable to the application.

d. Analog Inputs: Analog inputs shall monitor low-voltage (0-10 VDC), current (4-20 mA), or resistance (thermistor or RTD) signals.

e. Binary Outputs: Binary outputs shall have a toggle switch and send a pulsed 24 VDC low-voltage signal for modulation control, or provide a maintained open-closed position for on-off control. For HVAC equipment and plant controllers, provide for manual overrides, either with three-position (on-off-auto) override switches and status lights, or with an adjacent operator display and interface. Where appropriate, provide a method to select normally open or normally closed operation.

f. Analog Outputs: Analog outputs shall send modulating 0-10 VDC or 4-20 mA signals to control output devices.

g. Tri-State Outputs: Tri-State outputs shall provide three-point floating control of terminal unit electronic actuators.

2.1.2.10 Digital Controller BACnet Internetwork

Provide a BACnet internetwork with control products, multiple peer buss network cables, connectors, repeaters, hubs, and routers. Provide intermediate gateways, only when requested by the Government and shown on the contract drawings. Controller and operator interface communication shall conform to ASHRAE 135, BACnet. If a controller becomes non-responsive, the remaining controllers shall continue operating and not be affected by the failed controller. Network cable systems shall be provided as work of this section. The use of facility communication systems in lieu of network cables dedicated to the work of this section is prohibited.

2.1.2.11 Communications Ports

a. Direct-Connect Interface Ports: Provide at least one extra communication port at each local BACnet network for direct connecting a notebook computer or BACnet hand-held terminal so all network BACnet objects and properties may be viewed and edited by the operator.

b. BACnet routers supporting ARCnet shall also be capable of supporting MS/TP.
2.1.2.12 BACnet Gateways

Provide BACnet communication ports, whenever available as a plant equipment OEM standard option, for DDC integration via a single communication cable. Typical BACnet controlled plant equipment includes, but is not limited to, boilers, chillers, and variable frequency motor drives.

Provide gateways to connect BACnet to legacy systems, existing non-BACnet devices, and existing non-BACnet DDC controlled plant equipment, only when specifically requested and approved by the Government, and shown on the Government approved BACnet Communication Architecture Schematic. Provide with each gateway an interoperability schedule showing each point or event on the legacy side that the BACnet "client" will read, and each parameter that the BACnet network will write to. Describe this interoperability in terms of BACnet services, or Interoperability Building Blocks (BIBBS), defined in ASHRAE 135 Annex K. Provide two-year minimum warranty for each gateway, including parts and labor.

The following minimum capabilities are required:

a. Middleware shall be able to read and view all readable object properties listed in the interoperability schedule on the non-BACnet network to the BACnet network and vice versa where applicable.

b. Middleware shall be able to write to all writeable object properties listed in the interoperability schedule on the non-BACnet network from the BACnet network and vice versa where applicable.

c. Middleware shall provide single-pass (only one protocol to BACnet without intermediary protocols) translation from the non-BACnet protocol to BACnet and vice versa.

d. Middleware shall meet the requirements of Data Sharing Read Property (DS-RP-B), Data Sharing Write Property (DS-WP-B), Device Management Dynamic Device Binding-B (DM-DDB-B), and Device Management Communication Control (DM-DCC-B) BIBBS, in accordance with ASHRAE 135.

e. Middleware shall include all hardware, software, software licenses, and configuration tools for operator-to-gateway communications. Provide backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.

2.1.2.13 Digital Controller Cabinet

Provide each digital controller in a factory fabricated metallic cabinet enclosure. Cabinet shall be locked and alarmed. The alarm shall include both a local audible alarm and a networked alarm (e.g. switch connected to controller DI). Networked alarm events shall be recorded remotely for a period not less than one year.

Cabinets located indoors shall protect against dust and have a minimum NEMA 1 rating, except where indicated otherwise. Cabinets located outdoors or in damp environments shall protect against all outdoor conditions and have a minimum NEMA 4 rating. Outdoor control panels and controllers must be able to withstand extreme ambient conditions, without malfunction or failure, whether or not the controlled equipment is
running. If necessary, provide a thermostatically controlled panel heater in freezing locations, and an internal ventilating fan in locations exposed to direct sunlight. Cabinets shall have a hinged lockable door and an offset removable metal back plate, except controllers integral with terminal units, like those mounted on VAV boxes. Provide like-keyed locks for all hinged panels provided and a set of two keys at each panel, with one key inserted in the lock. Each enclosure shall be sized to accommodate the number of controllers; I/O functions required for each enclosure, including installed spares, plus 10% expansion for each type of I/O function provided, control voltage transformers, fuses, terminal strips, relays, contactors, control enclosure incoming power disconnect switch, receptacle, wiring troughs, and system accessories. Controller wiring terminals shall clearly be divided into analog input and output groups and digital input and output groups. The controllers and terminal strips shall be equipped with double sided screw type terminals. One side of the terminal strip shall be used for termination of field wiring from instrumentation and controls. The other side shall be used to connect the controller and system accessories to the network. Terminal strips shall have individual terminal identification numbers.

2.1.2.14 Main Power Switch, Duplex 120V Receptacle and Transformers

Provide each control cabinet with a main external power on/off switch located inside the cabinet. Also provide each cabinet with a separate 120 VAC duplex receptacle. Provide control voltage (24v) transformer(s) interior to cabinet to enable power to controllers, input and output devices associated to the system.

2.1.3 DDC Software

Provide DDC operating and graphic software to execute sequences of operation, enable monitoring and system interrogation.

2.1.3.1 Programming

Provide programming to execute the sequence of operation indicated on the Contract Drawings, as modified by work of this section. Provide all programming and tools to configure and program all controllers. Provide programming routines in simple, easy-to-follow logic with detailed text comments describing what the logic does and how it corresponds to the project's written sequence of operation. All logic programming and control functions shall be closed loop, command and feedback for fault detection and alarming when status != command.

a. Graphic-based programming shall use a library of function blocks made from pre-programmed code designed for BAS control. Function blocks shall be assembled with interconnecting lines, depicting the control sequence in a flowchart. If providing a computer with device programming tools as part of the project, graphic programs shall be viewable in real time showing present values and logical results from each function block.

b. Menu-based programming shall be done by entering parameters, definitions, conditions, requirements, and constraints.

c. For line-by-line and text-based programming, declare variable types (variable types include but are not limited to the following: local, global, real, and integer) at the beginning of the program. Use descriptive comments frequently to describe the programming.
d. If providing a computer with device programming tools as part of the project, provide a means for detecting program errors and testing software strategies with a simulation tool. Simulation may be inherent within the programming software suite, or provided by physical controllers mounted in a NEMA 1 test enclosure. The test enclosure shall contain one dedicated controller of each type provided under this contract, complete with power supply and relevant accessories.

2.1.3.2 Parameter Modification

All writeable object properties, and all other programming parameters needed to comply with the project specification shall be adjustable for devices at any network level, including those accessible with web-browser communication, and regardless of programming methods used to create the applications.

2.1.3.3 Short Cycling Prevention

Provide setpoint differentials and minimum on/off times to prevent equipment short cycling.

2.1.3.4 Equipment Status Delay

Provide an adjustable delay from when equipment is commanded on or off and when the control program looks to the status input for confirmation.

2.1.3.5 Run Time Accumulation

Use the Elapsed Time Property to provide re-settable run time accumulation for each Binary Output Object connected to mechanical loads greater than 1 HP, electrical loads greater than 10 KW, or wherever else specified.

2.1.3.6 Timed Local Override

Provide an adjustable override time for each push of a timed local override button.

2.1.3.7 Time Synchronization

Provide time synchronization, including adjustments for leap years, daylight saving time, and operator time adjustments.

2.1.3.8 Scheduling

Provide operating schedules as indicated, with equipment assigned to groups. Changing the schedule of a group shall change the operating schedule of all equipment in the group. Groups shall be capable of operator creation, modification, and deletion. Provide capability to view and modify schedules in a seven-day week format. Provide capability to enter holiday and override schedules one full year at a time.

2.1.3.9 Object Property Override

Allow writeable object property values to accept overrides to any valid value. Where specified or required for the sequence of control, the Out-Of-Service property of Objects shall be modifiable using BACnet's write property service. When documented, exceptions to these requirement
are allowed for life, machine, and process safeties.

2.1.3.10 Alarms and Events

Alarms and events shall be capable of having programmed time delays and high-low limits. When a computer workstation or web server is connected to the BACnet internetwork, alarms/events shall report to the computer, printer, alphanumeric pager, e-mail, cell phone, as defined by an authorized operator. Otherwise alarms/events shall be stored within a device on the BACnet network until connected to a user interface device and retrieved. Provide alarms/events in agreement with the point schedule, sequence of operation, and the BAS Owner. At a minimum, provide programming to initiate alarms/events any time a piece of equipment fails to operate, a control point is outside normal range or condition shown on schedules, communication to a device is lost, a device has failed, or a controller has lost its memory.

2.1.3.11 Trending

Provide BACnet trend services capable of trending all object present values set points, and other parameters indicated for trending on project schedules. Trends may be associated into groups, and a trend report may be set up for each group. Trends are stored within a device on the BACnet network, with operator selectable trend intervals from 10 seconds up to 60 minutes. The minimum number of consecutive trend values stored at one time shall be 100 per variable. When trend memory is full, the most recent data shall overwrite the oldest data.

The BACnet system shall allow for Change-Of-Value (COV) subscription based trending at user defined thresholds.

The operator workstation shall upload trends automatically upon reaching 3/4 of the device buffer limit (via Notification_Threshold property), by operator request, or by time schedule for archiving. Archived and real-time trend data shall be available for viewing numerically and graphically for at the workstation and connected notebook computers.

2.1.3.12 Device Diagnostics

Each controller shall have diagnostic LEDs for power, communication, and device fault condition. The DDC system shall recognize and report a non-responsive controller.

2.1.3.13 Device Management

System shall be capable of managing devices remotely to include updating/loading firmware, restarting, and network configuration. These capabilities shall be restricted to authorized roles. The system shall support, either natively or with provided add-on software, remote read/write and management of BBMD tables.

2.1.3.14 Power Loss

Upon restoration of power, the DDC system shall perform an orderly restart and restoration of control.

2.1.3.15 Energy Data Recording

Provide a resettable signal accumulation for each flow meter and electric
meter. Program monthly usage reports for the following:

a. Calculate hot water thermal energy in MBTUH using hot water supply temperature and flow and hot water return temperature signals.

b. Calculate chilled water thermal energy in MBTUH using chilled water supply temperature and flow and chilled water return temperature signals.

c. Record electrical energy in KWH and electrical demand in KW.

d. Record water usage in K gallons.

e. Record natural gas usage in ft³ and therms.

2.1.4 BACnet Operator Workstation

The workstation shall be capable of accessing all DDC system devices and communicate using the BACnet protocol. The workstation shall be capable of displaying, modifying, creating, archiving, and deleting (as applicable): all points, objects, object properties, programming, alarms, trends, messages, schedules, and reports. For software, see the paragraph BACnet Operator Workstation and Notebook Computer Software.

2.1.4.1 BACnet Operator Workstation Hardware

Configure according to system manufacturer's specifications and conforming to BACnet Advanced Operator Workstation (B-AWS) device standards found in ASHRAE 135, Annex L. Install to permit complete monitoring and troubleshooting of the DDC system.

At a minimum the workstation hardware shall include: a desktop personal computer with Microsoft Windows Enterprise or Ultimate 64-bit operating system, processor and RAM exceeding capability and speed required by operating system and application software, hard drive capacity exceeding software and yearly archive requirements, 16X internal DVD+/−R/RW/CD-RW drive with archive creator software, 4 USB 3.0 ports, 10/100/1000 network interface card, 19-inch LCD monitor, internal V.92 modem, sound card with speakers, 101 character keyboard, optical mouse, USB Hub with four USB 3.0 ports and connecting cable, laser printer with USB port and cable, 3 matching color and black ink cartridges, 120-volt 800 VA uninterruptible power supply with automatic voltage regulation and 4 minimum battery back-up outlets and 2 surge protected outlets, Microsoft Office bundled software, Adobe Acrobat Writer, Anti-virus Software and Symantec Ghost disk imaging software or equal. Provide all original licenses, installation media, documentation, and recovery CDs capable of restoring the original configuration. Provide a manufacturer's 3-year next business day on-site warranty with the Government listed as the warranty owner.

2.1.5 Notebook Computer

Provide a notebook computer, complete with the project's installed DDC software, applications database, and graphics to fully troubleshoot and program the project's devices. Notebook computers for web-based systems do not require this installed software if they have the ability to connect locally in real time, view all graphics, and fully troubleshoot, modify, and program all project devices. Provide the notebook computer with ballistic nylon carrying case with shoulder strap with all necessary cables and interface hardware needed for setup and communication with the
controllers and control system components.

At a minimum the notebook computer shall include: Windows Enterprise or Ultimate 64-bit operating system, minimum 2.7 GHz processor with 3 MB Cache, discrete switchable graphics card with minimum 1 GB dedicated memory, 1 Terabyte hard drive, 6 GB DDR3 RAM, 2 USB 3.0 ports, 10/100/1000 network interface card, internal V.92 modem, 802.11 b/g/n WLAN, 17-inch display, keyboard with numeric keypad, 6-hour battery with charger, 8X internal DVD+/-R/RW drive with double layer support with DVD creator software, and Microsoft Office Home and Business 2013 bundled software. Provide all original licenses, installation media, documentation, and recovery CDs capable of restoring the original configuration. Provide a means to connect the notebook computer to the installed field bus. Provide the manufacturer's 3-year accidental damage protection with 3-day on site response for 2 year warranty with the Government listed as the warranty owner.

2.1.6 BACnet Operator Workstation and Notebook Computer Software

2.1.6.1 Password Protection

System shall support role based access. At a minimum OS administrator, auditor, DDC operator and user roles must be defined. The system must be capable of enforcing role based access by location (e.g., Bob may alter operating parameters for Building 1 but not Building 2. Building 2 is Alice's responsibility).

Workstation shall be capable of DoD Common Access Card (CAC) login in addition to traditional username and password.

The lowest level only allow viewing graphics. The second level allows viewing graphics and changing space temperature setpoints. The third level allows the previous level's capability, plus changing operating schedules. The fourth level allows access to all functions except passwords. The highest level provides all administrator rights and allows full access to all programming, including setting new passwords and access levels. Provide the BAS Owner with the highest level password access. Provide automatic log out if no keyboard or mouse activity is detected after a user-defined time delay.

2.1.6.2 BACnet Operator Workstation and Notebook Computer DDC Software

Provide the workstation software with the manufacturer's installation CDs and licenses. Configure the software according to the DDC system manufacturer's specifications, cybersecurity requirements, and in agreement with BACnet Operator Workstation (B-OWS) device standards found in ASHRAE 135, Annex L.

The workstation software shall permit complete monitoring, modification, and troubleshooting interface with the DDC system. The operator interface with the software shall be menu-driven with appropriate displays and menu commands to manipulate the DDC system's objects, point data, operating schedules, control routines, system configuration, trends, alarms, messages, graphics, and reports. Trends shall be capable of graphic display in real time, with variables plotted as functions of time. Each alarmed point shall be capable of displaying its alarm history, showing when it went into alarm, if and when it was acknowledged, and when it went out of alarm. The modification of DDC system parameters and object properties shall be accomplished with "fill in the blank" and or "point
2.1.6.3 Web-Based User Interface (UI) and Graphics

Provide web-based graphics specifically designed for this Project, fully compatible with Internet Explorer 9+, Safari, Firefox, and Google Chrome. Web-based user interface shall be browser agnostic and shall not rely on proprietary client side scripting to function. Graphics shall replicate the indicated HVAC system design and include building plans with equipment locations, and schematic plans of each item of mechanical equipment, with all control variables clearly identified and capable of real-time display. Include color text boxes to indicate a normal operating condition (green highlight) and alarm condition (red highlight) for each sensor setpoint and control variable.

Graphic displays shall have full-screen resolution when viewed on the workstation and notebook computers. Dynamic data on graphics pages shall refresh within 10 seconds using an Internet connection, or 30 seconds using a dial-up modem connection. Web-based user interface shall not rely on additional third-party browser "plug-in" software like Adobe Flash. Java client side applets may be used if appropriately signed. If Java client side runtimes are used they shall not require deprecated or otherwise unsupported Java runtime environments.

The graphics shall show the present value and object name for each of the project's I/O points on at least one graphic page. Arrange point values and names on the graphic displays in their appropriate physical locations with respect to the floor plan or equipment graphic displayed. Graphics shall allow the operator to monitor current status, view zone and equipment summaries, use point-and-click navigation between graphic pages, and edit setpoints and parameters directly from the screens. Items in alarm shall be displayed using a different color or other obvious visual indicator.

Provide graphics with the following:

a. Graphic Types: Provide at least one graphic display for each piece of HVAC equipment, building floor, and controlled zone. Indicate dynamic point values, operating statuses, alarm conditions, and control setpoints on each display. Provide summary pages where appropriate.

(1) Building Elevation: For buildings more than one story, provide an elevation view of the building with links to each of the building's floor plans. Simulate the building's architecture and include the building number and floor numbers. If possible, use an actual photograph of the building.

(2) Building Floor Plans: Provide a floor plan graphic for each of the building's floors and roof with dynamic display of space temperature and other important data. Indicate and provide links to sub-plan areas. Use the project's electronic drawing files for the graphic backgrounds. Provide clear names for important areas, such as "Main Conference Room." Include room names and numbers where applicable. Include features such as stairwells, elevators, and main entrances. Where applicable, include the mechanical room, HVAC equipment, and control component locations, with corresponding links to the equipment graphics.

(3) Sub-plan Areas: Where a building's floor plan is too large to
adequately display on the screen, sub-divide the plan into distinct areas, and provide a separate graphic display for each area. Provide same level of detail requested in building floor plan section above.

(4) HVAC Equipment: Provide a graphic display for each piece of HVAC equipment, such as a fan coil unit, VAV air terminal unit, or air handling unit system including related exhaust fans, boiler system and chiller system. Equipment shall be represented by a two or three-dimensional drawing. Where multiple pieces of equipment combine to form a system, such as a central chiller plant or central heating plant, provide one graphic to depict the entire plant. Indicate the equipment, piping, ductwork, dampers, and control valves in the installed location. Include labels for equipment, piping, ductwork, dampers, and control valves. Show the direction of air and water flow. Include dynamic display of applicable object data with clear names in appropriate locations.

(5) Sequence of Operation: Provide a graphic screen displaying the control installer final engineered full sequence of operation for each piece of HVAC equipment. Provide a link to the sequence of operation displays on their respective equipment graphics. Include dynamic real-time data within the text for setpoints and variables.

b. Graphic Title: Provide a prominent, descriptive title on each graphic page.

c. Dynamic Update: When the workstation is on-line, all graphic I/O object values shall update with change-of-value services, or by operator selected discrete intervals.

d. Graphic Linking: Provide forward and backward linking between floor plans, sub-plans, and equipment.

e. Graphic Editing: Provide installed software to create, modify, and delete the DDC graphics. Include the ability to store graphic symbols in a symbol directory and import these symbols into the graphics.

f. Dynamic Point Editing: Provide full editing capability for deleting, adding, and modifying dynamic points on the graphics.

2.1.7 BACnet Discovery Tool

Provide BACnet operator workstation and notebook computer with the capability of performing BACnet discovery either natively from within the DDC application or with the use of an included add-on application. The BACnet discovery tool must have the capability to enumerate the assets and objects in a BACnet environment.

2.2 SENSORS AND INPUT HARDWARE

Sensors and transmitters requiring attachment to insulated ductwork and piping systems shall be equipped with supplemental brackets and/or mountings to enable sensor and transmitter installation at the outside face of the insulation.
2.2.1 Field-Installed Temperature Sensors

Where feasible, provide the same sensor type throughout the project. Avoid using transmitters unless absolutely necessary.

2.2.1.1 Resistance Temperature Detectors (RTDs)

Provide RTD temperature sensors with platinum elements compatible with the digital controllers. Encapsulate sensors in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor stability error over five years shall not exceed 0.25 degrees F cumulative. Direct connection of RTDs to digital controllers without transmitters is preferred. When RTDs are connected directly, lead resistance error shall be less than 0.25 degrees F. The total error for a RTD circuit shall not exceed 0.5 degrees F.

2.2.1.2 Temperature Sensor Details

a. Room Type: Provide the sensing elements components within a decorative protective cover suitable for surrounding decor. Provide room temperature sensors with timed override button, setpoint adjustment lever, digital temperature display and humidity sensor. Provide a communication port or 802.11x wireless support for a portable operator interface like a notebook computer or PDA.

b. Duct Probe Type: Ensure the probe is long enough to properly sense the air stream temperature.

c. Duct Averaging Type: Continuous averaging sensors shall be one foot in length for each 4 square feet of duct cross-sectional area, and a minimum length of 6 feet.

d. Pipe Immersion Type: Provide minimum three-inch immersion. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel when used in steel piping, and brass when used in copper piping. Provide the sensor well with a heat-sensitive transfer agent between the sensor and the well interior.

e. Outside Air Type: Provide the sensing element on the building's north side with a protective weather shade that positions the sensor approximately 3 inches off the wall surface, does not inhibit free air flow across the sensing element, and protects the sensor from snow, ice, and rain.

2.2.1.3 Sensor Ranges and Accuracy

Temperature sensors may be provided without transmitters. Temperature sensors, including transmitter if used, shall have minimum operating ranges, minimum accuracy and maximum drift as specified below for the application:

a. Conditioned Space Temperature

   1) Operating Range: 50 to 86 degrees F.

b. Unconditioned Space Temperature
1) Operating Range: 20 to 150 degrees F.

c. Duct Temperature
1) Operating Range: -30 to +130 degrees F.

d. Outside Air Temperature
1) Operating Range: -30 to +130 degrees F.

e. Chilled Water and Potable Cold Water
1) Operating Range: 30 to 100 degrees F.

f. Heating Hot Water and Potable Hot Water
1) Operating Range: 50 to 250 degrees F.

2.2.2 Transmitters

Unless noted otherwise, provide transmitters with 4 to 20 mA or 0 to 10 VDC linear output scaled to the sensed input. Transmitters shall be matched to the respective sensor, factory calibrated, and sealed. Size transmitters for an output near 50 percent of its full-scale range at normal operating conditions. The total transmitter error shall not exceed 0.1 percent at any point across the measured span. Supply voltage shall be 12 to 24 volts AC or DC. Transmitters shall have non-interactive offset and span adjustments. For temperature sensing, transmitter drift shall not exceed 0.03 degrees F a year.

2.2.2.1 Relative Humidity Transmitters

Provide transmitters with an accuracy equal to plus or minus 2 percent from 0 to 90 percent scale, and less than one percent drift per year. Sensing elements shall be the polymer type.

2.2.2.2 Pressure Transmitters

Provide transmitters integral with the pressure transducer.

2.2.3 Current Transducers

Provide current transducers to monitor motor amperage, unless current switches are shown on design drawings or point tables.

2.2.4 Air Quality Sensors

Provide power supply for each sensor.

2.2.4.1 CO2 Sensors

Provide photo-acoustic type CO2 sensors with integral transducers and linear output. The devices shall read CO2 concentrations between 0 and 2000 ppm with full scale accuracy of at least plus or minus 100 ppm.
2.2.5 Input Switches

2.2.5.1 Timed Local Overrides

Provide buttons or switches to override the DDC occupancy schedule programming for each major building zone during unoccupied periods, and to return HVAC equipment to the occupied mode. This requirement is waived for zones clearly intended for 24 hour continuous operation.

2.2.6 Freeze Protection Thermostats

Provide special purpose thermostats with flexible capillary elements 20 feet minimum length for coil face areas up to 40 square feet. Provide longer elements for larger coils at 1-foot of element for every 4 square feet of coil face area, or provide additional thermostats. Provide switch contacts rated for the respective motor starter's control circuit voltage. Include auxiliary contacts for the switch's status condition. A freezing condition at any 18-inch increment along the sensing element's length shall activate the switch. The thermostat shall be equipped with a manual push-button reset switch so that when tripped, the thermostat requires manual resetting before the HVAC equipment can restart.

2.2.7 Electronic Air Flow Measurement Stations

Air flow measurement stations shall have an array of velocity sensing elements intended for duct mounting or fan inlet vortex array as indicated. The velocity sensing elements shall be the RTD or thermistor type, traversing the ducted air in at least two directions. The air flow pressure drop across the station shall not exceed 0.08 inch water gage at a velocity of 2,000 fpm. The station shall be suitable for air flows up to 5,000 fpm, and a temperature range of 40 to 120 degrees F. The station's measurement accuracy over the range of 125 to 2,500 fpm shall be plus or minus 3 percent of the measured velocity. Station transmitters shall provide a linear, temperature-compensated 4 to 20 mA or 0 to 10 VDC output. The output shall be capable of being accurately converted to a corresponding air flow rate in cubic feet per minute. Transmitters shall be a 2-wire, loop powered device. The output error of the transmitter shall not exceed 0.5 percent of the measurement. Airflow measurement stations similar to Ebtron Gold Series will meet the requirements.

2.2.8 Energy Metering

2.2.8.1 Electric Meters

Refer to Division 26 for electrical meter. Coordinate signal accumulation compatibility from electric heater to DDC System.

2.2.8.2 Chilled Water and Heating Water Flow Meters

Provide magnetic mass principle insertion type flow meters. Wiring installed by the contractor between the control system and the meters shall be Belden 9320, two wire, shielded twisted cable, and shall not be included in conduit containing AC circuit wiring. Each meter shall have dual electrode design, each with its own sensing system, and an averaging circuit to reduce measurement errors due to swirl in undeveloped flow locations caused by short straight pipe runs. Sensing shall be accomplished electromagnetically; not through mechanical or photoelectric means. Paddle type rotors will not be acceptable. The sensor shall have a maximum operating pressure of 400 PSI, maximum operating temperature of
250 deg F and a pressure drop of less than 0.1 PSI at 12 feet per second flow velocity. Flow sensor shall have 200:1 turndown ratio. Accuracy shall be within +1.0% of actual reading at a liquid velocity of 2 to 20 feet/second. Each sensor shall be individually wet-calibrated in a flow laboratory against a primary volumetric standard accurate to within 0.1% and directly traceable to the U.S. National Institute of Standards and Technology (NIST). Provide certificate of calibration with each flow meter. The sensor shall have integral analog outputs of 0-10 VDC and 4-20 mA linear to within +0.1% of calibrated span for connection to the control system. The sensor shall also include three internal frequency outputs, (top sensor, bottom sensor, average frequency) for commissioning and diagnostic purposes. All outputs shall be linear with flow rate. The meter shall be constructed of type 316 stainless steel for all wetted parts, electronics enclosure shall be NEMA 4 aluminum. The sensor head shall be constructed of polypropylene. The unit shall be installed with hot tap installation, in order to be both insertable and removable through a ball valve when the pipe is under pressure. Operating power shall be nominal 24 VDC. Local instantaneous flow indicator shall be LED type in NEMA 4 enclosure with 3-1/2 inch digit display for wall or panel mounting. Provide 4-20 ma analog output signal for use by the facility DDC system. Furnish with flow meter manufacturer temperature sensors and BTU totalizer panel where indicated on Contract Drawings. Flow meters similar to Onicon F3500 Series will meet the requirements.

2.2.8.3 Water Flow Meter (Make-up Water)

Sensor shall be a vane displacement device rated for liquid service as shown. A counter shall be mounted on top of the meter, and shall consist of a non-resettable mechanical totalizer for local reading, and a pulse transmitter for remote reading. The totalizer shall have a six digit register to indicate the volume passed through the meter in gallons, and a sweep-hand dial to indicate down to 1 liter 0.25 gallons. Output signal shall be pulse type. Body shall be Class 125, bronze or carbon steel, threaded or flanged connections. Accuracy shall be +/- 2% of the entire flow range. Maximum pressure drop at full flow: 1 psig.

2.2.8.4 Room Air Pressure Sensors and Monitor

Provide a microprocessor based monitor unit designed for flush wall mounting with field mounted airflow sensor. Sensor system shall be configured for trough-the-wall installation with velocity sensors placed in series determining the direction of flow and pressure differential for positive or negative room pressures while measuring the voltage drop access of each sensor to determine the direction of flow. Sensors shall include a temperature compensation sensor to ensure accuracy and repeatability over a wide range of operating temperatures. Monitor shall be set to maintain a minimum room pressure of 0.01 inches. Provide monitor and display unit with a digital display that indicates room pressure. Display to have a range of -0.19999 to +0.19999 inches of water. Display shall be updated every second and indicate pressure in units of inches water, for a running average period set between 2 and 10 seconds. Panel shall include four LED lights indicating conditions of normal, low alarm, high alarm and mute. Indicate the conditions via the display, visual alarm, audible alarm and alarm contacts. Panel shall allow the user to configure, calibrate and test the system. Panel shall allow for a time delay for loss of air pressure. Doors opening to room shall not initiate alarm. Provide each unit with relay contacts to enable remote monitoring at nurses station where indicated on contract drawings.
2.2.8.5 Current Transducers

Current transducers shall accept an AC current input and shall have an accuracy of +/- 0.5 percent of full scale. An integral power supply shall be provided if required for the analog output signal. The device shall have a means for calibration.

2.2.8.6 Current Sensing Relays (CSRs)

Current sensing relays (CSRs) shall provide a normally-open contact with a voltage and amperage rating greater than its connected load. Current sensing relays shall be of split-core design. The CSR shall be rated for operation at 200 percent of the connected load. Voltage isolation shall be a minimum of 600 volts. The CSR shall auto-calibrate to the connected load.

2.2.8.7 Voltage Transducers

Voltage transducers shall accept an AC voltage input and have an accuracy of +/- 0.25 percent of full scale. An integral power supply shall be provided if required for the analog output signal. The device shall have a means for calibration. Line side fuses for transducer protection shall be provided.

2.2.8.8 Carbon Monoxide Alarm

Carbon monoxide sensor and alarm shall consist of an infrared light source in a steel enclosure for room mounting. System shall enable the detection of non-combusted natural gas and liquified petroleum gas (propane) compounds within the boiler rooms. An optical detector/analyzer in a similar enclosure, suitable for indoor mounting shall be provided. Both assemblies shall include internal blower systems to keep optical windows free of dust at all times. The third component of the analyzer shall be the electronics cabinet. Automatic flue gas temperature compensation and manual/automatic zeroing devices shall be provided. Repeatability shall be +/- 2 percent of full scale with an accuracy of +/- 3 percent of full scale. Furnish with integral dry type contacts for alarm output connection to facility DDC system.

2.2.8.9 Pipe Mount Temperature Limit Switch (Aquastat)

Pipe mount temperature limit switches (aquastats) shall have a field adjustable setpoint between 60 and 90 degrees F, an accuracy of +/- 3.6 degrees F and a 10 degrees F fixed deadband. The switch shall have two sets of contacts, and each contact shall have a rating greater than its connected load. Contacts shall open or close upon change of temperature above or below setpoint as shown.

2.2.8.10 Damper and Valve End Switches

Each end switch shall be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure shall be suitable for mounting on the duct or valve exterior and shall permit setting the position of the trip lever that actuates the switch. The trip lever shall be aligned with the actuator linkage. End switches factory packaged to valve and damper actuators are not acceptable.
2.2.8.11 Oxygen Depletion Sensor

Provide a microprocessor based sensor transmitter unit. Unit shall be UL listed, with all components in a NEMA 1 enclosure. Front of panel shall be equipped with an LCD display and membrane sealed push buttons to access the unit setpoints and silence alarms. Unit shall include an audible alarm with push to silence through the panel front. Unit shall be capable of three separate oxygen level setpoints with separate output relays for each setpoint level, and one additional relay for a general alarm status. Unit shall be configured for wall mounting within the space served and include an integral sensor. The unit shall be compatible with a 120 volt electrical power supply and also include an integral battery backup. Each relay shall be equipped with 10 amp SPST contacts.

2.3 OUTPUT HARDWARE

2.3.1 Control Dampers

Provide factory manufactured stainless steel dampers where indicated. Control dampers shall comply with SMACNA 1966 except as modified or supplemented by this specification. Published damper leakage rates and respective pressure drops shall have been verified by tests in compliance with AMCA 500-D requirements. Outside air, return air, and exhaust dampers shall be provided where shown and shall include the blade type indicated. Opposed blade dampers shall include an airfoil blade design. Blades shall have silicone compressible seals at blade-end points of contact.

Provide damper assembly frames constructed of 0.064 inch minimum thickness stainless steel channels with mitered and welded corners. Damper axles shall be 0.5 inches minimum diameter plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings.

Dampers shall be rated for not less than 2000 fpm air velocity. The pressure drop through each damper when full-open shall not exceed 0.04 inches water gage at 1000 fpm face velocity. Damper assemblies in ductwork subject to above 3-inch water gauge static air pressure shall be constructed to meet SMACNA Seal Class "A" construction requirements.

Provide the damper operating linkages outside of the air stream, including crank arms, connecting rods, and other hardware that transmits motion from the damper actuators to the dampers, shall be adjustable. Additionally, operating linkages shall be designed and constructed to have a 2 to 1 safety factor when loaded with the maximum required damper operating force. Linkages shall be stainless steel.

Provide access doors or panels in hard ceilings and walls for access to all concealed damper operators and damper locking setscrews.

For field-installed control dampers, a single damper section shall have blades no longer than 48 inches and no higher than 72 inches. The maximum damper blade width shall be 12 inches. Larger sized dampers shall be built using a combination of sections.

Frames shall be at least 2 inches wide. Flat blades shall have edges folded for rigidity. Blades shall be provided with compressible gasket seals along the full length of the blades to prevent air leakage when closed.
The damper frames shall be provided with stainless steel jamb seals to minimize air leakage. Seals shall be suitable for an operating temperature range of minus 40 degrees F to 200 degrees F.

The leakage rate of each damper when full-closed shall be no more than 3 cfm per sq. foot of damper face area at 1.0 inches water gage static pressure.

2.3.2 Control Valves

2.3.2.1 Valve Assembly

Valve bodies shall be designed for 125 psig minimum working pressure or 150 percent of the operating pressure, whichever is greater. Valve stems shall be Type 316 stainless steel. Valve leakage ratings shall be 0.01 percent of rated Cv value. Class 125 copper alloy valve bodies and Class 150 steel or stainless steel valves shall meet the requirements of ASME B16.5. Cast iron valve components shall meet the requirements of ASTM A126 Class B or C. Valves with integral spring-loaded balancing element are not acceptable.

2.3.2.2 Butterfly Valves

Butterfly valves shall be the threaded lug type suitable for dead-end service and for modulation to the fully-closed position, with stainless steel shafts supported by bearings, stainless steel or vinyl coated ductile-iron discs geometrically interlocked with or bolted to the shaft (no pins), and EPDM seats suitable for temperatures from minus 20 degrees F to plus 250 degrees F. Valves shall have a means of manual operation independent of the actuator.

2.3.2.3 Two-Way Valves

Two-way modulating valves shall have an equal percentage characteristic.

2.3.2.4 Valves for Chilled Water

a. Bodies for valves 1-1/2 inches and smaller shall be brass or bronze, globe body with threaded or union ends. Bodies for valves from 2 inches to 3 inches inclusive shall be of globe body brass, bronze, or iron. Bodies for 2 inch valves shall have threaded connections. Bodies for valves from 2-1/2 to 3 inches shall have flanged connections.

b. Internal valve trim shall be brass or bronze, except that valve stems shall be stainless steel.

c. Unless indicated otherwise, provide modulating valves sized for 2 psi minimum and 4 psi maximum differential across the valve at the design flow rate.

d. Valves 4 inches and larger may be butterfly valves, unless indicated otherwise.

2.3.2.5 Valves for Hot Water Service

Valves for hot water service below 250 Degrees F:
a. Bodies for valves 1-1/2 inches and smaller shall be brass or bronze, globe body with threaded or union ends. Bodies for valves from 2 inches to 3 inches inclusive shall be globe body of brass, bronze, or iron. Bodies for 2 inch valves shall have threaded connections. Bodies for valves from 2-1/2 to 3 inches shall have flanged connections.

b. Internal trim (including seats, seat rings, modulation plugs, valve stems, and springs) of valves controlling water above 210 degrees F shall be Type 316 stainless steel.

c. Internal trim for valves controlling water 210 degrees F or less shall be brass or bronze. Valve stems shall be Type 316 stainless steel.

d. Non-metallic parts of hot water control valves shall be suitable for a minimum continuous operating temperature of 250 degrees F.

e. Unless indicated otherwise, provide modulating valves sized for 2 psi minimum and 4 psi maximum differential across the valve at the design flow rate.

f. Valves 4 inches and larger shall maybe butterfly valves, unless indicated otherwise.

2.3.3 Actuators

Provide direct-drive electric actuators for all control applications, except where indicated otherwise. All actuators shall include a feedback loop for detecting actuator faults. The actuator shall report actual position back to the control system. Binary actuators shall provide open/closed status, at a minimum. Modulating actuators and process shall provide position feedback expressed (directly or through span conversion) as percent open/closed. Actuator status shall be derived from actuator position; however, effect may be used in cases where direct feedback is not practical such as VAV coils and dampers.

Actuators at insulated ductwork and piping system valves and dampers shall be equipped with standoff brackets or mountings to enable actuator installation at the outside face of the insulation.

2.3.3.1 Electric Actuators

Each actuator shall deliver the torque required for continuous uniform motion and shall have internal end switches to limit the travel, or be capable of withstandng continuous stalling without damage. Actuators shall function properly within 85 to 110 percent of rated line voltage. Provide actuators with hardened steel running shafts and gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torques less than 16 inch-pounds. Provide modulating actuators capable of stopping at any point in the cycle, and starting in either direction from any point. Actuators shall be equipped with a switch for reversing direction, and a button to disengage the clutch to allow manual adjustments. Provide the actuator with a hand crank for manual adjustments. Spring return actuators shall be provided on all control dampers and all control valves except terminal fan coil units, VAV air terminal units, and unit heaters; unless indicated otherwise. Each actuator shall have distinct markings indicating the full-open and full-closed position, and the points in-between.
2.3.4 Output Switches

2.3.4.1 Control Relays

Field installed and DDC panel relays shall be double pole, double throw, UL listed, with contacts rated for the intended application, indicator light, and dust proof enclosure. The indicator light shall be lit when the coil is energized and off when coil is not energized. Relays shall be the socket type, plug into a fixed base, and replaceable without tools or removing wiring. Encapsulated "PAM" type relays may be used for terminal control applications.

2.4 ELECTRICAL POWER AND DISTRIBUTION

2.4.1 Transformers

Transformers shall conform to UL 506. For control power other than terminal level equipment, provide a fuse or circuit breaker on the secondary side of each transformer. Step down transformers shall be provided where control equipment operates at lower than line circuit voltage. Transformers shall have primaries wound for the incoming voltage available and secondaries wound for the correct control circuit voltage. Transformer shall be sized so that the connected load is 80 percent of the rated capacity or less. Transformers shall conform to UL 508 and NEMA ST 1. Provide transformers at DDC controller cabinets of capacity to accommodate power required by lower level DDC controllers and associated devices. Terminal equipment (VAV air terminal units, fan coil units) controllers shall obtain power from the transformer(s) at the AHU DDC controller cabinet in the relative floor area. Where auxiliary transformers are required below the penthouse level, they shall be installed above ceilings; where accessible in NEMA 1 enclosures similar to controller cabinets. If auxiliary transformers are provided, the electrical supply to the transformers shall be provided as work of this Section.

2.4.2 Surge and Transient Protection

Provide each digital controller with surge and transient power protection. Surge and transient protection shall consist of the following devices, installed externally to the controllers.

2.4.2.1 Power Line Surge Protection

Provide surge suppressors on the incoming power at each direct digital controller or grouped terminal controllers and shall be installed externally to the device or devices being protected. Surge suppressors shall be rated in accordance with UL 1449, have a fault indicating light, and conform to the following:

a. The device shall be a transient voltage surge suppressor, hard-wire type individual equipment protector for 120 VAC/1 phase/2 wire plus ground.

b. The device shall react within 5 nanoseconds and automatically reset.

c. The voltage protection threshold, line to neutral, shall be no more than 211 volts.

d. The device shall have an independent secondary stage equal to or greater than the primary stage joule rating.
e. The primary suppression system components shall be pure silicon avalanche diodes.

f. The secondary suppression system components shall be silicon avalanche diodes or metal oxide varistors.

g. The device shall have an indication light to indicate the protection components are functioning.

h. All system functions of the transient suppression system shall be individually fused and not short circuit the AC power line at any time.

i. The device shall have an EMI/RFI noise filter with a minimum attenuation of 13 dB at 10 kHz to 300 MHz.

j. The device shall comply with IEEE C62.41.1 and IEEE C62.41.2, Class "B" requirements and be tested according to IEEE C62.45.

k. The device shall be capable of operating between minus 20 degrees F and plus 122 degrees F.

2.4.2.2 Communication Line Surge Protection

Provide surge and transient protection for DDC controllers and DDC network related devices connected to network communication lines, in accordance with the following:

a. The device shall provide continuous, non-interrupting protection, and shall automatically reset after safely eliminating transient surges.

b. The protection shall react within 5 nanoseconds using only solid-state silicon avalanche technology.

c. The device shall be installed at the distance recommended by its manufacturer.

2.4.2.3 Controller Input/Output Protection

Provide controller inputs and outputs with surge protection via optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.

2.4.3 Wiring

Provide complete electrical wiring for the DDC System, including wiring to transformer primaries. Unless indicated otherwise, provide all wiring in electric metallic tubing (EMT). Control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 volts shall be in accordance with Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Run all circuits, metallic tubing, or covered metal raceways with the exception that raceways with wiring to stud partition mounted room sensors may terminate at the immediate interior of the stud space. All EMT junction boxes and EMT accessories used as work of this section shall be furnished with factory applied blue exterior color.

2.4.3.1 Power Wiring

The following requirements are for field-installed wiring:
a. Wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.

b. Wiring for 120 V circuits shall be insulated copper 14 AWG minimum and rated for 600 VAC service.

2.4.3.2 Analog Signal Wiring

Field-installed analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded and have a 20 AWG drain wire. Each wire shall have insulation rated for 300 VAC service. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape.

2.5 INDICATORS

2.5.1 Thermometers

Provide organic liquid filled thermometers at locations shown. Thermometers shall have 9 inch long scales, with insertion, elements. Provide matching thermowells for pipe-mounted installations. Select scale ranges indicated for the intended service. The thermometer's accuracy shall be plus or minus 2 percent of the scale range.

2.5.2 Pressure Gauges for Piping Systems

Provide pipe-mounted pressure gauges at the locations shown. Gauges shall at a minimum conform to ASME B40.100 and have a 4-inch diameter dial, liquid filled casing, piston snubber and EML and shutoff valve. Select scale ranges as indicated for the intended service. The gauge's accuracy shall be plus or minus 2 percent of the scale range.

2.6 Uninterruptible Power Supply (UPS)

The uninterruptible power supply (UPS) shall be a factory fabricated, self-contained device suitable for installation and operation at the location of Server and Workstation hardware and shall be sized to provide a minimum of 20 minutes of operation of the connected hardware. Equipment connected to the UPS shall not be affected in any manner by a power outage of a duration less than the rated capacity of the UPS. UPS shall be complete with all necessary power supplies, transformers, batteries, and accessories and shall include visual indication of normal power operation, UPS operation, abnormal operation and visual and audible indication of AC input loss and low battery power. The UPS shall be UL 1778 approved. UPS powering Server Hardware shall support notification to the server via serial interface of impending battery failure.

PART 3 EXECUTION

3.1 INSTALLATION

Perform the installation through competent technicians in the direct employ of DDC systems manufacturer. System wiring however, may be installed through sub-contract from the work in this Section. The HVAC control system shall be completely installed, tested and ready for operation. Provide dielectric isolation where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be made watertight. The control system
installation shall provide clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control system devices. The control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.1 BACnet Naming and Addressing

Coordinate with the BAS Owner and provide unique naming and addressing for BACnet networks and devices.

a. MAC Address

Every BACnet device shall have an assigned and documented MAC Address unique to its network. For Ethernet networks, document the MAC Address assigned at its creation. For ARCNET or MS/TP, assign from 01 to 64.

b. Network Numbering

Assign unique numbers to each new network installed on the BACnet internetwork. Provide ability for changing the network number; either by device switches, network computer, or field operator interface. The BACnet internetwork (all possible connected networks) can contain up to 65,534 possible unique networks.

c. Device Object Identifier Property Number

Assign unique Device "Object_Identifier" property numbers or device instances for each device on the BACnet internetwork. Provide for future modification of the device instance number; either by device switches, network computer, or field interface. BACnet allows up to 4,194,302 possible unique devices per internetwork.

d. Device Object Name Property Text

The Device Object Name property field shall support 32 minimum printable characters. Assign unique Device "Object_Name" property names with plain-English descriptive names for each device. For example, the Device Object Name that for the device controlling the chiller plant at Building 3408 would be:

Device Object_Name = CW System B3408

A Device Object Name for a VAV box controller might be:

Device Object_Name = VAV BOX25

e. Object Name Property Text (Other than Device Objects)

The Object Name property field shall support 32 minimum printable characters. Assign Object Name properties with plain-English names descriptive of the application using camelCase. Abbreviations, while necessary, shall be standard throughout the control environment and unique (i.e. Don't use SA for supply air temperature everywhere there is air blowing. Use it for FAN supply air temperature, and use a different abbreviation for VAV supply air temperature). Examples include "Zone 1 Temperature" and "Fan Start/Stop".
Object Identifier Property Number (Other than Device Objects)

Assign Object Identifier property numbers according to design drawings or tables if provided. If not provided, Object Identifier property numbers may be assigned at the Contractor's discretion but must be approved by the Government. In this case they must be documented and unique for like object types within the device.

Minimum BACnet Object Requirements

a. Use of Standard BACnet Objects

For the following points and parameters, use standard BACnet objects, where all relevant object properties can be read using BACnet's Read Property Service, and all relevant object properties can be modified using BACnet's Write Property Service:
all device physical inputs and outputs, all set points, all PID tuning parameters, all calculated pressures, flow rates, and consumption values, all alarms, all trends, all schedules, and all equipment and lighting circuit operating status.

b. BACnet Object Description Property

The Object Description property shall support 32 minimum printable characters. For each object, complete the description property field using a brief, narrative, plain English description specific to the object and project application. For example: "HW Pump 1 Proof." Document compliance, length restrictions, and whether the description is writeable in the device PICS.

c. Analog Input, Output, and Value Objects

Support and provide Description and or Device_Type text strings matching signal type and engineering units shown on the points list.

d. Binary Input, Output, and Value Objects

Support and provide Inactive_Text and Active_Text property descriptions matching conditions shown on the points list.

e. Calendar Object

For devices with scheduling capability, provide at least one Calendar Object with ten-entry capacity. All operators may view Calendar Objects; authorized operators may make modifications from a workstation. Enable the writeable Date List property and support all calendar entry data types.

f. Schedule Object

Use Schedule Objects for all building system scheduling. All operators may view schedule entries; authorized operators may modify schedules from a workstation.

g. Loop Object or Equal

Use Loop Objects or equivalent BACnet objects in each applicable field device for PID control. Regardless of program method or object used, allow authorized operators to adjust the Update Interval, Setpoint,
Proportional Constant, Integral Constant, and Derivative Constant using BACnet read/write services.

3.1.3 Minimum BACnet Service Requirements

a. Command Priorities

Use commandable BACnet objects to control machinery and systems, providing the priority levels listed below. If the sequence of operation requires a different priority, obtain approval from the Contracting Officer.

<table>
<thead>
<tr>
<th>Priority Level</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manual-Life Safety</td>
</tr>
<tr>
<td>2</td>
<td>Automatic-Life Safety</td>
</tr>
<tr>
<td>3</td>
<td>(User Defined)</td>
</tr>
<tr>
<td>4</td>
<td>(User Defined)</td>
</tr>
<tr>
<td>5</td>
<td>Critical Equipment Control</td>
</tr>
<tr>
<td>6</td>
<td>Minimum On/Off</td>
</tr>
<tr>
<td>7</td>
<td>(User Defined)</td>
</tr>
<tr>
<td>8</td>
<td>Manual Operator</td>
</tr>
<tr>
<td>9</td>
<td>(User Defined)</td>
</tr>
<tr>
<td>10</td>
<td>(User Defined)</td>
</tr>
<tr>
<td>11</td>
<td>Load Shedding</td>
</tr>
<tr>
<td>12</td>
<td>(User Defined)</td>
</tr>
<tr>
<td>13</td>
<td>(User Defined)</td>
</tr>
<tr>
<td>14</td>
<td>(User Defined)</td>
</tr>
<tr>
<td>15</td>
<td>(User Defined)</td>
</tr>
<tr>
<td>16</td>
<td>(User Defined)</td>
</tr>
</tbody>
</table>

b. Alarming

(1) Alarm Priorities - Coordinate alarm and event notification with the BAS Owner.

(2) Notification Class - Enable writeable Priority, Ack Required, and Recipient List properties of Notification Class objects.

(3) Event Notification Message Texts - Use condition specific
narrative text and numerical references for alarm and event notification.

c.  Updating Displayed Property Values

Allow workstations to display property values at discrete polled intervals, or based on receipt of confirmed and unconfirmed Change of Value notifications. The COV increment shall be adjustable by an operator using BACnet services, and polled intervals shall be adjustable at the operator workstation.

3.1.4  Local Area Networks

Coordinate the procurement of a utility company cable model and service with the Contracting Officer to enable internet communication. Network numbers and device instance numbers shall remain unique when joining networks. Do not change existing network addressing without Government approval. See also "BACnet Naming and Addressing".

3.1.5  BACnet Routers and Protocol Gateways

Provide the quantity of BACnet routers necessary for communications shown on the submitted BACnet Communication Architecture schematic. Provide BACnet routers with BACnet Broadcast Message Device (BBMD) capability on each BACnet internetwork communicating across an IP network. Configure BBMD tables to enable unicast forwarding of broadcast messaging across Layer-3 IP subnets.

3.1.5.1  Cable Modem

Arrange with Contracting Officer to acquire a cable modem to enable out of facility internet access. DDC Networks shall not connect to non-DDC Facility Communications Systems. Provide internet capability through modem.

3.1.6  Wiring Criteria

a.  Run circuits operating rigid electric metallic tubing or covered metal raceways.

b.  Do not run binary control circuit wiring in the same conduit as power wiring over 100 volts. Where analog signal wiring requires conduit, do not run in the same conduit with AC power circuits or control circuits operating at more than 100 volts.

c.  Provide circuit and wiring protection required by NFPA 70.

d.  Run all wiring located inside mechanical rooms in conduit.

e.  Do not bury aluminum conduit in concrete.

f.  Input/output identification: Permanently label each field-installed wire, cable, and pneumatic tube at each end with descriptive text using a commercial wire marking system that fully encircles the wire, cable, or tube. Locate the markers within 2 inches of each termination. Match the names and I/O number to the project's point list. Similarly label all power wiring serving control devices, including the word "power" in the label. Label all terminal blocks with alpha/numeric labels. All wiring and the wiring methods shall be in accordance with UL 508A.
g. For controller power, provide new 120 VAC circuits, with ground. Provide each circuit with a dedicated breaker, and run wiring in its own conduit, separate from any control wiring. Connect the controller's ground wire to the electrical panel ground; conduit grounds are not acceptable. For DDC control panels, workstation computer and servers indicated to be equipped with an uninterruptible power supply systems provide control panel.

h. Surge Protection: Install surge protection according to manufacturer's instructions. Multiple controllers fed from a common power supply may be protected by a common surge protector, properly sized for the total connected devices.

i. Grounding: Ground controllers and cabinets to a good earth ground as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Conduit grounding is not acceptable; all grounding shall have a direct path to the building earth ground. Ground sensor drain wire shields at the controller end.

j. The Contractor shall be responsible for correcting all associated ground loop problems.

k. Run wiring in panel enclosures in covered wire track.

l. Final connections to wired duct and pipe mounted sensors may be constructed with flexible metallic tubing; seal-tight in wet locations.

m. For sheathed cable terminations at conduit ends, provide rubber grommet compression fittings to seal ends.

3.1.7 Wiring Interlocks

Provide wiring interlocks and DDC communication points as indicated and necessary to accomplish sequences of operation. It is the work of this Section to coordinate the interface type; gateway, direct low-voltage interlock wiring, terminal connections and communication platform with the additional sub-control systems furnished under this Contract such as but not limited to the water chillers, hot water boilers, variable-primary pumping systems, surgery air valve systems, computer room systems, fuel oil systems, standby electrical power system, fuel oil systems, medical gas systems and heat trace cable systems.

3.1.8 Accessibility

Install all equipment so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install digital controllers, data ports, and concealed actuators, valves, dampers, and like equipment in locations freely accessible through access doors.

3.1.9 Digital Controllers

a. Install as stand alone control devices (see definitions).

b. Locate control cabinets at the locations shown on the drawings. If not shown on the drawings, install in the most accessible space, close to the controlled equipment.
3.1.10 Hand-Off-Auto Switches

Wire safety controls such as smoke detectors and freeze protection thermostats to protect the equipment during both hand and auto operation.

3.1.11 Temperature/Humidity Sensors

Install temperature and humidity sensors in locations that are accessible and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate sensors according to manufacturer's instructions. Do not use sensors designed for one application in a different application.

3.1.11.1 Room/Humidity Temperature Sensors

Room sensor locations are indicated on Contract Drawings to primarily associate terminal cooling or heating units with the space served. Provide final coordination of sensor locations to facilitate the installation of adjacent trade materials, finishes and Contractor or Owner provided equipment. The primary mounting location for room sensors is at stud partition work or masonry walls. Coordinate and shift final sensor locations to avoid wood panels, laminate panels, metal panels and similar decorative surface finish conditions. Prior to rough-in of room sensors, coordinate through Contracting Officer, final sensor locations with equipment furnished under this contract, Owner furnished furniture, equipment, wall hangings and similar items which may either prevent the installation of the sensor where indicated on the Contract Drawings. Mount the sensors on interior walls to sense the average room temperature. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount sensors at centerline common with electrical switch mounting heights.

3.1.11.2 Duct Temperature Sensors

a. Probe Type: Provide a gasket between the sensor housing and the duct wall. Seal the duct termination air tight. Seal the duct insulation penetration vapor tight.

b. Averaging Type (and coil freeze protection thermostats): Weave the capillary tube sensing element in a serpentine fashion perpendicular to the flow, across the duct or air handler cross-section, using durable non-metal supports. Prevent contact between the capillary and the duct or air handler internals. Provide a duct access door at the sensor location. The access door shall be hinged on the side, factory insulated, have cam type locks, and be as large as the duct will permit, maximum 18 by 18 inches. For sensors inside air handlers, the sensors shall be fully accessible through the air handler's access doors without removing any of the air handler's internals.

3.1.11.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring piping, tank, or pressure vessel temperatures. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide thermal conductivity material within the well to fully coat the inserted sensor.
3.1.11.4 Outside Air Temperature Sensors

Provide outside air temperature sensors in weatherproof enclosures on the north side of the building, away from exhaust hoods and other areas that may affect the reading. Provide a shield to shade the sensor from direct sunlight.

3.1.12 Meters

Locate meters as indicated. Connect each meter output to the DDC system, to measure both instantaneous and accumulated energy usage.

3.1.13 Damper Actuators

Mount actuators outside the air stream in accessible areas. Coordinate damper locations with ductwork installer.

3.1.14 Thermometers and Gages

Mount devices to allow reading while standing on the floor or ground, as applicable. Coordinate thermometer and gage locations with piping installers.

3.1.15 Pressure Sensors

Locate pressure sensors where indicated; coordinate locations with ductwork and piping installers.

3.1.16 Sensing Tubing

Tubing shall be run at right angles to and perpendicular to ductwork, piping and building structure. For air and dry pressure sensors, sensing tubing may be either hard drawn copper with soldered or flared wrought copper fittings or aluminum with flared fittings. Minimum size shall be \( \frac{1}{4} \) inch diameter. Maximum tubing length shall not exceed 3 lineal feet. Final connections to transmitters may be constructed of \( \frac{1}{4} \) inch diameter nylon tubing with flare fittings; length not to exceed three inches. For wet pressure sensors, provide hard drawn copper sensing tubing with soldered fittings in accordance with Section 23 64 26, CHILLED AND HOT WATER PIPING SYSTEMS. Provide reducers at transmitters and connect with threaded fittings. Wet sensing lines shall be minimum \( \frac{1}{2} \) inch diameter.

3.1.17 Component Identification Labeling

Using an electronic hand-held label maker with white tape and bold black block lettering, provide an identification label on the exterior of each new control panel, control device, actuator, and sensor. Also provide labels on the exterior of each new control actuator indicating the (full) open and (full) closed positions. For labels located outdoors, use exterior grade label tape, and provide labels on both the inside and outside of the panel door or device cover. Acceptable alternatives are white plastic labels with engraved bold black block lettering permanently attached to the control panel, control device, actuator, and sensor. Have the labels and wording approved by the BAS Owner prior to installation.

3.1.18 Network Communication Lines

When telephone lines or network connections by the Government are
required, provide the Contracting Officer at least 60 days advance notice of need.

3.1.19 Device Mounting Criteria

Install all devices in accordance with manufacturer's recommendations and as specified and shown. Provide control devices installed in piping and ductwork with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements shall not be used except as specified. Install spare thermowells adjacent to each thermowell containing a sensor and as shown. Devices located outdoors shall have a weathershield.

3.1.20 Labels and Tags

Key labels and tags to the unique identifiers shown on the As-Built drawings. Label all enclosures and DDC hardware. All sensors and actuators in mechanical rooms shall be tagged. Tag airflow measurement arrays to show flow rate range for signal output range, and duct size. Duct static pressure taps shall be tagged at the location of the pressure tap. Tags shall be plastic or metal and shall be mechanically attached directly to each device or attached by a metal chain or wire. Labels, outside of protective enclosures, shall be engraved plastic and mechanically attached to the enclosure or DDC Hardware. Labels inside protective enclosures may attached using adhesive, but shall not be hand written.

3.1.21 DDC Hardware

Install DDC hardware in metallic control panel enclosures. Provide local control bus cables indicated.

3.1.22 Gateways

Provide gateways for sub-control interfaces indicated and elsewhere as required to accomplish sequences of operation on Contract Drawings.

3.1.23 Network Interface Jack

A standard network interface jack shall be provided for each controller on the control network. For terminal unit controllers with hardwired sensors this network interface jack shall be located at the sensor or within 10 feet of the controller. Locating the interface jack at the sensor is preferred. For all other nodes the network interface jack shall be located within 10 feet of the node. If the network interface jack is other than a 1/8 inch phone jack, provide an interface cable with a standard 1/8 inch phone jack on one end and a connector suitable for mating with installed network interface jack on the other. No more than one type of interface cable shall be required to access all network interface jacks. Furnish two interface cable(s).

3.1.24 Temperature Limit Switch

A temperature limit switch (freezestat) shall be provided to sense the temperature at the location shown. A sufficient number of temperature limit switches (freezestats) shall be installed to provide complete coverage of the duct section. Manual reset limit switches shall be installed in approved, accessible locations where they can be reset.
easily. The temperature limit switch (freezestat) sensing element shall be installed in a serpentine pattern and in accordance with the manufacturer's installation instructions.

3.1.25 Averaging Temperature Sensing Elements

Sensing elements shall be installed in a serpentine pattern located where shown.

3.1.26 Air Flow Measurement Stations (AFMS)

Locate where indicated.

3.1.27 Duct Static Pressure Sensors

The duct static pressure sensing tap shall be located where indicated but not beyond 75 percent of the distance from the AHU outlet. Transmitters shall be wired in a homerun configuration to the system controller.

3.1.28 Relative Humidity Sensors

Relative humidity sensors in supply air ducts shall be installed at least 10 feet downstream of humidity injection elements.

3.1.29 Flowmeters

Coordinate installation of piping flow meters with Section 23 64 26, CHILLED AND HOT WATER PIPING installer. The minimum straight unobstructed piping for the flowmeter installation shall be a minimum of 10 pipe diameters upstream and at least 5 pipe diameters downstream and in accordance with the manufacturer's installation instructions.

3.1.30 Dampers

3.1.30.1 Damper Actuators

Coordinate damper installations with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION AND EXHAUST SYSTEMS installers. Actuators shall not be mounted in the air stream. Multiple actuators shall not be connected to a common drive shaft. Actuators shall be installed so that their action shall seal the damper to the extent required to maintain leakage at or below the specified rate and shall move the blades smoothly. Coordinate and provide control and operation of damper and valve actuators which are factory supplied as an integral part of assembly such as fire/smoke dampers and internal face/bypass heating coils to enable sequence of operation.

3.1.30.2 Damper Installation

Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking (parallelogramming), bowing, or other installation error. Blades shall close completely and leakage shall not exceed that specified at the rated static pressure. Provide structural support for multi-section dampers and multiple damper arrays. Acceptable methods include but are not limited to U-channel, angle iron, corner angles and bolts, bent galvanized steel stiffeners, sleeve attachments, braces, and building structure. Where multi-section dampers and multiple damper arrays are installed in ducts or sleeves, they shall not sag due to
lack of support. Jackshafts shall not be used to link more than three
damper sections. Blade to blade linkages shall not be used. Outside and
return air dampers shall be installed such that their blades direct their
respective air streams towards each other to provide for maximum mixing of
air streams.

3.1.31 Valves

3.1.31.1 Ball Valves

Coordinate installation of piping motor actuated valves with Section 23 64 26, CHILLED AND HOT WATER PIPING installer. Provide attachment of actuators to valves. In modulating applications a characterizing equal-percentage bore shall be used.

3.1.31.2 Butterfly Valves

In modulating control applications, valve travel shall be limited to 70 percent (60 degrees) open position.

3.2 TEST AND BALANCE SUPPORT

The controls contractor shall coordinate with and provide on-site support to the test and balance (TAB) personnel specified under Section 23 05 93 TESTING, ADJUSTING AND BALANCING. This support shall include:

a. On-site operation and manipulation of control systems during the testing and balancing.

b. Control setpoint adjustments for balancing all relevant mechanical systems, including VAV air terminal units.

c. Tuning control loops with setpoints and adjustments determined by TAB personnel.

3.3 CONTROLS SYSTEM OPERATORS MANUALS

Provide two electronic and printed copies of a Controls System Operators Manual. The manual shall be specific to the project, written to actual project conditions, and provide a complete and concise depiction of the installed work. Provide information in detail to clearly explain all operation requirements for the control system.

Provide with each manual: CDs of the project's control system drawings, control programs, data bases, graphics, and all items listed below. Include gateway back-up data and configuration tools where applicable. Provide CDs in jewel case with printed and dated project-specific labels on both the CD and the case. For text and drawings, use Adobe Acrobat or MS Office file types. When approved by the Government, AutoCAD and Visio files are allowed. Give files descriptive English names and organize in folders.

Provide printed manuals in sturdy 3-ring binders with a title sheet on the outside of each binder indicating the project title, project location, contract number, and the controls contractor name, address, and telephone number. Each binder shall include a table of contents and tabbed dividers, with all material neatly organized. Manuals shall include the following:
a. A copy of the as-built control system (shop) drawings set, with all items specified under the paragraph SUBMITTALS. Indicate all field changes and modifications.

b. A copy of the project's mechanical design drawings, including any official modifications and revisions.

c. A copy of the project's approved Product Data submittals provided under the paragraph SUBMITTALS.

d. A copy of the project's approved Performance Verification Testing Plan and Report.

e. A copy of the project's approved final TAB Report.

f. Printouts of all control system programs, including controller setup pages if used. Include plain-English narratives of application programs, flowcharts, and source code.

g. Printouts of all physical input and output object properties, including tuning values, alarm limits, calibration factors, and set points.

h. A table entitled "AC Power Table" listing the electrical power source for each controller. Include the building electrical panel number, panel location, and circuit breaker number.

i. The DDC manufacturer's hardware and software manuals in both print and CD format with printed project-specific labels. Include installation and technical manuals for all controller hardware, operator manuals for all controllers, programming manuals for all controllers, operator manuals for all workstation software, installation and technical manuals for the workstation and notebook, and programming manuals for the workstation and notebook software.

j. A list of qualified control system service organizations for the work provided under this contract. Include their addresses and telephone numbers.

k. A written statement entitled "Technical Support" stating the control system manufacturer or authorized representative will provide toll-free telephone technical support at no additional cost to the Government for a minimum of two years from project acceptance, will be furnished by experienced service technicians, and will be available during normal weekday working hours. Include the toll-free technical support telephone number.

l. A written statement entitled "Software Upgrades" stating software and firmware patches and updates will be provided upon request at no additional cost to the Government for a minimum of two years from contract acceptance. Include a table of all DDC system software and firmware provided under this contract, listing the original release dates, version numbers, part numbers, and serial numbers.

3.3.1 Storage Cabinets

In each project mechanical room, provide a wall-mounted metal storage cabinet with hinged doors. In addition to the number of manuals specified above, provide an additional copy of the manuals in each of these
mechanical room storage cabinets. Provide cabinets large enough to hold the entire set of Controls System Operators Manuals, and the HVAC operation and maintenance manuals. Locate cabinets adjacent to DDC control panels where applicable. Have each cabinet's proposed installation site approved in advance by the Contracting Officer and the BAS Owner. Prominently label each cabinet with the wording "OPERATION AND MAINTENANCE MANUALS." Prominently label each binder with the wording "MECHANICAL ROOM COPY - DO NOT REMOVE."

3.4 PERFORMANCE VERIFICATION TESTING (PVT)

3.4.1 General

The PVT shall demonstrate compliance of the control system work with the contract requirements. The PVT shall be performed by the Contractor and witnessed and approved by the Government. If the project is phased, provide separate testing for each phase. A Pre-PVT meeting to review the Pre-PVT Checklist is required to coordinate all aspects of the PVT and shall include the Contractor's QA representative, the Contractor's PVT administrator, the Contracting Officer's representative.

3.4.2 Performance Verification Testing Plan

Submit a detailed PVT Plan of the proposed testing for Government approval. Develop the PVT Plan specifically for the control system in this contract. The PVT Plan shall be a clear list of test items arranged in a logical sequence. Include the purpose of each test, intended test procedure, test setup and test conditions, the expected response, and the pass/fail criteria for every component tested.

The plan shall clearly describe how each item is tested, indicate where assisting personnel are required (like the mechanical contractor), and include what procedures are used to simulate conditions. Include a separate column for each checked item and extra space for comments. Where sequences of operations are checked, insert each corresponding routine from the project’s sequence of operation. For each test area, include signature and date lines for the Contractor's PVT administrator, the Contractor's QA representative, the Contracting Officer's representative, and the BAS Owner to acknowledge successful completion.

3.4.3 PVT Sample Size

Test all central plant equipment, exhaust fans, VFR units, fan coils and primary air handling unit controllers unless otherwise directed. Twenty percent sample testing is allowed for identical controllers typical of terminal control like VAV boxes, VFR units and fan coil units. The Government may require testing of like controllers beyond a statistical sample if sample controllers require retesting or do not have consistent results.

The Government may witness all testing, or random samples of PVT items. When only random samples are witnessed, the Government may choose which ones.

3.4.4 Pre-Performance Verification Testing Checklist

Submit the following as a list with items checked off once verified. Provide a detailed explanation for any items that are not completed or verified.
a. Verify all required mechanical installation work is successfully completed, and all HVAC equipment is working correctly (or will be by the time the PVT is conducted).

b. Verify HVAC motors operate below full-load amperage ratings.

c. Verify all required control system components, wiring, and accessories are installed.

d. Verify the installed control system architecture matches approved drawings.

e. Verify all control circuits operate at the proper voltage and are free from grounds or faults.

f. Verify all required surge protection is installed.

g. Verify the A/C Power Table specified in the paragraph CONTROLS SYSTEM OPERATORS MANUALS is accurate.

h. Verify all DDC network communications function properly, including uploading and downloading programming changes.

i. Using the BACnet protocol analyzer (if provided or required in this specification), verify communications are error free.

j. Verify each digital controller’s programming is backed up.

k. Verify all wiring, components, and panels are properly labeled.

l. Verify all required points are programmed into devices.

m. Verify all TAB work affecting controls is complete.

n. Verify all valve and actuator zero and span adjustments are set properly.

o. Verify all sensor readings are accurate and calibrated.

p. Verify each control valve and actuator goes to normal position upon loss of power.

q. Verify all control loops are tuned for smooth and stable operation. View trend data where applicable.

r. Verify each controller works properly in stand-alone mode.

s. Verify all safety controls and devices function properly, including freeze protection and interfaces with building fire alarm systems.

t. Verify all electrical interlocks work properly.

u. Verify all workstations, notebooks and maintenance personnel interface tools are delivered, all system and database software is installed, and graphic pages are created for each workstation and notebook.

v. Verify the as-built (shop) control drawings are completed.
3.4.5 Performance Verification Test Procedures

Six copies of the HVAC Control System Performance Verification Test Procedures, in booklet form and indexed, 60 days before the Contractor's scheduled test dates. The performance verification test procedures shall refer to the devices by their unique identifiers as shown, shall explain, step-by-step, the actions and expected results that will demonstrate that the HVAC control system performs in accordance with the sequences of operation, and other contract documents. An HVAC control system performance verification test equipment list shall be included that lists the equipment to be used during performance verification testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

3.4.6 Conducting Performance Verification Testing

a. Conduct Government-witnessed PVT after approval of the PVT Plan and the completed Pre-PVT Checklist. Notify the Contracting Officer of the planned PVT at least 15 days prior to testing. Provide an estimated time table required to perform the testing. Furnish personnel, equipment, instrumentation, and supplies necessary to perform all aspects of the PVT. Ensure that testing personnel are regularly employed in the testing and calibration of DDC systems. Using the project's as-built control system (shop) drawings, the project's mechanical design drawings, the approved Pre-PVT Checklist, and the approved PVT Plan, conduct the PVT.

b. During testing, identify any items that do not meet the contract requirements and if time permits, conduct immediate repairs and re-test. Otherwise, deficiencies shall be investigated, corrected, and re-tested later. Document each deficiency and corrective action taken.

c. If re-testing is required, follow the procedures for the initial PVT. The Government may require re-testing of any control system components affected by the original failed test.

3.4.7 Controller Capability and Labeling

Test the following for each controller:

a. Memory: Demonstrate that programmed data, parameters, and trend/alarm history collected during normal operation is not lost during power failure.

b. Direct Connect Interface: Demonstrate the ability to connect directly to each type of digital controller with a portable electronic device like a notebook computer or PDA. Show that maintenance personnel interface tools perform as specified in the manufacturer's technical literature.

c. Stand Alone Ability: Demonstrate controllers provide stable and reliable stand-alone operation using default values or other method for values normally read over the network.

d. Wiring and AC Power: Demonstrate the ability to disconnect any controller safely from its power source using the AC Power Table. Demonstrate the ability to match wiring labels easily with the control...
drawings. Demonstrate the ability to locate a controller's location using the BACnet Communication Architecture Schematic and floor plans.

e. Nameplates and Tags: Show the nameplates and tags are accurate and permanently attached to control panel doors, devices, sensors, and actuators.

3.4.8 Workstation and Software Operation

For every user workstation or notebook provided:

a. Show points lists agree with naming conventions.

b. Show that graphics are complete.

c. Show the UPS operates as specified.

3.4.9 BACnet Communications and Interoperability Areas

Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. If available or required in this specification, use a BACnet protocol analyzer to assist with identifying devices, viewing network traffic, and verifying interoperability. These requirements must be met even if there is only one manufacturer of equipment installed. Testing includes the following:

a. Data Presentation: On each BACnet Operator Workstation, demonstrate graphic display capabilities.

b. Reading of Any Property: Demonstrate the ability to read and display any used readable object property of any device on the network.

c. Setpoint and Parameter Modifications: Show the ability to modify all setpoints and tuning parameters in the sequence of control or listed on project schedules. Modifications are made with BACnet messages and write services initiated by an operator using workstation graphics, or by completing a field in a menu with instructional text.

d. Peer-to-Peer Data Exchange: Show all BACnet devices are installed and configured to perform BACnet read/write services directly (without the need for operator or workstation intervention), to implement the project sequence of operation, and to share global data.

e. Alarm and Event Management: Show that alarms/events are installed and prioritized according to the BAS Owner. Demonstrate time delays and other logic is set up to avoid nuisance tripping, e.g., no status alarms during unoccupied times or high supply air during cold morning start-up. Show that operators with sufficient privilege can read and write alarm/event parameters for all standard BACnet event types. Show that operators with sufficient privilege can change routing (BACnet notification classes) for each alarm/event including the destination, priority, day of week, time of day, and the type of transition involved (types of transition include but are not limited to the following: TO-OFF NORMAL and TO-NORMAL).

f. Schedule Lists: Show that schedules are configured for start/stop, mode change, occupant overrides, and night setback as defined in the sequence of operations.
g. Schedule Display and Modification: Show the ability to display any schedule with start and stop times for the calendar year. Show that all calendar entries and schedules are modifiable from any connected workstation by an operator with sufficient privilege.

h. Archival Storage of Data: Show that data archiving is handled by the operator workstation/server, and local trend archiving and display is accomplished with BACnet Trend Log objects.

i. Modification of Trend Log Object Parameters: Show that an operator with sufficient privilege can change the logged data points, sampling rate, and trend duration.

j. Device and Network Management: Show the following capabilities:
   1. Display of Device Status Information
   2. Display of BACnet Object Information
   3. Silencing Devices that are Transmitting Erroneous Data
   4. Time Synchronization
   5. Remote Device Reinitialization
   6. Backup and Restore Device Programming and Master Database(s)
   7. Configuration Management of Half-Routers, Routers and BBMDs

3.4.10 Execution of Sequence of Operation

Demonstrate that the HVAC system operates properly through the complete sequence of operation. Use read/write property services to globally read and modify parameters over the internetwork.

3.4.11 Control Loop Stability and Accuracy

For all control loops tested, give the Government trend graphs of the control variable over time, demonstrating that the control loop responds to a 20 percent sudden change of the control variable set point without excessive overshoot and undershoot. If the process does not allow a 20 percent set point change, use the largest change possible. Show that once the new set point is reached, it is stable and maintained. Control loop trend data shall be in real-time with the time between data points 30 seconds or less.

3.4.12 Performance Verification Testing Report

Upon successful completion of the PVT, submit a PVT Report to the Government and prior to the Government taking use and possession of the facility. Do not submit the report until all problems are corrected and successfully re-tested. The report shall include the annotated PVT Plan used during the PVT. Where problems were identified, explain each problem and the corrective action taken. Include a written certification that the installation and testing of the control system is complete and meets all of the contract's requirements.
3.5 CONTROLLER TUNING

Calibrate each controller. Tuning shall consist of adjustment of the proportional, integral, and where applicable, the derivative (PID) settings to provide stable closed-loop control. Each loop shall be tuned while the system or plant is operating at a high gain (worst case) condition, where high gain can generally be defined as a low-flow or low-load condition. Upon final adjustment of the PID settings, in response to a change in controller setpoint, the controlled variable shall settle out at the new setpoint with no more than two (2) oscillations above and below setpoint. Upon settling out at the new setpoint the controller output shall be steady. With the exception of naturally slow processes such as zone temperature control, the controller shall settle out at the new setpoint within five (5) minutes. Return the controller to its original setpoint and shall record and submit the final PID configuration settings with the O&M Instructions and on the associated Points Schedule.

3.6 START-UP AND START-UP TEST

Perform the following startup tests for each control system to ensure that the described control system components are installed and functioning in accordance with this specification.

a. General: Adjust, calibrate, measure, program, configure, set the time schedules, set alarms, and otherwise perform all necessary actions to ensure that the systems function as specified and shown in the sequence of operation and other contract documents.

b. Systems Check: An item-by-item check shall be performed for each HVAC system;

1) Step 1 - System Inspection: With the system shut down, it shall be verified that power and main air are available where required and that all output devices are in their failsafe and normal positions. Each local display panel shall be inspected to verify that all displays indicate shutdown conditions.

2) Step 2 - Calibration Accuracy Check: A two-point accuracy check of the calibration of each HVAC control system sensing element and transmitter shall be performed by comparing the output from the DDC Hardware the sensor is connected to the actual value of the variable measured at the sensing element. Digital indicating test instruments shall be used, such as digital thermometers, motor-driven psychrometers, and tachometers. The test instruments shall be at least twice as accurate as the specified sensor accuracy. The calibration of the test instruments shall be traceable to National Institute Of Standards And Technology standards. The first check point shall be with the HVAC system in the shutdown condition, and the second check point shall be with the HVAC system in an operational condition. Calibration checks shall verify that the sensing element-to-DDC system readout accuracies at two points are within the specified product accuracy tolerances. If not, the device shall be recalibrated or replaced and the calibration check repeated.

3) Step 3 - Actuator Range Check: With the system running, a signal shall be applied to each actuator through the DDC Hardware controller. Proper operation of the actuators and positioners for
all actuated devices shall be verified and the signal levels shall be recorded for the extreme positions of each device. The signal shall be varied from live zero to full range, and it shall be verified that the actuators travel from zero stroke to full stroke within the signal range. Where applicable, it shall be verified that all sequenced actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

c. Weather Dependent Test: Weather dependent test procedures that cannot be performed by simulation shall be performed in the appropriate climatic season. When simulation is used, the actual results shall be verified in the appropriate season.

d. Test Report: Upon completion of the Start-Up Test, prepare and submit a Start-Up and Start-Up Testing Report documenting the results of the tests performed and certifying that the system is installed and functioning in accordance with this specification, and is ready for the Performance Verification Test (PVT).

3.7 TRAINING REQUIREMENTS

Provide a qualified instructor (or instructors) with two years minimum field experience with the installation and programming of similar BACnet DDC systems. Orient training to the specific systems installed. Coordinate training times and location with the Contracting Officer and BAS Owner after receiving approval of the training course documentation. Training shall take place at the job site. A training day shall occur during normal working hours, last no longer than 8 hours and include a one-hour break for lunch and two additional 15-minute breaks. The project's approved Controls System Operators Manual shall be used as the training text. The Contractor shall ensure the manuals are submitted, approved, and available to hand out to the trainees before the start of training.

3.7.1 Training Documentation

Submit training documentation for review 30 days minimum before training. Documentation shall include an agenda for each training day, objectives, a synopses of each lesson, and the instructor's background and qualifications. The training documentation can be submitted at the same time as the project's Controls System Operators Manual.

3.7.2 Phase I Training - Fundamentals

The Phase I training session shall last one day and be conducted in a classroom environment with complete audio-visual aids provided by the contractor. Provide each trainee a printed 8.5 by 11 inch hard-copy of all visual aids used. Upon completion of the Phase I Training, each trainee should fully understand the project's DDC system fundamentals. The training session shall include the following:

a. BACnet fundamentals (objects, services, addressing) and how/where they are used on this project

b. This project's list of control system components

c. This project's list of points and objects
d. This project's device and network communication architecture

e. This project's sequences of control, and:

f. Alarm capabilities

g. Trending capabilities

h. Troubleshooting communication errors

i. Troubleshooting hardware errors

3.7.3 Phase II Training - Operation

Provide Phase II Training shortly after completing Phase I Training. The Phase II training session shall last one day and be conducted at the DDC system workstation, at a notebook computer connected to the DDC system in the field, and at other site locations as necessary. Upon completion of the Phase II Training, each trainee should fully understand the project's DDC system operation. The training session shall include the following:

a. A walk-through tour of the mechanical system and the installed DDC components (components include but are not limited to the following: controllers, valves, dampers, surge protection, switches, thermostats, and sensors)

b. A discussion of the components and functions at each DDC panel

c. Logging-in and navigating at each operator interface type

d. Using each operator interface to find, read, and write to specific controllers and objects

e. Modifying and downloading control program changes

f. Modifying setpoints

g. Creating, editing, and viewing trends

h. Creating, editing, and viewing alarms

i. Creating, editing, and viewing operating schedules and schedule objects

j. Backing-up and restoring programming and data bases

k. Modifying graphic text, backgrounds, dynamic data displays, and links to other graphics

l. Creating new graphics and adding new dynamic data displays and links

m. Alarm and Event management

n. Adding and removing network devices

3.8 COMMISSIONING

Provide the services of a supervisory level technician, in responsible charge of the work in this section, and factory authorized start-up and service technicians; for each major component or system in this section,
to participate in the work specified in Section 23 08 02.00 50
COMMISSIONING OF HVAC SYSTEMS. Coordinate PVT work with the requirements
of Section 23 08 00.02 50, COMMISSIONING OF HVAC. Where a test is
indicated as part of functional performance testing in Section
23 08 02.00 50, it shall be provided as work of Section 23 08 02.00 50 or
this section as deemed practicable by the Cx. For each of these items,
the PVT report required by this section or the commissioning report
required by Section 23 08 02.00 50 shall be annotated to indicate where
the test results are recorded.

3.9 CYBERSECURITY

Provide completed Cybersecurity Hygiene Checklist in accordance with
Section 25 50 00.00 20 CYBERSECURITY OF FACILITY-RELATED CONTROL SYSTEMS.

3.10 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19
CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1  GENERAL

1.1  SUMMARY

This specification section applies to incidental underground piping under building, and above ground steel piping both outside (up to 5 feet beyond exterior walls) and within buildings in compliance with NFPA 54/AGA Z223.1 "Fuel Gas Piping".

1.2  REFERENCES

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

AMERICAN GAS ASSOCIATION (AGA)

AGA XR0603 (2006; 8th Ed) AGA Plastic Pipe Manual for Gas Service


AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


ANSI Z21.18/CSA 6.3 (2007; Addenda A 2010; Addenda B 2012; R 2013) Gas Appliance Pressure Regulators


AMERICAN PETROLEUM INSTITUTE (API)

API 570 (2009, 3rd Ed) Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems


API Spec 6D (2014; Errata 1-2 2014; Errata 3 2015; ADD 1 2015) Specification for Pipeline Valves
API Std 598 (2009) Valve Inspecting and Testing

ASME INTERNATIONAL (ASME)


ASME B1.1 (2003; R 2008) Unified Inch Screw Threads (UN and UNR Thread Form)

ASME B1.20.1 (2013) Pipe Threads, General Purpose (Inch)

ASME B16.11 (2011) Forged Fittings, Socket-Welding and Threaded

ASME B16.21 (2011) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.3 (2011) Malleable Iron Threaded Fittings, Classes 150 and 300


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


ASME B31.8 (2014; Supplement 2014) Gas Transmission and Distribution Piping Systems

ASME B31.9 (2014) Building Services Piping

ASME B40.100 (2013) Pressure Gauges and Gauge Attachments

ASME BPVC SEC IX (2010) BPVC Section IX-Welding and Brazing Qualifications

ASME BPVC SEC VIII D1 (2010) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1
ASME PTC 25 (2014) Pressure Relief Devices

ASTM INTERNATIONAL (ASTM)


ASTM A194/A194M (2014a) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both


ASTM D2513 (2014; E 2014) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings


ASTM D2774 (2012) Underground Installation of Thermoplastic Pressure Piping


CSA GROUP (CSA)


MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)


MSS SP-69 (2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI...
1.3 SYSTEM DESCRIPTION

The gas piping system includes natural gas piping and appurtenances from point of connection with supply system, as indicated, to gas operated equipment within the facility. Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, in three separate packages. Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies to this section, with additions and modifications specified herein.

1.3.1 Gas Facility System and Equipment Operation

Include shop drawings showing piping layout, locations of system valves, gas line markers; step-by-step procedures for system start up, operation and shutdown (index system components and equipment to the system drawings); isolation procedures including valve operation to shutdown or isolate each section of the system (index valves to the system maps and provide separate procedures for normal operation and emergency shutdown if required to be different). Submit Data package No. 4.

1.3.2 Gas Facility System Maintenance

Include maintenance procedures and frequency for system and equipment; identification of pipe materials and manufacturer by locations, pipe repair procedures, and jointing procedures at transitions to other piping material or material from a different manufacturer. Submit Data Package No.4.
1.3.3 Gas Facility Equipment Maintenance

Include identification of valves, shut-offs, test ports, gages, gage cocks disconnects, and other equipment by materials, manufacturer, vendor identification and location; maintenance procedures and recommended tool kits for valves and equipment; recommended repair methods (i.e., field repair, factory repair, or replacement) for each valve and piece of equipment; and preventive maintenance procedures, possible failure modes and troubleshooting guide. Submit Data Package No. 3.

1.4 SUBMITTALS

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

SD-02 Shop Drawings
   Gas Piping System; G

SD-03 Product Data
   Pipe and Fittings; G
   Pressure regulators; G
   Risers; G
   Transition fittings; G
   Valves; G
   Warning and identification tape; G
   Gas Meters; G
   Identification Materials; G

SD-06 Test Reports
   Pressure Tests; G
   Test With Gas; G

SD-07 Certificates
   Welders procedures and qualifications; G
   assigned number, letter, or symbol; G

SD-08 Manufacturer's Instructions
   polyethylene (PE) pipe and fittings; G
   pipe coating materials; G

SD-10 Operation and Maintenance Data
   Gas facility system and equipment operation; G
   Gas facility system maintenance; G
   Gas facility equipment maintenance; G

1.5 QUALITY ASSURANCE

Submit manufacturer's descriptive data and installation instructions for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Mark all valves, flanges and fittings in accordance with MSS SP-25.
1.5.1 Welding Qualifications

a. Weld piping in accordance with qualified procedures using performance qualified welders and welding operators in accordance with API RP 2009, ASME BPVC SEC IX, and ASME B31.9. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.9. Notify the Contracting Officer at least 24 hours in advance of tests, and perform at the work site if practicable.

b. Submit a certified copy of welders procedures and qualifications metal and PE in conformance with ASME B31.9 for each welder and welding operator. Submit the assigned number, letter, or symbol that will be used in identifying the work of each welder to the Contracting Officer.

1.5.2 Jointing Thermoplastic Piping

Perform all jointing of piping using qualified joiners and qualified procedures in accordance with AGA XR0603. Furnish the Contracting Officer with a copy of qualified procedures and list of and identification symbols of qualified joiners. Submit manufacturer's installation instructions and manufacturer's visual joint appearance chart, including all polyethylene (PE) pipe and fittings.

1.5.3 Shop Drawings

Submit drawings for complete Gas Piping System, within 30 days of contract award, showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of gas equipment connectors and supports. Include LP storage tank, pad, and mounting details. Submit dimensioned shop drawings of piping showing both the accurately scaled piping and its relationship to space enclosure. Include piping from point of connection to utility company furnished portion of system, into facility and all terminal locations. Provide in accordance with Section 01 33 00, SUBMITTAL PROCEDURES and as modified by this section. Illustration shall be drawn to a minimum scale of 1/4 inch per foot. Drawings shall indicate actual plan dimensions and elevations above finished floor. Provide illustrations including sections to clarify elevations of equipment, equipment connections, piping, and piping accessories. Drawings shall conform to standard drafting industry procedures. Include contractors name, project title, date and phone number in title block.

1.5.4 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.5.5 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.
1.5.6 Coordination of Trades

The Contract Drawings indicate engineered solutions and design intent for the natural gas piping system. If through the coordination effort it is required to shift piping or system accessories from the locations indicated to enable the installation of adjacent trades, the materials required to coordinate the final locations shall be provided as work of this Section. Provide piping offsets, fittings, and accessories as required to provide a complete installation and to eliminate interference with adjacent construction. Coordinate equipment locations with space required for trades in the adjacent installation area.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 General

Materials shall be delivered and stored with protective crating and weatherproof wrapping to provide protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter. Any porous materials found to be contaminated with mold or mildew will be replaced at the Contractor's expense. Non-porous materials found to be contaminated with mold or mildew will be disinfected and cleaned prior to installation. Handle, transport, and store plastic pipe and fittings carefully. Plug or cap pipe and fittings ends during transportation or storage to minimize dirt and moisture entry. Do not subject piping to abrasion or concentrated external loads. Discard PE pipe sections and fittings that have been damaged.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos are not allowed. Submit catalog data and installation instructions for pipe, valves, all related system components, and installation procedures. Conform to NFPA 54 and with requirements specified herein. Provide supply piping to appliances or equipment at least as large as the inlets thereof.

2.2 GAS PIPING SYSTEM AND FITTINGS

2.2.1 Steel Pipe, Joints, and Fittings

a. Pipe: Black carbon steel in accordance with ASTM A53/A53M, Schedule 40, threaded ends for sizes 2 inches and smaller; otherwise, plain end beveled for butt welding.


d. Butt-Welding Fittings: ASME B16.9, with backing rings of compatible material.


f. Flanges and Flanged Fittings: ASME B16.5 steel flanges or convoluted steel flanges conforming to ASME BPVC SEC VIII D1, with flange faces having integral grooves of rectangular cross sections which afford containment for self-energizing gasket material.

2.2.2 Polyethylene Pipe, Tubing, Fittings and Joints

Provide IPS polyethylene pipe, tubing, fittings and joints conforming to ASTM D3350 and ASTM D2513, pipe designations PE 2406 and PE 3408, rated SDR 11.5 or less, as specified in ASME B31.8. Mark pipe sections as required by ASTM D2513. Provide butt fittings conforming to ASTM D3261 and socket fittings conforming to ASTM D2683. Match fittings to the service rating of the pipe. Use polyethylene pipe, tubing, and fittings as recommended by the manufacturer for use with LPG. Perform underground installations in conformance with ASTM D2774.

2.2.3 Sealants for Steel Pipe Threaded Joints

Provide joint sealing compound as listed in UL FLAMMABLE & COMBUSTIBLE, Class 20 or less. For taping, use tetrafluoroethylene tape conforming to UL FLAMMABLE & COMBUSTIBLE.

2.2.4 Warning and Identification Tape

Provide pipe flow markings, warning and identification tape, and metal tags as required.

2.2.5 Flange Gaskets

Provide gaskets of nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type, containing aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 600 degree F service, to be used for hydrocarbon service.

2.2.6 Pipe Threads

Provide pipe threads conforming to ASME B1.20.1.

2.2.7 Escutcheons

Provide chromium-plated steel or chromium-plated brass escutcheons, either one piece or split pattern, held in place by internal spring tension or set screw.

2.2.8 Gas Transition Fittings

a. Provide steel to plastic (PE) designed for steel-to-plastic with tapping tee or sleeve conforming to AGA XR0603 requirements for transitions fittings. Coat or wrap exposed steel pipe with heavy plastic coating.

b. Manufacturer's standard fused tapping (PE-to-PE) tee assembly with shut-off feature.
c. Provide manually operated shut-off valve conforming to CGA 9.2-M88

2.2.9 Insulating Pipe Joints

2.2.9.1 Insulating Joint Material

Provide insulating joint material between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.2.9.2 Threaded Pipe Joints

Provide threaded pipe joints of steel body nut type dielectric unions with insulating gaskets.

2.2.9.3 Flanged Pipe Joints

Provide joints for flanged pipe consisting of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts.

2.3 VALVES

Provide lockable shutoff or service isolation valves conforming to the following:

2.3.1 Valves 2 Inches and Smaller

Provide valves 2 inches and smaller conforming to ASME B16.33 of metallic materials and manufacture compatible with system materials used.

2.3.2 Valves 2-1/2 Inches and Larger

Provide valves 2-1/2 inches and larger of carbon steel conforming to API Spec 6D, Class 150.

2.3.3 Valve Support on PE Piping

Provide valve support assembly in accordance with the PE piping manufacturer's requirements at valve terminations points.

2.4 RISERS

Provide manufacturer's standard riser, transition from plastic to steel pipe with 7 to 12 mil thick epoxy coating. Use swaged gas-tight construction with O-ring seals, metal insert, and protective sleeve. Provide remote bolt-on or bracket or wall-mounted riser supports.

2.5 PIPE HANGERS AND SUPPORTS

Provide pipe hangers and supports conforming to MSS SP-58.

2.6 PRESSURE REGULATORS AND SHUTOFF VALVES METERS

Provide regulators conforming to ANSI Z21.80/CSA 6.22 for line pressure regulators. Provide shutoff valves conforming to ANSI Z21.15/CSA 9.1 for manually controlled gas shutoff valves. Where indicated on Contract Drawings, provide ferrous bodied regulators with backflow protection, designed to meet the pressure, load and other service conditions.
2.6.1 Gas Main Regulators

Equip pressure regulators for main distribution lines, supplied from a source of gas which is at a higher pressure than the maximum allowable operating pressure for the system, with pressure regulating devices of adequate capacity. In addition to the pressure regulating devices, provide a protective method to prevent overpressuring of the system in accordance with ASME B31.8. Suitable protective devices are as follows:

a. Spring-loaded relief valve meeting the provisions of ASME BPVC SEC VIII D1.

b. Pilot-loaded back pressure regulator used as relief valve, so designed that failure of the pilot system will cause the regulator to open.

c. Weight-loaded relief valves conforming to ASME PTC 25.

d. Monitoring regulator installed in series with the primary pressure regulator.

e. Series regulator installed upstream from the primary regulator, set to limit the pressure on the inlet of the primary regulator continuously to the maximum allowable operating pressure of the system, or less.

f. Automatic shutoff device installed in series with the primary regulator, set to shut off when the pressure on the distribution system reaches the maximum allowable operating pressure of the system, or less, which remains closed until manually reset.

g. Spring-loaded, diaphragm type relief valves.

2.6.2 Service Line Regulators

Provide ferrous bodied pressure regulators for individual service lines, capable of reducing distribution line pressure to pressures indicated. Provide regulators where indicated with flow rate and pressure regulation characteristics as scheduled.

Provide regulator(s) with external concealed adjustment having a single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas pressure at the regulator inlet. Provide regulator valve vent of resilient materials designed to withstand flow conditions when pressed against the valve port, capable of regulating downstream pressure within limits of accuracy and limiting the buildup of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Provide a self-contained service regulator, sized to meet to required demand.

2.6.3 Gas Meters

In addition to the main gas meter provided by the local gas company at the service entry, provide (downstream of the gas company meter) a digital single path ultrasonic gas meter with configurable and scalable dual pulse outputs, integral temperature and pressure compensation field replaceable battery with minimum 10 year battery warranty, minimum 15 year meter warranty, flanged connections, LCD display, integral flash memory with
maximum pressure drop of .5 inch water column at 2,000 CFH. The meter shall be connected to the facility Direct Digital Control System for monitoring of utility consumption. The secondary pulse output shall be reserved for connection to a separate utility consumption data collection and transmission system. Provide pressure gauges and attachments conforming to ASME B40.100. Provide regulators conforming to ANSI Z21.18/CSA 6.3 ANSI Z21.80/CSA 6.22 for line pressure regulators. Provide shutoff valves conforming to ANSI Z21.15/CSA 9.1 for manually controlled gas shutoff valves and ANSI Z21.21/CSA 6.5 for automatic shutoff valves for gas appliances.

2.7 BOLTING (BOLTS AND NUTS)

Stainless steel bolting; ASTM A193/A193M, Grade B8M or B8MA, Type 316, for bolts; and ASTM A194/A194M, Grade 8M, Type 316, for nuts. Dimensions of bolts, studs, and nuts shall conform with ASME B18.2.1 and ASME B18.2.2 with coarse threads conforming to ASME B1.1, with Class 2A fit for bolts and studs and Class 2B fit for nuts. Bolts or bolt-studs shall extend through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Bolts shall have American Standard regular square or heavy hexagon heads; nuts shall be American Standard heavy semifinished hexagonal.

2.8 GASKETS

Fluorinated elastomer, compatible with flange faces.

2.9 IDENTIFICATION FOR ABOVEGROUND PIPING

MIL-STD-101 for legends and type and size of characters. For pipes 3/4 inch od and larger, provide printed legends to identify contents of pipes and arrows to show direction of flow. Color code label backgrounds to signify levels of hazard. Make labels of plastic sheet with pressure-sensitive adhesive suitable for the intended application. For pipes smaller than 3/4 inch od, provide brass identification tags 1 1/2 inches in diameter with legends in depressed black-filled characters.

2.10 IDENTIFICATION MATERIALS

General: Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for application, selection shall be at Installer's option, but provide single selection for each product category.

2.10.1 Pipe Markers

Provide adhesive type pipe markers with nomenclature that closely matches contract drawings. Comply with designations indicated on contract drawings for piping system nomenclature and abbreviate only as necessary for each application length. Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.


b. Application: For exterior diameters greater than 2 inches (including
insulation if any), provide continuous directional flow arrow tape around pipe circumference; two places, before and after pipe marker. Provide adhesive plastic pipe markers. For external diameters less than 2 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1) Adhesive lap joint in pipe marker overlap.

2) Laminated or bonded application of pipe marker to pipe (or insulation).

c. Underground Warning Tape shall be 0.004 inch thick, 6 inches wide, yellow polyethylene with a ferrous metallic core, acid and alkali-resistant and shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise with an elongation factor of 350 percent. Provide bold black letters on the tape identifying the type of system. Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill material.

2.10.2 Color Coding

Color code marking shall be of the color listed in Table I and the side listed in Table II. The arrows shall be installed adjacent to each band to indicate the direction of flow in the pipe. The legends shall be printed in upper-case black letters as listed in Table I. Letter sizes shall be as listed in Table II. Marking shall be painted or applied using colored, pressure-sensitive adhesive markers of standard manufacturer. Paint shall be as specified for insulated and uninsulated piping.

<table>
<thead>
<tr>
<th>Letters and Material</th>
<th>Band</th>
<th>Arrow</th>
<th>Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>Yellow</td>
<td>Black</td>
<td>Natural Gas</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outside Diameter of Pipe Covering (in)</th>
<th>Width of Color Band (in)</th>
<th>Arrow Length X Width (in)</th>
<th>Size of Legend Letters and Numerals (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1-1/2</td>
<td>8</td>
<td>8x2</td>
<td>1/2</td>
</tr>
<tr>
<td>1-1/2 to 2</td>
<td>8</td>
<td>8x2</td>
<td>3/4</td>
</tr>
<tr>
<td>2 to 6</td>
<td>12</td>
<td>8x2</td>
<td>1-1/4</td>
</tr>
<tr>
<td>8 to 10</td>
<td>24</td>
<td>12x3</td>
<td>2-1/2</td>
</tr>
</tbody>
</table>

2.10.3 Valve Tags

Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4 inch high letters and sequenced valve numbers.
1/2 inch high, and with hole for fastener, or engraved plastic laminate valve tags, with piping system abbreviation in 1/4 inch high letters and sequenced valve numbers 1/2 inch high, and with hole for fastener. Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose. Compile valve schedule for each service. For each page of valve schedule, provide laminated plastic coated cardboard stock sheets.

a. Provide 1-1/2 inch diameter tags, except as otherwise indicated.

b. Provide size and shape as specified or scheduled for each piping system.

c. Fill tag engraving with black enamel.

2.10.4 Engraved Plastic Laminate Signs

Provide engraving stock melamine plastic laminate, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.10.5 Plastic Equipment Markers

Provide manufacturer's standard laminated plastic, color coded equipment markers. Include terminology matching equipment schedules as closely as possible. Provide approximate 2 inch x 4 inches markers for control devices, and 4 inch x 6 inches for equipment. Identify equipment and electrical devices furnished under this section.

2.10.6 Plasticized Tags

Provide pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3 inch x 6 inch with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.10.7 Lettering and Graphics

Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 2, Unit Heater No. 1H,).

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any
discrepancy or areas of conflict before performing the work.

3.2 EXCAVATION AND BACKFILLING

Provide required excavation, backfilling, and compaction as specified in Section 31 23 00.00 20 EXCAVATION SUPPORT AND PROTECTION.

3.3 GAS PIPING SYSTEM

Provide a gas piping system from the point of delivery, as indicated to the connections to each gas utilization device. Coordinate the installation of system components furnished by the gas utility company. Unless noted otherwise, the responsibility of the natural gas system installation shall be borne by this section. Provide steel piping system materials for above ground natural gas. Provide PE piping system materials for below ground natural gas. Provide transition fittings above ground as indicated on Contract Drawings.

3.3.1 Protection and Cleaning of Materials and Components

Protect equipment, pipe, and tube openings by closing with caps or plugs during installation. At the completion of all work, thoroughly clean the entire system.

3.3.2 Workmanship and Defects

Piping, tubing and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and chip-and scale-blown. Repair of defects in piping, tubing or fittings is not allowed; replace defective items when found.

3.4 PROTECTIVE COVERING

3.4.1 Aboveground Metallic Piping Systems

3.4.1.1 Ferrous Surfaces

Touch up shop primed surfaces with ferrous metal primer. Solvent clean surfaces that have not been shop primed. Mechanically clean surfaces that contain loose rust, loose mill scale and other foreign substances by power wire brushing and prime with ferrous metal primer. Finish primed surfaces with two coats of exterior oil paint.

3.4.1.2 Nonferrous Surfaces

Except for aluminum alloy pipe, do not paint nonferrous surfaces. Paint surfaces of aluminum alloy pipe and fittings to protect against external corrosion where they contact masonry, plaster, insulation, or are subject to repeated wettings by such liquids as water, detergents or sewage. Solvent-clean the surfaces and treat with vinyl type wash coat. Apply a first coat of aluminum paint and a second coat of alkyd gloss enamel or silicone alkyd copolymer enamel.

3.5 INSTALLATION

Install the gas system in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54 and AGA XR0603, and as indicated. Perform all pipe cutting without damage to the pipe, with an approved type of mechanical cutter, unless otherwise authorized. Use
wheel cutters where practicable. On steel pipe 6 inches and larger, an approved gas cutting and beveling machine may be used. Cut thermoplastic pipe in accordance with AGA XR0603.

3.5.1 Metallic Piping Installation

Bury underground piping a minimum of 18 inches below grade. Make changes in direction of piping with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction is not permitted. Branch connection may be made with either tees or forged branch outlet fittings. Provide branch outlet fittings which are forged, flared for improvement of flow where attached to the run, and reinforced against external strains.

3.5.2 Metallic Tubing Installation

Install metallic tubing using gas tubing fittings approved by the tubing manufacturer. CSST gas piping systems shall be installed by contractors who have completed the manufacturer’s training program as indicated on a certification card. Make branch connections with tees. Prepare all tubing ends with tools designed for that purpose. Do not use aluminum alloy tubing in exterior locations or underground.

3.5.3 PE Piping, Tubing, and Fittings

Installation of PE piping, tubing, and fittings is permitted only outside and underground. Bury piping a minimum of 18 inches below grade. Install the piping to avoid excessive stresses due to thermal contraction, and use only where indicated.

3.5.4 Connections Between Metallic and Plastic Piping

Connections between metallic and plastic piping are only allowed outside, underground, and with approved transition fittings.

3.5.5 Concealed Piping in Buildings

Do not use combinations of fittings (unions, tubing fittings, running threads, right- and left-hand couplings, bushings, and swing joints) to conceal piping within buildings.

3.5.5.1 Piping and Tubing in Partitions

Locate concealed piping and tubing in hollow, rather than solid, partitions. Protect tubing passing through walls or partitions against physical damage both during and after construction, and provide appropriate safety markings and labels. Provide protection of concealed pipe and tubing in accordance with ANSI LC 1/CSA 6.26.

3.5.6 Aboveground Piping

Run aboveground piping as straight as practicable along the alignment and elevation indicated, with a minimum of joints, and separately supported from other piping system and equipment. Install exposed horizontal piping no farther than 6 inches from nearest parallel wall and at an elevation which prevents standing, sitting, or placement of objects on the piping.
3.5.7 Final Gas Connections

Unless otherwise specified, make final connections with rigid metallic pipe and fittings. Provide accessible gas shutoff valve and coupling for each gas equipment item. Shutoff and coupling shall be located to allow removal of an individual piece of equipment without disrupting the operation of remaining equipment.

3.6 PIPE JOINTS

Design and install pipe joints to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

3.6.1 Threaded Metallic Joints

Provide threaded joints in metallic pipe with tapered threads evenly cut and made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 1-1/2 inches in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 2 inches in diameter may be made with approved joint sealing compound. After cutting and before threading, ream pipe and remove all burrs. Caulking of threaded joints to stop or prevent leaks is not permitted.

3.6.2 Welded Metallic Joints

Conform beveling, alignment, heat treatment, and inspection of welds to NFPA 54. Remove weld defects and make repairs to the weld, or remove the weld joints entirely and reweld. After filler metal has been removed from its original package, protect and store so that its characteristics or welding properties are not affected adversely. Do not use electrodes that have been wetted or have lost any of their coating.

3.6.3 PE Piping Joints

3.6.3.1 PE Fusion Welding Inspection

Visually inspect butt joints by comparing with, manufacturer's visual joint appearance chart. Inspect fusion joints for proper fused connection. Replace defective joints by cutting out defective joints or replacing fittings. Inspect, in conformance with API 570, 100 percent of all joints and re-inspect all corrections. Arrange with the pipe manufacturer's representative in the presence of the Contracting Officer to make first time inspection.

3.6.4 Joining PE to Metallic Piping or Tubing

When compression type mechanical joints are used, provide gasket material in the fittings compatible with the plastic piping and with the gas in the system. Use an internal tubular rigid stiffener in conjunction with the fitting, flush with end of the pipe or tubing, extending at least to the outside end of the compression fitting when installed. Remove all rough or sharp edges from stiffener. Do not force fit stiffener in the plastic. Split tubular stiffeners are not allowed.

3.7 PIPE SLEEVES

Provide pipes passing through concrete or masonry walls or concrete floors or roofs with pipe sleeves fitted into place at the time of construction.
Do not install sleeves in structural members except where indicated or approved. Make all rectangular and square openings as detailed. Extend each sleeve through its respective wall, floor or roof, and cut flush with each surface, except in mechanical room floors not located on grade where clamping flanges or riser pipe clamps are used. Extend sleeves in mechanical room floors above grade at least 4 inches above finish floor. Unless otherwise indicated, use sleeves large enough to provide a minimum clearance of 1/4 inch all around the pipe. Provide steel pipe for sleeves in bearing walls, waterproofing membrane floors, and wet areas. Provide sleeves in nonbearing walls, floors, or ceilings of steel pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. For penetrations of fire walls, fire partitions and floors which are not on grade, seal the annular space between the pipe and sleeve with fire-stopping material and sealant that meet the requirement of Section 07 84 00 FIRESTOPPING.

3.8 PIPES PENETRATING WATERPROOFING MEMBRANES

Sleeves in exterior below grade masonry walls, below grade concrete walls and slab-on-grade floors shall be equipped with an integral steel plate waterstop welded perpendicular to sleeve. Waterstop shall be positioned at the centerline of the substrate. Sleeves in exterior masonry and concrete walls below and above grade, and slab-on-grade floors shall be with a modular mechanical type sealing assembly. Seal shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

3.9 FIRE SEAL

Fire seal all penetrations of fire rated partitions, walls and floors in accordance with Section 07 84 00 FIRESTOPPING. Details are indicated on the Architectural Drawings indicating conditions for penetrations through fire and smoke rate assemblies. Provide sleeved or non-sleeved installation as indicated. Seal the annular space between the pipe and sleeve with fire-stopping material and sealant that meet the requirement of Section 07 84 00, FIRESTOPPING.

3.10 ESCUTCHEONS

Provide escutcheons for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.11 SPECIAL REQUIREMENTS

Provide drips, grading of the lines, freeze protection, and branch outlet locations as shown and conforming to the requirements of NFPA 54.

3.12 BUILDING STRUCTURE

Do not weaken any building structure by the installation of any gas
piping. Do not cut or notch beams, joists or columns. Attach piping supports to metal decking. Do not attach supports to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer.

3.13 PIPING SYSTEM SUPPORTS

Support gas piping systems in buildings with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Do not support any gas piping system by other piping. Conform spacing of supports in gas piping and tubing installations to the requirements of NFPA 54. Conform the selection and application of supports in gas piping and tubing installations to the requirements of MSS SP-69. In the support of multiple pipe runs on a common base member, use a clip or clamp where each pipe crosses the base support member. Spacing of the base support members is not to exceed the hanger and support spacing required for any of the individual pipes in the multiple pipe run. Rigidly connect the clips or clamps to the common base member. Provide a clearance of 1/8 inch between the pipe and clip or clamp for all piping which may be subjected to thermal expansion.

3.14 ELECTRICAL BONDING AND GROUNDING

Provide a gas piping system within the building which is electrically continuous and bonded to a grounding electrode as required by NFPA 70.

3.15 SHUTOFF VALVE

Install the main gas shutoff valve controlling the gas piping system to be easily accessible for operation, as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled. Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally. Provide stop valve on service branch at connection to main and shut-off valve on riser outside of building.

3.16 PRESSURE REGULATOR

Provide plug cock or ball valve ahead of regulator. Install regulators where indicated. Install regulators inside building and extend a full-size vent line from relief outlet on regulator to a point outside of building.

3.17 TESTING

Submit test procedures and reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Test entire gas piping system to ensure that it is gastight prior to putting into service. Prior to testing, purge the system, clean, and clear all foreign material. Test each joint with an approved gas detector, soap and water, or an equivalent nonflammable solution. Inspect and test each valve in conformance with API Std 598 and API Std 607. Complete testing before any work is covered, enclosed, or concealed, and perform with due regard for the safety of employees and the public during the test. Install bulkheads, anchorage and bracing suitably designed to resist test pressures if necessary, and as directed and or approved by the Contracting Officer. Do not use oxygen as a testing medium.
3.17.1 Pressure Tests

Submit test procedures and reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Before appliances are connected, test by filling the piping systems with air or an inert gas to withstand a minimum pressure of 3 pounds gauge for a period of not less than 10 minutes as specified in NFPA 54 without showing any drop in pressure. Do not use Oxygen for test. Measure pressure with a mercury manometer, slope gauge, or an equivalent device calibrated to be read in increments of not greater than 0.1 pound. Isolate the source of pressure before the pressure tests are made.

3.17.2 Test With Natural Gas

Before turning on gas under pressure into any piping, close all openings from which gas can escape. Immediately after turning on the gas, check the piping system for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. Conform all testing to the requirements of NFPA 54NFPA 58. If leakage is recorded, shut off the gas supply, repair the leak, and repeat the tests until all leaks have been stopped.

3.17.3 Purging

After testing is completed, and before connecting any appliances, fully purge all gas piping. Do not purge piping into the combustion chamber of an appliance. Do not purge the open end of piping systems into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 are followed.

3.17.4 Labor, Materials and Equipment

Furnish all labor, materials and equipment necessary for conducting the testing and purging.

3.18 PIPE COLOR CODE MARKING

Provide color code marking of piping as specified in Section 09 90 00 PAINTS AND COATINGS, conforming to ASME A13.1.

3.19 IDENTIFICATION OF PIPING, EQUIPMENT AND PHYSICAL HAZARDS

Identify piping, main shutoff valve and physical hazards in accordance with 29 CFR 1910.144, ASME A13.1, ANSI Z535.1 and as modified herein. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment. Identify each gas piping system indicated on contract drawings.

3.19.1 Piping System Identification

Install plastic pipe markers on each system, and include arrows to show normal direction of flow. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, mechanical rooms,
accessible maintenance spaces (shafts) and exterior non-concealed locations.

a. Near each valve and control device.

b. Near each branch, excluding short take-offs for terminal units; mark each pipe at branch, where there could be question of flow pattern.

c. Near each branch, excluding short take-offs for terminal units; mark each pipe at branch, where there could be question of flow pattern.

d. At access doors, valve boxes and similar access points which permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.

f. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.

g. Entire length of below ground piping; warning tape.

3.19.2 Valves

Provide valve tag on every shutoff valve and facility main motor actuated shutoff valve. List each tagged valve in valve schedule for each piping system. Turn valve schedules over to Contracting Officer.

3.20 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- 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 720 (2002) Refrigerant Access Valves and Hose Connectors


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


AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2011; Amendment 2012) Specification for Filler Metals for Brazing and Braze Welding


ASME INTERNATIONAL (ASME)


ASME B31.1 (2014; INT 1-47) Power Piping

ASME B31.5 (2013) Refrigeration Piping and Heat Transfer Components
1.2 SUBMITTALS

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

SD-02 Shop Drawings

Refrigerant Piping System; G

Drawings for each ductless split system, variable refrigerant flow system and split system, at least 5 weeks prior to beginning construction, shall provide adequate detail to demonstrate compliance with contract.
requirements. At the minimum, drawings shall consist of:

a. Equipment layouts which identify assembly and installation details.

b. Piping layouts which identify locations and sizes of piping, all valves and fittings. Pipe sizes shall be validated by the manufacturer's representatives of the associated equipment and systems proposed for installation. Annotate compliance of validation on submittal.

c. Plans and elevations which identify installation heights, clearances required for maintenance and operation of associate equipment.

d. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction or roof equipment support installation for all connected equipment.

e. Installation details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.

Submit dimensioned shop drawings indicating piping and equipment showing both the accurately scaled piping and its relationship to space enclosure. The drawings shall utilize the building floor plans and roof plans. Provide in accordance with Section 01 33 00, "Submittal Procedures," and as modified by this section. Illustration shall be drawn to a minimum scale of 1/4 inch = 1 foot. Drawings shall indicate actual plan dimensions and elevations above finished floor and/or grade. Provide illustrations including sections to clarify elevations of equipment, equipment connections, piping, and piping accessories. Drawings shall conform to standard drafting industry procedures. Replication of the Contract Drawings; marked up or otherwise, as a substitute to the requirements of this Section will not be acceptable. Include Contractors name, project title, date and phone number in title block. Coordinate piping and equipment with work of all other trades. This pre-installation planning effort shall consider and include the submitted and approved equipment manufacturer recommendations relating to pipe sizing, lift, oil return, maximum pipe lengths and pipe slopes. Include as a minimum the following:

a. Refrigerant piping; plan and vertical sections.

b. Indoor Terminal equipment.

c. Pipeline accessories and specialties; valves strainers, access points, oil traps, branch connection details, etc.

d. Air cooled condensing units, air cooled condensers.

e. Pipe penetrations through walls and floors including details for penetrations.

f. Location of concrete foundations.

g. Location of roof equipment supports and roof piping supports for roof mounted conditions.

SD-03 Product Data
Refrigerant Piping System
Spare Parts
Qualifications
Refrigerant Piping Tests
Verification of Dimensions
SD-06 Test Reports
Refrigerant Piping Tests
SD-07 Certificates
Service Organization
Manufacturer Concurrence; G
SD-10 Operation and Maintenance Data
Maintenance; G
Operation and Maintenance Manuals; G
Demonstrations; G
Data Package 2 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

Six complete copies of an operation manual in bound 8 1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

Six complete copies of maintenance manual in bound 8 1/2 x 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping layouts and simplified wiring and control diagrams of the system as installed.

1.3 QUALITY ASSURANCE

1.3.1 Coordination of Trades

The Contract Drawings indicate an engineered solution and design intent for the refrigerant piping system. If through the coordination effort it is required to shift piping from the locations indicated to enable the installation of adjacent trades, the materials required to coordinate the final locations shall be provided as work of this Section. Provide piping, offsets, fittings, and accessories as required to provide a complete installation and to eliminate interference with adjacent construction. Coordinate piping system locations with space required for trades in the adjacent installation area.

1.3.2 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any
discrepancy before performing any work.

1.3.3 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. During installation, cap piping and similar openings to keep out dirt and other foreign matter. Any porous materials found to be contaminated with mold or mildew will be replaced at the Contractor's expense. Non-porous materials found to be contaminated with mold or mildew will be disinfected and cleaned prior to installation.

1.5 MAINTENANCE

1.5.1 General

Submit Data Package 2 plus operation and maintenance data complying with the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

a. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship and that have been in satisfactory commercial or industrial use for 2 years prior to bid opening.

b. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours during the two year period 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

2.1.1 Manufacturer Concurrence

A certified letter from each equipment manufacturer indicating that the
proposed pipe routing, sizes, connections and pipeline accessories will
enable the successful operation of the connection equipment.

2.2 ELECTRICAL WORK

Electrical equipment and wiring shall be in accordance with Section
26 20 00 INTERIOR DISTRIBUTION SYSTEM. Field wiring shall be in
accordance with manufacturer's instructions. Manual or automatic control
and protective or signal devices required for the operation specified and
any control wiring required for controls and devices specified, but not
shown, shall be provided.

2.3 REFRIGERANT PIPING SYSTEM

Refrigerant piping, valves, fittings, and accessories shall be in
accordance with ANSI/ASHRAE 15 & 34 and ASME B31.5, except as specified
herein. Refrigerant piping, valves, fittings, and accessories shall be
compatible with the fluids used and capable of withstanding the pressures
and temperatures of the service. Refrigerant piping, valves, and
accessories used for refrigerant service shall be cleaned, dehydrated, and
sealed (capped or plugged) prior to shipment from the manufacturer's plant.

2.4 PIPE, FITTINGS AND END CONNECTIONS (JOINTS)

2.4.1 Pipe

2.4.1.1 Manifold Fittings

For VRF systems, provide wrought copper fittings to enable connecting each
indoor unit to the refrigerant piping system. Fittings shall be furnished
by the manufacturer of the VRF equipment.
2.4.2 Copper Tubing

Copper tubing shall conform to ASTM B280 hard drawn. Copper tubing shall be hard drawn. Joints shall be brazed. 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. All joints in the piping system shall be brazed.

2.4.3 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.

2.5 Valves

Valves shall be designed, manufactured, and tested specifically for refrigerant service. Valve bodies shall be of brass construction. Valves shall have brazed connections. Threaded end connections shall not 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. Direction of flow shall be legibly and permanently indicated on the valve body. Control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by the manufacturer. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

2.5.1 Refrigerant Stop Valves

Valve shall be the globe or full-port ball type with a back-seating stem especially packed for refrigerant service. Valve packing shall be replaceable under line pressure. Valve shall be provided with a handwheel operator and a seal cap. Valve shall be the straight or angle pattern design as determined by piping system installer.

2.5.2 Check Valves

Valve shall be the swing or lift type as required to provide positive shutoff at the differential pressure indicated. Valve shall be provided with resilient seat.

2.5.3 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.
2.5.4 Refrigerant Access Valves

Refrigerant access valves and hose connections shall be in accordance with AHRI 720.

2.6 PIPING ACCESSORIES

2.6.1 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. Provide valved bypass around each filter dryer with dryer shutoff valves and piping length adequate to enable dryer replacement.

2.6.2 Sight Glass

2.6.2.1 Assembly and Components

Assembly shall be pressure- and temperature-rated and constructed of materials suitable for the service. Glass shall be borosilicate type. Ferrous components subject to condensation shall be electro-galvanized.

2.6.2.2 Bull's-Eye and Inline Sight Glass Reflex Lens

Bull's-eye and inline sight glass reflex lens shall be provided for dead-end liquid service. For pipe line mounting, two plain lenses in one body suitable for backlighted viewing shall be provided.

2.6.2.3 Moisture Indicator

Indicator shall be a self-reversible action, moisture reactive, color changing media. Indicator shall be furnished with full-color-printing tag containing color, moisture and temperature criteria. Unless otherwise indicated, the moisture indicator shall be an integral part of each corresponding sight glass.

2.6.3 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports shall conform to MSS SP-58. Hangers for uninsulated copper piping shall be copper clad.

2.6.4 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

2.7 FABRICATION

2.7.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have
weather resistant finishes that will withstand 1000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D520, Type I.

2.8 IDENTIFICATION MATERIALS

General: Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.8.1 Plastic Pipe Markers

Provide snap-on or adhesive type pipe markers with nomenclature that closely matches Contract Drawings. Comply with designations indicated on contract drawings for piping system nomenclature and abbreviate only as necessary for each application length. Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

a. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers.

b. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ASME A13.1.

c. Application: For exterior diameters greater than 2 inch (including insulation if any), provide continuous directional flow arrow tape around pipe circumference; two places, before and after pipe marker. Provide adhesive plastic pipe markers. For external diameters less than 2 inch (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1) Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2) Adhesive lap joint in pipe marker overlap.
3) Laminated or bonded application of pipe marker to pipe (or insulation).

2.8.2 Color Coding

Color code marking shall be of the color listed in Table I and the side listed in Table II. The arrows shall be installed adjacent to each band to indicate the direction of flow in the pipe. The legends shall be printed in upper-case black letters as listed in Table I. Letter sizes shall be as listed in Table II. Marking shall be painted or applied using colored, pressure-sensitive adhesive markers of standard manufacturer. Paint shall be as specified for insulated and uninsulated piping.
TABLE 1 COLOR CODES FOR MARKING PIPE

<table>
<thead>
<tr>
<th>Letters and Materials</th>
<th>Band</th>
<th>Arrow</th>
<th>Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerant Suction</td>
<td>Yellow</td>
<td>Black</td>
<td>RS</td>
</tr>
<tr>
<td>Refrigerant Liquid</td>
<td>Yellow</td>
<td>Black</td>
<td>RL</td>
</tr>
<tr>
<td>Refrigerant Hot Gas</td>
<td>Yellow</td>
<td>Black</td>
<td>HG</td>
</tr>
<tr>
<td>Refrigerant Vent</td>
<td>Yellow</td>
<td>Black</td>
<td>Vent</td>
</tr>
</tbody>
</table>

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, confirmation 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.

Provide pipe and fittings for each split-refrigeration system.

3.2.1 Directional Changes

Make changes in direction with wrought-copper fittings. 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 or malformed fittings showing kinks, wrinkles, flattening, or other malformations will not be accepted.

3.2.2 Functional Requirements

Piping shall be installed with slope and pitch as recommended by equipment manufacturer connected to refrigerant piping 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. Protect tubing against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Demonstrate purge process to Contract Officer during initial piping system installation. Support piping prior to brazing and do not spring or force.

3.2.4  Valves

3.2.4.1  General

Refrigerant stop valves shall be installed where indicated but as a minimum on each side of each piece of equipment such as condensing units evaporators, 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. 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  Valve Identification

Each system valve, including those which are part of a factory assembly, shall be tagged. Tags shall be in alphanumeric sequence, progressing in direction of fluid flow. Tags shall be embossed, engraved, or stamped plastic or nonferrous metal of various shapes, sized approximately 1-3/8 inch diameter, or equivalent dimension, substantially attached to a component or immediately adjacent thereto. Tags shall be attached with nonferrous, heavy duty, bead or link chain, 14 gauge annealed wire, nylon cable bands or as approved. Tag numbers shall be referenced in Operation and Maintenance Manuals and system diagrams.

3.2.5  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 minimum full refrigerant liquid line size, and no less than accordance with the manufacturer’s recommendations for the system in which it is installed. Dryers shall be installed with valved bypass piping 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.
3.2.6  Sight Glass

A moisture indicating sight glass shall be installed in all refrigerant circuits downstream of all filter dryers and where indicated. Site glasses shall be full line size.

3.2.7  Access Fittings

Provide schraeder access fittings where indicated.

3.2.8  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. Provide dielectric isolation between ferrous and copper materials consisting of either copper clad hangers or factory fabricated felt-lined galvanized steel mechanical compression bushings.

3.2.8.1  Hangers

Do not use Type 3 on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.2.8.2  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.

3.2.8.3  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.

3.2.8.4  Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.2.8.5  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.

3.2.8.6  Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at
each change in direction of the piping. Pipe supports shall be spaced not
over 5 feet apart at valves. Pipe hanger loads suspended from steel joist
with hanger loads between panel points in excess of 50 pounds shall have
the excess hanger loads suspended from panel points.

3.2.8.7 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.

3.2.8.8 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.

3.2.8.9 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. Material
used for support shall be as specified under Section 05 12 00 STRUCTURAL
STEEL.

3.2.9 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.

3.2.9.1 General Service Areas and Fire-Rated/Smoke-Rated Penetrations

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. Details are indicated on
the Architectural Drawings indicating conditions for penetrations through
fire and smoke rate assemblies. Provide sleeved or non-sleeved
installation as indicated. Seal the annular space between the pipe and
sleeve with fire-stopping material and sealant that meet the requirement
of Section 07 84 00, FIRESTOPPING.
3.2.9.2  Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a 17 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by either one of the following methods. Sleeves in exterior masonry walls shall be equipped with an integral steel plate waterstop welded perpendicular to sleeve. Waterstop shall be positioned at the centerline of the substrate. Sleeves in exterior masonry and concrete walls below and above grade, and slab-on-grade floors shall be with a modular mechanical type sealing assembly. Seal shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

3.2.9.3  Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07 84 00 FIRESTOPPING.

3.2.9.4  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.

3.2.10  Access Panels

Access panels shall be provided in non-accessible assemblies to enable access to all concealed valves, vents, controls, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.2.11  Field Applied Insulation

Field installed insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.2.12  Field Painting

Painting required for surfaces not otherwise specified, and finish
painting of items only primed at the factory are specified in Section 09 90 00 PAINTS AND COATINGS.

3.2.12.1 Color Coding

Color coding for piping identification is specified in Section 09 90 00 PAINTS AND COATINGS.

3.2.13 Identification Tags

Provide identification tags made of brass, engraved laminated plastic or engraved anodized aluminum indicating service and item number on all valves and dampers. Tags shall be 1-3/8 inch minimum diameter and marking shall be stamped or engraved. Indentations shall be black for reading clarity. Tags shall be attached to valves with No. 12 AWG copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.3 IDENTIFICATION OF PIPING, EQUIPMENT AND PHYSICAL HAZARDS

Identify piping and physical hazards in accordance with 29 CFR 1910.144, ASME A13.1, ANSI Z535.1 and as modified herein. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment. Identify each piping system and item of equipment indicated on contract drawings. HVAC fan coil units do not require identification.

3.3.1 Piping System Identification

Install plastic pipe markers on each system, and include arrows to show normal direction of flow. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, mechanical rooms, accessible maintenance spaces (shafts) and exterior non-concealed locations.

a. Near each valve and control device.

b. Near each branch, excluding short take-offs for terminal units; mark each pipe at branch, where there could be question of flow pattern.

c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

d. At access doors, manholes and similar access points which permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.

f. At each change in direction and spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.

3.3.2 Valves

Provide valve tag on every valve, cock and control device in each piping
system; exclude check valves, valves within factory-fabricated equipment units, HVAC terminal devices and similar rough-in connections of end-use units. List each tagged valve in valve schedule for each piping system. Turn valve schedules over to Contracting Officer.

3.3.3 Mechanical Equipment

Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device. Provide minimum 1/4 inch high lettering for name of unit where viewing distance is less than 3 feet, 1/2 inch high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering. In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.4 CLEANING AND ADJUSTING

Clean uncontaminated system(s) by evacuation and purging procedures currently recommended by refrigerant and refrigerant equipment manufacturers, and as specified herein, to remove small amounts of air and moisture. Systems containing moderate amounts of air, moisture, contaminated refrigerant, or any foreign matter shall be considered contaminated systems. Restoring contaminated systems to clean condition including disassembly, component replacement, evacuation, flushing, purging, and re-charging, shall be performed using currently approved refrigerant and refrigeration manufacturer's procedures. Restoring contaminated systems shall be at no additional cost to the Government as determined by the Contracting Officer. Water shall not be used in any procedure or test.

3.5 TRAINING COURSE

a. Submit a schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training. Conduct a training course for 4 members of the operating staff as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests.

b. The field posted instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

c. Submit 6 complete copies of an operation manual in bound 8 1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

d. Submit 6 complete copies of maintenance manual in bound 8 1/2 x 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include
piping layouts and simplified wiring and control diagrams of the system as installed.

3.6 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. 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.

3.6.1 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.

3.6.2 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. 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.
3.6.3 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.

3.6.4 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.

3.6.5 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.

3.6.6 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.

3.7 TESTING, ADJUSTING AND BALANCING

Except as specified herein, testing, adjusting, and balancing shall be in accordance with Section 23 05 93 TESTING, ADJUSTING, and BALANCING for HVAC.

   a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the system toward
completing TAB. Provide the TAB any needed unique instruments for setting valves and instruct TAB in their use.

b. Provide a qualified technician to operate the systems to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

3.7.1 System Calibration and Adjustments

System calibration shall be performed for each refrigeration system; condensing units and evaporators. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform calibration and testing of the HVAC control system with Section 23 05 93 TESTING, ADJUSTING and BALANCING for HVAC Contractor. All instrumentation and controls shall be calibrated and the specified accuracy shall be verified using test equipment with calibration traceable to NIST standards. Mechanical control devices shall be adjusted to operate as specified. Controllers shall be pretested off-site as a functioning assembly ready for field connections, calibration and adjustment of the operational systems. Control parameters and logic (virtual) points including control loop setpoints, gain constants, and integral constraints, shall be adjusted before the system is placed on line. Written notification of any planned calibration and testing of the systems shall be given to the Government at least 14 calendar days in advance.

3.8 MANUFACTURER'S SERVICES

Provide the services of a manufacturer's representatives who are experienced in the installation, adjustment, and operation of refrigeration systems related to the refrigeration equipment. The representative shall supervise the installation, start-up adjustment, and testing of the equipment. Coordinate manufacturer services for VRF Systems with Section 23 81 00 00 20, "Unitary Air Conditioning Equipment".

3.9 COMMISSIONING

Provide the services of the supervisory level technicians in responsible charge of the work in this section to participate in the work specified in Section 23 08 00 02 50, COMMISSIONING OF HVAC. Refer to Section 23 08 02 00 50, COMMISSIONING OF HVAC for description of work.

3.10 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 23 52 46.00 20

LOW PRESSURE WATER HEATING BOILERS (OVER 800,000 BTU/HR OUTPUT)

05/15

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.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)


AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


ASME INTERNATIONAL (ASME)


ASME BPVC SEC IV (2010) BPVC Section IV-Rules for Construction of Heating Boilers

ASME CSD-1 (2016) Control and Safety Devices for Automatically Fired Boilers

ASTM INTERNATIONAL (ASTM)


NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS (NBBI)


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

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein.

1.3 DESIGN REQUIREMENTS

Boiler shall be suitable for installation in the space shown with ample room for opening doors and cleaning and removal and replacement internal components. Boiler shall have an efficiency as indicated on Contract Drawings. Boiler shall be designed and tested in accordance with ASME BPVC SEC IV, ASME CSD-1, NFPA 70, NFPA 54, and ANSI Z21.13/CSA 4.9. Boiler shall be installed in accordance with NBBI NB-23 PART 1. Boiler design working pressure shall be 50 psig. Boiler burners shall be configured for use with natural gas; 1000 BTU/HR per cubic foot.

1.3.1 Boiler Installation Requirements

1.3.1.1 Location

Install Boiler(s) and associated hot water pumps in a mechanical room inside the facility in accordance with NBBI NB-23 PART 1. Provide ample clearance around boilers to allow access for inspection, maintenance and repair. Passageways around all sides of boilers shall have an unobstructed minimum width of 36 inches or the clearances recommended by the boiler manufacturer whichever is greater.

1.3.1.2 Combustion Air

Provide supply of air for combustion and ventilation. In accordance with NFPA 54, NFPA 211 and manufacturer's installation manual, calculate the amount of combustion air necessary to operate the boiler. Install and locate properly sized combustion ductwork of size indicated but not less than the boiler manufacturer recommendations.

1.3.2 Detail Drawings

1.3.2.1 Drawings

Show boiler hot water isolation valves, emergency disconnect switch, and complete boiler gas train on the contract drawings.

1.3.2.2 Fuel Train / Wiring Diagram

Submit fuel train and wiring diagram.

1.3.3 Safety Standards

Hot water boilers, burners, and any supplementary control devices, safety
interlocks, or limit controls required under this specification shall meet requirements of the following standards as applicable:


b. All Units: ASME BPVC SEC IV, NFPA 70 and ASME CSD-1.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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:

Submittals for this Section shall be delivered to the project Contracting Officer, who shall forward two complete sets of copies to the appropriate approving official for review and approval. Approved equipment submittals shall be provided to the air quality contacts prior to their installation (AQ contacts: Stan Ohrablo, 451-5836 and Travis Voorhees, 451-9421).

SD-02 Shop Drawings

Fuel Train; G

Include air valve components. Indicate natural gas pressure required at valve train inlet.

Wiring Diagram; G

Point to point wiring diagrams including wiring between multiple boilers, electrical power connections and points of connection to facility direct digital control system.

SD-03 Product Data

Boilers; G: Natural gas input, gross output, efficiency, ASME certification, allowable working pressure, model number

Boiler Trim and Control Equipment; G

Burners and Control Equipment; G

Stack, Breeching, and Supports; G

SD-06 Test Reports

Operational Tests

Field Acceptance Testing

System Performance Tests

SD-07 Certificates

Boilers
Burners and Control Equipment
Boiler Trim and Control Equipment
Water Analysis

Boiler manufacturer's certificate of boiler performance.

SD-08 Manufacturer's Instructions

Boilers

SD-10 Operation and Maintenance Data

Boilers, Data Package 4
Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Energy Efficient Equipment for Boilers; S

Posted Operating Instructions for Heating Water Boilers

1.5 QUALITY ASSURANCE

Hot water boilers, burners, and any supplementary control devices, safety interlocks, or limit controls required under this specification shall meet requirements of the following standards as applicable:


b. All Units: ASME BPVC SEC IV, NFPA 70 and ASME CSD-1.

Controls not covered by the above shall have a UL label, UL listing mark, or shall be listed in the Factory Mutual Approval Guide.

1.5.1 Coordination of Trades

The Contract Drawings indicate engineered solutions and design intent for the heating water boiler systems. If through the coordination effort it is required to shift boiler components or accessories from the locations indicated to enable the installation of adjacent trades, the materials required to coordinate the final locations shall be provided as work of this Section. Provide piping and stack offsets, fittings, and accessories as required to provide a complete installation and to eliminate interference with adjacent construction. Coordinate equipment locations with space required for trades in the adjacent installation area.

1.5.2 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.
1.5.3 Delivery Storage and Handling

Equipment shall be delivered and stored with protective crating and weatherproof wrapping to provide protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter. Any porous materials found to be contaminated with mold or mildew will be replaced at the Contractor's expense. Non-porous materials found to be contaminated with mold or mildew will be disinfected and cleaned prior to installation.

1.5.4 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. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required hangers, supports, piping offsets, fittings, and accessories to meet such conditions.

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 for Boilers

Provide boilers meeting the efficiency requirements as stated within this section and provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph ENERGY EFFICIENT EQUIPMENT.

2.2 BOILERS

Shall conform to the applicable requirements of ASME BPVC SEC IV and ASME CSD-1. Hot-water boilers shall be horizontal firetube, multipass, modified scotch-type of the dry or wet-back type, packaged units mounted on a skid-type structural steel base. Provide each boiler complete burner and fuel system, a forced or induced draft fan, an automatic electronic control system complete with combustion and flame safeguard controls, firing sequence programmer, safety interlocks, limit controls and central control panel, and such trim and appurtenances as are peculiar to water units as specified herein. Units shall be factory-wired and assembled except for such readily installed appurtenances as safety valves, water columns, and pressure gages. Units shall be complete and ready for operation when connected to water, fuel, and electrical supplies.

2.3 MATERIALS AND EQUIPMENT

2.3.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at
least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Submit manufacturer's catalog data included with the detail drawings for the following:

2.3.2 Asbestos Prohibition

Asbestos and asbestos-containing products will not be allowed.

2.3.3 Nameplates

Secure a plate to each major component of equipment containing the manufacturer's name, address, type or style, model or serial number, and catalog number. Also, display an ENERGY STAR labels as applicable. Each pressure vessel shall have an approved ASME stamp.

2.3.4 Equipment Guards

High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

2.4 BOILERS

Each boiler shall have the output capacity in British thermal units per hour (Btuh) as indicated when fired with the specified fuel. The boiler shall be furnished complete with the natural gas burning equipment, boiler fittings and trim, automatic controls, induced draft fan, electrical wiring, insulation, piping connections, and protective jacket. The boiler shall be completely assembled and tested at the manufacturer's plant. Boiler auxiliaries including fans, motors, drives, and similar equipment shall be provided with at least 10 percent excess capacity to allow for field variations in settings and to compensate for any unforeseen increases in pressure losses in appurtenant piping and ductwork. However, the boiler safety devices shall not be sized for a 10 percent excess capacity. The boiler and its accessories shall be designed and installed to permit ready accessibility for operation, maintenance, and service. Boilers shall be designed, constructed, and equipped in accordance with ASME BPVC SEC IV. Each boiler shall be of the condensing type and designed for water service as specified herein. The boiler capacity shall be based on the ratings shown in HYI-005 or as certified by the American Boiler Manufacturers Association, or American Gas Association.

2.4.1 Condensing Boiler

Each boiler shall be a self-contained packaged type, complete with accessories, mounted on a structural steel base or a steel base which is integral to the boiler shell. Each boiler shall conform to the commercial design used by the manufacturer and shall permit free thermal expansion without placing undue stress on any part of the boiler. Boilers shall each be equipped with a natural gas modulating burner, condensing firetube furnace, boiler, induced draft burner fan and microprocessor based control system. Each boiler shall be provided with flanged connections for combustion air intake and flue gas outlet, flanged inlet water piping, flanged outlet water piping, NPT tappings for relief valve, air vent and condensate drain. Each boiler shall be designed to withstand the water temperature differentials scheduled and indicated on the Contract Drawings without experiencing any damage due to thermal shock. Equip boiler burner with a direct-drive induced draft fan and variable speed burner fan motor
controller. Provide boiler with capacity indicated on Contract Drawings. The boiler shall have a minimum operational efficiency as indicated at the flow rate and water temperatures scheduled.

2.4.2 Boiler Construction

Wetted sections of the boiler shall be constructed of type 304 stainless steel. Carbon steel, corrosion resistant linings, or other steel alloys are not acceptable. Provide the manufacturer recommended floor mounted acid neutralizing sump to accommodate drain effluent condensed through the combustion process. The natural gas burner shall be radial pattern, constructed of high corrosion resistant alloy stainless steel. The burner shall be warranted for a minimum of five years; parts and labor. Gas orifices shall be replaceable without total removal of the burner assembly. Construct boiler with a reinforced steel frame. Boiler shall be covered with a continuous and furniture grade steel insulated jacket, with baked on enamel finish.

2.4.3 Boiler Controls

Provide boiler with an integral factory wired control panel. Provide each boiler with a programmable logic controller (PLC) capable of executing all boiler combustion and safety commands. Controller shall be equipped with a native BACnet interface for connection to the facility Direct Digital Control system. Provide operating interface with pilot lights to indicate ignition, pre-purge, fuel on post purge, and failure status. Furnish unit with master on-off switch, electronic ignition, operating aquastat, manual reset high-limit, natural gas pressure regulator, pilot gas pressure regulator, pilot gas solenoid valve, automatic operating and safety shutoff natural gas valves, water safety relief valve, water flow switch, and digital readout water inlet/outlet temperature display. Unit shall meet or exceed ASHRAE 90.1.

2.5 FUEL BURNING EQUIPMENT

Boiler shall be designed to burn natural gas. Each boiler shall comply with The State of Maine emission regulations.

2.5.1 Burners

2.5.1.1 Gas Burners and Control Equipment

Burners shall be UL approved induced draft burners with all air necessary for combustion supplied by a blower where the operation is coordinated with the burner. Burner shall be provided complete with fuel supply system in conformance with the following safety codes or standards:

- Gas-fired units shall conform to UL 795.

2.5.2 Draft Fans

Fans conforming to AMCA 801 induced-draft shall be furnished as an integral part of boiler design. Fans shall be centrifugal with backward-curved blades. Each fan shall be sized for output volume and static pressure rating sufficient for pressure losses, excess air requirements at the burner, leakages, temperature, and elevation corrections for worst ambient conditions, all at full combustion to meet net-rated output at normal firing conditions, plus an overall excess air volume of 10 percent against a 20 percent static overpressure. Noise
levels for fans shall not exceed 85 decibels in any octave band. Induced-draft fans shall be designed for handling hot flue gas at the maximum outlet temperature in the boiler. Induced draft fan housings shall be provided with drain holes to accommodate the drainage of condensation. Induced draft fan bearings shall be air-cooled. Induced draft fan scroll sheets and rotor blades shall have protective liners.

2.5.2.1 Draft Fan Drives

Fans shall be direct-driven by electric motors. Electric motor shall be totally enclosed fan-cooled, suitable for installation in a Class II, Division 1, Group F, hazardous location conforming to NFPA 70. Motor starter shall be as recommended by the boiler manufacturer.

2.5.3 Draft Damper

Boilers shall each be provided with a motor actuated outlet damper. Actuator shall be electric and of type recommended by boiler manufacturer. Actuator shall be factory wired to boiler control system.

2.6 COMBUSTION CONTROL EQUIPMENT AND ACCESSORIES

Combustion control equipment shall be provided as a system by the boiler manufacturer. Field installed automatic combustion control system accessories shall be installed in accordance with the manufacturer's recommendations and under the direct supervision of a representative of the control manufacturer. The boiler water temperature shall be controlled by the indicated water temperature controller. The control equipment shall operate electrically. Provide control configuration indicated on Contract Drawings.

2.6.1 Water Temperature Controllers

The controller shall be of sturdy construction and shall be protected against dust and dampness. The thermostatic element shall be inserted in a separable socket installed where indicated. Boiler burner shall be capable of modulating over an adjustable temperature range of approximately 90 to 210 degrees F. Controller shall be furnished with necessary equipment to automatically adjust the setting of the boiler temperature to suit the outside weather conditions. The outside air reset controller shall be operated in such a manner that the operating temperatures required by the boiler manufacturer are not compromised.

2.6.2 Combustion Controls and Safety Equipment

Combustion controls and safety equipment shall include a UL listed, microprocessor-based distributed process controller. The system shall include mounting hardware, wiring and cables, and associated equipment. The controller shall be completely factory wired, programmed, debugged, and tested to perform all of its functions. The controller shall process the signals for complete control and monitoring of the boiler. This shall include output temperature command, boiler status, starting and stopping all control functions, and signaling alarm conditions. The program shall be documented and include cross references in description of contacts. Microprocessor shall be able to perform self-diagnostics and contain a message center to provide operator with status and failure mode information. Controllers for each boiler shall be integrated to the boiler casing and include a LCD touch screen for interrogation and display of boiler operational conditions. Control systems and safety devices for
automatically fired boilers shall conform to ASME CSD-1. Electrical combustion and safety controls shall be rated at 120 volts, single phase, 60 Hz.

2.6.3 Field Mounted Boiler Safety Equipment

Indicating identifiers shall be provided on the control panel. Indicate flame failure, main fuel valve open and additional boiler operating conditions. The following shutdown conditions shall require a manual reset before the boiler can automatically recycle:

a. Flame failure.

b. High water temperature.

c. Low-water cutoff.

2.6.3.1 Low-water Cutoff

Low water cutoff shall be float actuated switch or electrically actuated probe type low-water cutoff. Float chamber units shall be provided with a blow-down connection. Cutoff shall cause a safety shutdown and sound an alarm when the boiler water level drops below a safe minimum level. A safety shutdown due to low water shall require manual reset before operation can be resumed and shall prevent recycling of the burner. The cutoff shall be in strict accordance to the latest version of code, ASME CSD-1 Controls and Safety Devices for Automatically Fired Boilers.

2.6.3.2 Water Flow Interlock

Provide a factory wired water flow switch or differential pressure sensor to prevent boiler operation without water flow. The controls shall not allow boiler startup unless hot water flow is proven.

2.7 BOILER ACCESSORY EQUIPMENT

Provide in accordance with ASME CSD-1 and ASME BPVC SEC IV. Boiler trim shall comply with ASME BPVC SEC IV and additional appurtenances specified below. Non-recycling control interlocks shall have the reset located on control panel.

2.7.1 Emergency Disconnect Switch

Provide and locate on wall outside boiler room entrance or just inside door, when boiler room door is on the building exterior to allow rapid and complete shutdown of the boilers in the event of an emergency as required by ASME CSD-1. Emergency switch shall be a minimum 20-amp. fuse-type safety switch. Switch shall be red and furnished with a label indicating function of switch.

2.7.2 Relief Valves

Provide relieving capacity for the full output of boiler installed. Safety relief-valve piping shall conform to ASTM A53/A53M, schedule 40 steel pipe and be piped full size to a floor drain.

2.7.3 Pressure Gage

Provide with a scale equivalent to 1.5 time outlet water pressure with a 4
inch diameter. Locate one on supply water piping and one on the return water piping.

2.7.4 Thermometers

Provide thermometers with a scale equivalent to 1.5 times the outlet water temperature. Provide one located on supply water piping and one on return water piping.

2.7.5 Drain Tapping

Provide drain valve and piping to a floor drain.

2.7.6 Make-up Water Station

2.7.6.1 Pressure Reducing Station

Provide a water pressure-reducing valve and relief valve, Refer to Section 23 64 26, CHILLED AND HEATING HOT WATER PIPING. Provide a 3/4 inch globe valve by-pass around this valve.

2.7.6.2 Backflow Preventers

Section 22 00 70 PLUMBING, GENERAL PURPOSE. Locate upstream of by-pass.

2.7.7 Stack Thermometer

Provide flue gas-dial type thermometer with scale calibrated from 150 to 750 degrees F and mount in flue gas outlet.

2.7.8 Air Vent Valve

Provide with screwed connections, stainless steel disk, and stainless steel seats to vent entrapped air from boiler.

2.7.9 Boiler Safety Control Circuits

Provide boiler safety control circuits, including control circuits for burner and draft fan, shall be single-phase, two-wire one-side grounded, and not over 120 volts. Provide safety control switching in ungrounded conductors. Provide overcurrent protection. In addition to circuit grounds, ground metal parts which do not carry current to a grounding conductor.

2.7.10 Indicating Lights

Each safety interlock requiring a manual reset shall have an individually labeled red indicating light. Non-recycling control interlocks shall have the reset located on the control itself. Red indicating lights on the control panel may be omitted if the burner combustion control system has a Keyboard Display Module installed that will identify the lockout information required in Item c. below. Indicating lights shall have colors as follows:

a. Amber: Ignition on
b. Blue: Draft
c. Green: Main fuel safety shut-off valves open
d. Red (One for Each): Safety lockout, flame failure, low water level, and high temperature.

2.7.11 Alarm Bell

Provide alarm bell, electrically operated, with a manual disconnect switch. Disconnect switch shall be type and wired so that switching off alarm following a safety shutdown will not prevent alarm from sounding again upon recurrence of a subsequent safety shutdown condition.

2.7.12 Post-Combustion Purge

Provide a post-combustion purge in accordance with ASME CSD-1. Provide controls and wiring necessary to assure operation of draft fan for a period of not less than 15 seconds or of sufficient duration to provide four complete air changes in the boiler combustion chamber (whichever is greater) following shutdown of burner upon satisfaction of heat demand. Upon completion of post-combustion purge period, draft fan shall automatically shutdown until next restart.

2.7.13 Draft

Comply with boiler manufacturer's recommendations.

2.7.14 Stack, Breeching, and Supports

For boiler outlet flue gas, provide UL listed double wall steel stack, accessories and connectors for use with natural gas appliances stack materials as a minimum shall comply with NFPA 211. Stack and components shall be constructed as a positive pressure assembly to convey flue gas from the boiler outlet to a roof discharge outlet. Stack system shall be rated for an internal pressure of 60 inches w.g.

2.7.14.1 Flue Gas Stack

All flue gas conveying components shall be double wall; minimum 1/4 inch thick air gap between, with a superferritic stainless steel inner jacket designed for resistance to corrosive condensates created by partially or fully condensing natural gas and propane fired heating appliances, with outer jacket of type 316 stainless steel. Inner and outer walls shall be connected with structural spacer clips. All components shall be of a singular manufacturer, UL listed and tested as an assembly to a distance of 2 inches from combustible materials at the maximum boiler flue gas operating temperature. Provide flue gas thermometer with scale calibrated from 150 to 750 degrees F and mount in flue gas outlet. Where combustion air is indicated to be directly ducted to boilers, provide UL listed single wall type 316 stainless steel stack materials. Note that stack components constructed of plastic and galvanized steel are not acceptable.

Elbows shall be long radius type. Tee fittings shall be equipped with 45 degree lateral connections. Roof penetration fitting shall be UL listed ventilating sleeve type. Furnish adjustable mounting collar for roof penetration to enable compensation for roof pitch and slope. Stack fittings and straight sections shall be mechanical compression joined and sealed with silicone caulk.

Provide all elbows, increasers, roof thimble, metal cap on discharge with bird barrier, and all intermediate supports and hangers. Furnish stack...
tee base with threaded pipe tap for drainage.

2.7.14.2 Combustion Air Ductwork

Provide type G90 galvanized steel combustion air ductwork as indicated in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION AND EXHAUST SYSTEMS.

2.8 ELECTRIC MOTORS

Motors which are an integral part of the packaged boiler system shall be the highest efficiency available by the manufacturer of the packaged boiler.

2.9 MECHANICAL IDENTIFICATION MATERIALS

General: Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.9.1 Engraved Plastic Laminate Signs

Provide engraving stock melamine plastic laminate, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Thickness: 1/16 inch for units up to 40 sq. in. or 8 inch length; 1/4 inch for larger units. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.9.2 Plastic Equipment Markers

Provide manufacturer's standard laminated plastic, color coded equipment markers. Include terminology matching equipment schedules as closely as possible. Provide approximate 2-1/2 x 4 inch markers for control devices, and 4-1/2 x 6 inch for equipment. Identify equipment and electrical devices furnished under this section.

2.9.3 Plasticized Tags

Provide pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3 inch x 6 inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.9.4 Lettering and Graphics

Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3).
PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Install equipment in accordance with the manufacturer's installation instructions and NBBI NB-23 PART 1. Anchor equipment mounted on concrete foundations before installing piping. Install piping in such a manner as not to place a strain on equipment. Do not bolt flanged joints tight unless they match. Grade, anchor, guide, and support piping without low pockets.

3.1.1 Condensing Boilers

Install units on reinforced housekeeping pads as indicated; level units. Provide heating hot water piping in accordance with Section 23 64 26, CHILLED AND HEATING HOT WATER PIPING SYSTEMS. Start-up systems in the presence of a factory authorized boiler manufacturer representative.

a. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

b. Examine rough-in for hydronic piping, and electrical to verify actual locations of connections prior to installation. Do not proceed until unsatisfactory conditions have been corrected.

c. Install equipment level and plumb, in accordance with manufacturer's written instructions.

d. Extend piping from relief valves, boiler drain and boiler trim drains to the floor drain in the vicinity of the boiler.

e. Install acid neutralization sump adjacent to each boiler. Configure height of equipment pads to enable drainage of effluent. Connect drain piping to boiler, sump; extend to nearest floor drain.

f. Install combustion air intake ductwork and stack components; connect to boiler. Support stack from building structure so that weight is not imposed on boiler.

3.1.2 Piping Installation Requirements

Specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The arrange piping installations adjacent to units to allow unit servicing and maintenance.

3.2 EQUIPMENT FOUNDATIONS

Locate equipment foundations as indicated, designed, and made of sufficient size and weight to preclude shifting of equipment under operating conditions or under any abnormal conditions that could be imposed upon the equipment. Foundations shall meet requirements of the equipment manufacturer. Concrete and grout shall conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.
3.3 IDENTIFICATION

Identify equipment and physical hazards in accordance with 29 CFR 1910.144, ASME A13.1, ANSI Z53.1. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment. Identify each piping system and item of equipment indicated on contract drawings.

3.3.1 Mechanical Equipment

Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device. Provide minimum 3/8 inch high lettering for name of unit where viewing distance is less than 2 feet, 1/2 inch high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering. In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.4 MANUFACTURER'S FIELD SERVICES

Furnish the services of an engineer or technician approved by the boiler manufacture for installation inspection, startup, and tests of equipment as specified below. After installation of equipment the engineer or technician shall provide a signed certificate or certified written statement that the equipment is installed in accordance with the manufacturer's recommendations. Services of more than one engineer or technician may be required based on types of specific equipment. One engineer or technician as appointed by the Contractor shall supervise and be responsible for the overall installation, start-up, test, and check out of systems. This person shall remain on the job until each unit has been in successful operation for 3 days and accepted.

3.5 BOILER CLEANING

Before being placed in service, boiler shall be boiled out for a period of 24 hours at a pressure not exceeding 12 psig. Solution to be used in the boiler for the boiling out process shall be as recommended by boiler manufacturer to ensure cataloged boiler performance. Upon completion of boiling out, flush out boiler with potable water, drain, and charge with chemically treated water. Protect boiler and appurtenances against internal corrosion until testing is completed and boiler is accepted. Professional services are required for cleaning/treatment process.

3.6 FIELD QUALITY CONTROL

Perform and furnish everything required for inspections and tests as specified herein to demonstrate that boiler and auxiliary equipment, as installed, are in compliance with contract requirements. Start up and operate the system. During this time, clean strainers until no further accumulation of foreign material occurs. Exercise care to minimum loss of water occurs when strainers are cleaned. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence. During startup and during tests, factory-trained engineers or
technicians employed by individual suppliers of such components as the burner, flame safeguard and combustion controls, and other auxiliary equipment shall be present as required, to insure proper functioning, adjustment, and testing of individual components and systems. Test instrumentation shall be calibrated and have full scale reading from 1.5 to 2 times test values.

3.6.1 Operational Tests

Furnish the services of an engineer or technician approved by the boiler manufacturer of installation, startup, operational and safety testing. This person shall remain on the job until each boiler has been successfully operated. Furnish and perform everything required for inspections and tests of the boiler and auxiliary equipment. Test instrumentation shall be calibrated and have full-scale reading from 1.5 to 2 times test values. Demonstrate proper operability of combustion control, flame safeguard control and safety interlocks. Provide a detailed description of all boiler startup and operational tests in the Commissioning Plan.

3.6.1.1 Preliminary Operational Test

Operate boilers continuously for a period of at least 8 hours to demonstrate proper operability of the combustion control, flame safeguard control, and safety interlocks.

3.6.1.2 Acceptance Operational Test and Inspection

Prior to requesting an acceptance test, conduct a satisfactory operational test for at least 8 hours, and provide a certified statement that the equipment is installed per all requirements of this guide. The Contracting Officer, upon receipt of the notice from the Contractor, shall request a boiler be inspected by a Naval Facilities Engineering and Expeditionary Warfare Center (EXWC) NAVFAC boiler inspector. Fifteen days advance notice is required for scheduling inspector to conduct acceptance operational test and inspection.

3.7 CLEANING AND ADJUSTING

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Control system and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Testing, adjusting, and balancing shall be as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING.

3.8 FIELD ACCEPTANCE TESTING

Manufacturer Test Plans: Within 120 calendar days after contract award, submit the following plans:

a. Boiler System - field acceptance test plan: Field acceptance test plans shall be developed by the boiler manufacturer detailing recommended field test procedures for the particular type and size of equipment, while providing and sequence of operation indicated on the Contract Drawings. Field acceptance test plans developed by the installing Contractor, or the equipment sales agency furnishing the equipment, will not be acceptable. The Contracting Officer will review and approve the field acceptance test plan for
b. Coordinated testing: Indicate in each field acceptance test plan when work required by this section requires coordination with test work required by other specification sections. Furnish test procedures for the simultaneous or integrated testing of Direct Digital Control system which interlock and interface with controls factory prewired or external controls for the equipment provided under Section 23 09 23.13 20, BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

c. Prerequisite testing: Boilers for which performance testing is dependent upon the completion of the work covered by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING must have that work completed as a prerequisite to testing work under this section. Indicate in each field acceptance test plan when such prerequisite work is required.

d. Test procedure: Indicate in each field acceptance test plan each equipment manufacturers published installation, start-up, and field acceptance test procedures. Include in each test plan a detailed step-by-step procedure for testing automatic controls provided by the manufacturer. Each test plan shall include the required test reporting forms to be completed by the Contractor's testing representatives. Procedures shall be structured to test the controls through all modes of control to confirm that the controls are performing with the intended sequence of control. Controllers shall be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.

e. Performance variables: Each test plan shall list performance variables that are required to be measured or tested as part of the field test. Include in the listed variables performance requirements indicated on the equipment schedules on the design drawings. Boiler manufacturer shall furnish with each test procedure a description of acceptable results that have been verified. Boiler manufacturer shall identify the acceptable limits or tolerance within which each tested performance variable shall acceptably operate.

f. Job specific: Each test plan shall be job specific and shall address the particular boilers and particular conditions which exist in this contract. Generic or general preprinted test procedures are not acceptable.

g. Specialized components: Each test plan shall include procedures for field testing and field adjusting specialized components, such as gas pressure regulators, combination gas valves and pressure relief valves.

3.8.1 Testing

Each boiler and boiler system shall be field acceptance tested in compliance with its approved field acceptance test plan. Provide time and materials to conduct testing. Prior to testing, verify that work of Section 23 64 26, CHILLED, AND HEATING HOT WATER PIPING SYSTEMS work has
been completed. Verify that all pipeline strainers are clean. Coordinate system operation and setpoints with work of Section 23 09 23.13 20, BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC. Provide the following tests:

a. Manufacturer's recommended testing: Conduct the manufacturer's recommended field testing in compliance with the approved test plan. Furnish a factory trained field representative authorized by and to represent the equipment manufacturer at the complete execution of the field acceptance testing.

b. Operational test: Conduct a continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed shall result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every two hours. Use the test report forms for logging the operational variables.

c. Notice of tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.

d. Report forms: Type data entries and writing on the test report forms. Completed test report forms for each item of equipment shall be reviewed, approved, and signed by the Contractor's test director. The manufacturer's field test representative shall review, approve, and sign the report of the manufacturer's recommended test. Signatures shall be accompanied by the person's name typed.

e. Deficiency resolution: The test requirements acceptably met; deficiencies identified during the tests shall be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

3.8.2 SYSTEM PERFORMANCE TESTS

3.8.2.1 General Requirements

Before each boiler system is accepted, tests to demonstrate the general operating characteristics of all equipment shall be conducted by a registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Tests shall cover a period of not less than 48 hours for each system and shall demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made as necessary and tests shall be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points shall be installed and tightened. If tests do not demonstrate satisfactory system performance, deficiencies shall be corrected and the system shall be retested. Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. Field tests shall be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND
BALANCING FOR HVAC.

3.8.3 Test Report

The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

a. Date and outside weather conditions.
b. The load on the system.
c. Boiler firing with natural gas.
d. Boiler stack temperatures.
e. Boiler hot water inlet and outlet temperatures.
f. Boiler hot water inlet and outlet temperatures.

3.9 COMMISSIONING

Provide the services of a supervisory level technician, in responsible charge of the work in this section, and factory authorized start-up and service technicians; for each major component or system in this section, to participate in the work specified in Section 23 08 02.00 50 COMMISSIONING OF HVAC. Refer to Section 23 08 02.00 50, COMMISSIONING OF HVAC for description of work.

3.10 TRAINING AND DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total 8 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

3.11 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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)


AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11 (1990; R 2008) Load Ratings and Fatigue Life for Roller Bearings

ABMA 9 (1990; R 2008) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


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


AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1 (2005) Safety in Welding, Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME BPVC SEC VIII D1 (2007; Addenda 2008; Addenda 2009) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

1.2 SUBMITTALS

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

SD-03 Product Data

Water Chiller; G

Manufacturer's standard catalog data, at least highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data shall include manufacturer's recommended installation instructions and procedures. Data shall be adequate to demonstrate compliance with contract requirements as specified within the paragraphs:

a. Water Chiller.

b. Chiller Components.

Posted Instructions

Posted instructions, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures,
methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions shall be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

Verification of Dimensions

A letter including the date the site was visited, conformation of existing conditions, and any discrepancies found.

Manufacturer's Multi-Year Compressor Warranty

Manufacturer's multi-year warranty for compressor(s) in air-cooled water chillers as specified.

System Performance Tests

A schedule, at least 2 weeks prior to the start of related testing, for the system performance tests. The schedules shall identify the proposed date, time, and location for each test.

Demonstrations

A schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

Water Chiller - field acceptance test plan

SD-06 Test Reports

Salt Spray Tests

Field Acceptance Testing

Water Chiller - field acceptance test report; G

Factory Tests

Six copies of the report shall be provided in bound 8 1/2 x 11 inch booklets. Reports shall certify the compliance with performance requirements and follow the format of the required testing standard for both the Chiller Performance Tests and the Chiller Sound Tests. Test report shall include certified calibration report of all test instrumentation. Calibration report shall include certification that all test instrumentation has been calibrated within 6 months prior to the test date, identification of all instrumentation, and certification that all instrumentation complies with requirements of the test standard. Test report shall be submitted 1 week after completion of the factory test.

System Performance Tests

Six copies of the report shall be provided in bound 8 1/2 x 11 inch booklets.

SD-07 Certificates

Water Chiller; G
Where the system, components, or equipment are specified to comply with requirements of NFPA, ARI, ASHRAE, ASME, or UL, 1 copy of proof of such compliance shall be provided. The label or listing of the specified agency shall be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

SD-08 Manufacturer's Instructions
Water Chiller - Installation Instruction; G

SD-10 Operation and Maintenance Data
Operation and Maintenance Manuals; G

Six complete copies of an operation manual in bound 8 1/2 x 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features. Six complete copies of maintenance manual in bound 8 1/2 x 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed. Submit Data Package 4.

1.3 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

1.4 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

SECTION 23 64 11 Page 4
1.5 QUALITY ASSURANCE

1.5.1 Modification of References

Accomplish work in accordance with the referenced publications, except as modified by this section. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "the Authority having jurisdiction," "the Administrative Authority," "the Owner," or "the Design Engineer" to mean the Contracting Officer.

1.5.2 Coordination of Trades

The Contract Drawings indicate engineered solutions and design intent for the air cooled chiller systems. If through the coordination effort it is required to shift equipment from the locations indicated to enable the installation of adjacent trades, the materials required to coordinate the final locations shall be provided as work of this Section. Provide piping, offsets, fittings, and accessories as required to provide a complete installation and to eliminate interference with adjacent construction. Coordinate equipment locations with space required for trades in the adjacent installation area.

1.5.3 Packaging

Equipment shall be delivered and stored with protective crating and weatherproof wrapping. Any porous materials found to be contaminated with mold or mildew will be replaced at the Contractor's expense. Non-porous materials found to be contaminated with mold or mildew will be disinfected and cleaned prior to installation.

1.5.4 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. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required hangers, supports, piping offsets, fittings, and accessories to meet such conditions.

1.6 PROJECT REQUIREMENTS

1.6.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.7 Warranty

In addition to the warranty requirements specification in Division 00, Contract Requirements, the following major components of the chiller shall be covered by a warranty of a duration period of five years: compressor, and refrigerant.
1.8 MANUFACTURER'S MULTI-YEAR COMPRSSOR WARRANTY

The Contractor shall provide a 5 year parts and labor (includes refrigerant) manufacturer's warranty on the chiller compressor(s). This warranty shall be directly from the chiller manufacturer to the Government and shall be in addition to the standard one-year warranty of construction. The manufacturer's warranty shall provide for the repair or replacement of the chiller compressor(s) that become inoperative as a result of defects in material or workmanship within 5 years after the date of final acceptance. When the manufacturer determines that a compressor requires replacement, the manufacturer shall furnish new compressor(s) at no additional cost to the Government. Upon notification that a chiller compressor has failed under the terms of the warranty, the manufacturer shall respond in no more than 24 hours. Response shall mean having a manufacturer-qualified technician onsite to evaluate the extent of the needed repairs. The warranty period shall begin on the same date as final acceptance and shall continue for the full product warranty period.

1.8.1 Indexed Notebook

The Contractor shall furnish to the Contracting Officer a bound and indexed notebook containing a complete listing of all water chillers covered by a manufacturer's multi-year warranty. The chiller list shall state the duration of the warranty thereof, start date of the warranty, ending date of the warranty, location of the warranted equipment, and the point of contact for fulfillment of the warranty. This information shall be provided for each chiller and the recorded chiller serial numbers shall identify each chiller. Point of contact shall include the name of the service representative along with the day, night, weekend, and holiday phone numbers for a service call. The completed bound and indexed notebook shall be delivered to the Contracting Office prior to final acceptance of the facility. The Contractor shall furnish with each manufacturer's multi-year warranty the name, address, and telephone number (day, night, weekend, and holiday) of the service representative nearest to the location where the equipment is installed. Upon a request for service under the multi-year warranty, the service representative shall honor the warranty during the warranty period, and shall provide the services prescribed by the terms of the warranty.

1.8.2 Equipment Warranty Tags

At the time of installation, each item of manufacturer's multi-year warranted equipment shall be tagged with a durable, oil- and water-resistant tag, suitable for interior and exterior locations, resistant to solvents, abrasion, and fading due to sunlight. The tag shall be attached with copper wire or a permanent, pressure-sensitive, adhesive backing. The tag shall be installed in an easily noticed location attached to the warranted equipment. The tag for this equipment shall be similar to the following in format, and shall contain all of the listed information:

MANUFACTURER'S MULTI-YEAR WARRANTY EQUIPMENT TAG

Equipment/Product Covered: ____________________
Manufacturer:_______Model No.:_____Serial No.:__
Warranty Period: From _________to _____________
Contract No.: _________________________________
Warranty Contact: _____________________________
Name:  _________________________________________
Address:  ______________________________________

SECTION 23 64 11  Page 6
Telephone:

STATION PERSONNEL SHALL PERFORM PREVENTIVE MAINTENANCE AND OPERATIONAL MAINTENANCE

PART 2   PRODUCTS

2.1   STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard Commercial cataloged products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship.

These products shall have a two year record of satisfactory field service prior to bid opening. The two year record of service shall include applications of equipment and materials under similar circumstances and of similar size.

Products having a two year record of satisfactory field service shall be acceptable if a certified record of satisfactory field service for not less than 6000 hours can be shown. The 6000 hour service record shall not include any manufacturer's prototype or factory tests.

Satisfactory field service shall have been completed by a product that has been, and presently is being sold or offered for sale on the commercial market through the following copyrighted means: advertisements, manufacturer's catalogs, or brochures.

2.2   MANUFACTURER'S STANDARD NAMEPLATES

Major equipment including chillers, compressors, compressor drivers, condensers, water coolers, receivers, fans, and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

Nameplates are required on major components if the manufacturer needs to provide specific engineering and manufacturing information pertaining to the particular component. Should replacement of this component be required, nameplate information will ensure correct operation of the unit after replacement of this component.

2.3   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. Manual or automatic control and protective or signal devices required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers including the required monitors and timed restart.

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.

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 11.

d. Provide motors in accordance with NEMA MG 11 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

e. Provide inverter duty premium efficiency motors for use with variable frequency drives.

2.4 SELF-CONTAINED WATER CHILLERS, VAPOR COMPRESSION TYPE

Units shall be assembled, factory piped and wired, leak-tested, charged (refrigerant), and adjusted at the factory. Unit shall be factory evacuated and charged with nitrogen for shipping. Unit components delivered separately shall each be sealed and charged with a nitrogen holding charge. Parts weighing 50 pounds or more which must be removed for inspection, cleaning, or repair, such as motors, shall have lifting eyes or lugs. Chiller shall be provided with a single point wiring connection for incoming power supply. Chiller's water cooler shall be provided with standard water boxes with flanged mechanical connections. Chiller shall be equipped with hermetic screw compressors. Equip chiller compressors with velcro strap removeable double-wall sound attenuating blankets; vinyl surfaces and mineral wool liner quilted to compressor shape.

2.4.1 Rotary Screw Type

Chiller shall be constructed and rated in accordance with AHRI 550/590. Chiller shall conform to ASHRAE 15 & 34. As a minimum, chiller shall include the following components as defined in paragraph CHILLER COMPONENTS.

a. Refrigerant and oil
b. Structural base
c. Chiller refrigerant circuit
d. Controls package
e. Centrifugal or rotary screw compressor
f. Compressor driver, electric motor
g. Compressor driver connection
h. Water cooler (evaporator)
i. Air-cooled condenser coil  
j. Receiver  
k. Purge system for chillers which operate below atmospheric pressure  
l. Tools  

2.4.2 Rate of Change  

Chiller shall be able to withstand a chilled-water flow rate change of twenty five percent (25%) per minute while maintaining plus or minus one degree Fahrenheit (± 1°F) of design supply chilled water temperature, and fifty percent (50%) per minute at any load above the compressor minimum without cycling "off" on low load (low leaving water temperature) or evaporator refrigerant temperature limit.  

2.4.3 Demonstration  

The chiller manufacturer shall demonstrate chiller operational stability to the Contracting Officer with flows varying up to 25 percent per minute as described above during chiller system commissioning. The chiller manufacturer shall have a factory trained technician present along with the Contracting Officer representative and the Package Pump System representative; work of Section 23 64 26 CHILLED CONDENSER AND HEATING HOT WATER PIPING SYSTEMS, during this on-site testing. If the chiller does not pass the validation it shall be the responsibility of the mechanical contractor and chiller manufacturer to modify the chiller and/or chiller system to provide reliable operation with system flow rates-of-change of up to 25 percent per minute.  

2.5 CHILLER COMPONENTS  

2.5.1 Refrigerant  

Refrigerants shall be one of the fluorocarbon gases. Refrigerants shall have number designations and safety classifications in accordance with ASHRAE 15 & 34. Refrigerants shall have an Ozone Depletion Potential (ODP) of 0.055 or less. Refrigerants classified by the EPA as Class 2 shall not be allowed. The ODP shall be in accordance with the "Montreal Protocol On Substances That Deplete The Ozone Layer," September 1987, as amended through 2000, sponsored by the United Nations Environment Programme.  

2.5.2 Structural Base and Casing  

Chiller and individual chiller components shall be provided with a factory-mounted structural steel base (welded or bolted) frame. Chiller and individual chiller components shall be isolated from the Base by means of molded neoprene isolation pads. Vibration isolators shall have isolation characteristics as recommended by the manufacturer for the unit supplied and the service intended. All chiller components shall be enclosed in a furniture grade steel enclosure with additional open mesh panels, suitable for exterior use, painted with a factory applied powder-coat finish. Portions of the unit enclosure required for airflow shall be equipped with removable heavy gage steel mesh panels. Except for the piping and power connections, the entire unit shall be either enclosed with steel panel or wire mesh construction.
2.5.3 Chiller Refrigerant Circuit

Chiller refrigerant circuit shall be completely piped and factory leak tested. For multicompressor units, not less than 2 independent refrigerant circuits shall be provided. Circuit shall include as a minimum a combination sight glass and moisture indicator, charging ports, and compressor service valves.

2.5.4 Controls Package

Chiller shall be provided with a complete factory-mounted, prewired microprocessor based operating and safety control system. Controls package shall contain as a minimum a digital display, an on-auto-off switch, motor starters, power wiring, and control wiring. Controls package shall provide operating controls, monitoring capabilities, programmable setpoints, safety controls, and interfaces as defined below.

2.5.4.1 Operating Controls

Unit shall include a factory wired control system consisting of an industrial grade programmable logic controller (PLC), LCD interface screen for system interrogation, and operating software. The system shall provide essential capacity control, supervision of safety devices and parameters, and automatically rotate compressor operation every 24 hour period. The control system shall display a discharge pressure fault, suction pressure fault, compressor winding temperatures and evaporator leaving chilled water temperature. Out of tolerance conditions shall result in a fault indication and compressor shutdown. A pumpdown cycle of the nonrecycling start type shall be provided for each compressor 20 tons or larger. Provide system capacity control to adjust chiller output to a minimum of 25 percent of full load capacity without cycling operating compressor and to automatically recycle system on power interruption. Provide start-up and head pressure controls to allow for system operation at all ambient temperatures down to minus 20 degrees F. The control system shall be configured for integration through a BacNet communication platform. Chiller shall be provided with the following adjustable operating controls as a minimum.

a. Leaving chilled water temperature control.

b. Adjustable timer or automated controls to prevent a compressor from short cycling.

c. Automatic lead/lag controls (adjustable) for multi-compressor units.

d. Load limiting and unload limiting.

e. System capacity control to adjust the unit capacity in accordance with the system load and the programmable setpoints. Controls shall automatically re-cycle the chiller on power interruption.

f. Startup and head pressure controls to allow system operation at all ambient temperatures down to 0 degrees F.

g. Fan sequencing and fan speed modulation for air-cooled condenser.

h. Compressor speed modulation based on head pressure.
2.5.4.2 Monitoring Capabilities

During normal operations, the control system shall be capable of monitoring and displaying the following operating parameters. Access and operation of display shall not require opening or removing any panels or doors.

a. Entering and leaving chilled water temperatures.
b. Self diagnostic.
c. Operation status.
d. Operating hours.
e. Number of starts.
f. Compressor status (on or off).
g. Refrigerant discharge and suction pressures.

2.5.4.3 Programmable Setpoints

The control system shall be capable of being reprogrammed directly at the unit. No parameters shall be capable of being changed without first entering a security access code. The programmable setpoints shall include the following as a minimum.

a. Leaving Chilled Water Temperature.

2.5.4.4 Safety Controls with Manual Reset

Chiller shall be provided with the following safety controls which automatically shutdown the chiller and which require manual reset.

a. Low chilled water temperature protection.
b. High condenser refrigerant discharge pressure protection.
c. Low evaporator pressure protection.
d. Chilled water flow detection.
e. High motor winding temperature protection.

2.5.4.5 Safety Controls with Automatic Reset

Chiller shall be provided with the following safety controls which automatically shutdown the chiller and which provide automatic reset.

a. Over/under voltage protection.
b. Chilled water flow interlock.
c. Phase reversal protection.

2.5.4.6 Remote Alarm

During the initiation of a safety shutdown, a chiller's control system
shall be capable of activating a remote alarm bell. In coordination with the chiller, the Contractor shall provide an alarm circuit (including transformer if applicable) and a minimum 4 inch diameter alarm bell. Alarm circuit shall activate bell in the event of machine shutdown due to the chiller's monitoring of safety controls.

2.5.4.7 Energy Management Control System (EMCS) Interface

Equip chiller control system with a native BACnet control connection. The control system shall be capable of communicating all data to a remote integrated DDC processor through a single shielded cable. The data shall include as a minimum all system operating conditions, capacity controls, and safety shutdown conditions. The control system shall also be capable of receiving at a minimum the following operating commands.

a. Remote Unit Start/Stop.
c. Demand limiting.
d. Unload limiting.
e. Evaporator pressure/temperature.
f. Condenser pressure/temperature.
g. Current draw.
h. Chiller fault.

2.5.5 Compressor(s)

2.5.5.1 Rotary Screw Compressor(s)

Compressors shall operate stably for indefinite time periods at any stage of capacity reduction without hot-gas bypass. Provision shall be made to insure proper lubrication of bearings and shaft seals on shutdown with or without electric power supply. Rotary screw compressors shall include:

a. An open or hermetic, positive displacement, oil-injected design directly driven by the compressor driver. Compressor shall allow access to internal compressor components for repairs, inspection, and replacement of parts.
b. Rotors shall be solid steel, possessing sufficient rigidity for proper operation.
c. A maximum rotor operating speed no greater than 3600 RPM. provide cast iron rotor housing
d. Casings of cast iron, precision machined for minimal clearance about periphery of rotors with minimal clearance at rotor tops and rotor ends.
e. A lubrication system of the forced-feed type that provides oil at the proper pressure to all parts requiring lubrication.
f. Bearing housing shall be conservatively loaded and rated for an
L(10) life of not less than 200,000 hours. Shaft main bearings of
the sleeve type with heavy duty bushings or rolling element type
in accordance with ABMA 9 or ABMA 11.

g. A differential oil pressure or flow cutout to allow the compressor
to operate only when the required oil pressure or flow is provided
to the bearings.

h. A temperature- or pressure-initiated, hydraulically actuated,
single-slide-valve, capacity-control system to provide minimum
automatic capacity modulation from 100 percent to 15 percent.

i. An oil separator and oil return system to remove oil entrained in
the refrigerant gas and automatically return the oil to the
compressor.

j. Crankcase oil heaters controlled as recommended by the
manufacturer.

2.5.6 Compressor Driver, Electric Motor

Motors, starters, variable speed drives, wiring, etc. shall be in
accordance with paragraph ELECTRICAL WORK. Motor starter shall be unit
mounted with starter type, wiring, and accessories coordinated with the
chiller manufacturer.

2.5.7 Water Cooler (Evaporator)

Cooler shall be of the shell-and-coil or shell-and-tube type design. Condenser's refrigerant side shall be designed and factory pressure tested
to comply with ASHRAE 15 & 34. Condenser's water side shall be designed
and factory pressure tested for not less than 250 psi. Cooler shell shall
be constructed of seamless or welded steel. Coil bundles shall be totally
removable and arranged to drain completely. Tubes shall be seamless
copper, plain, integrally finned with smooth bore or integrally finned
with enhanced bore. Each tube shall be individually replaceable. Tubes
shall be installed into carbon mild steel tube sheets by rolling. Tube
baffles shall be properly spaced to provide adequate tube support and
cross flow. Performance shall be based on a water velocity not less than
Performance shall be based on a water velocity not less than 3 fps nor
more than 12 fps and a fouling factor of 0.0005 h(ft2)(degrees F)/Btu.

2.5.8 Air-Cooled Condenser Coil

Condenser coil shall be of the extended-surface fin-and-tube type and
shall be constructed of seamless copper tubes with compatible aluminum
fins. Fins shall be soldered or mechanically bonded to the tubes and
installed in a metal casing. Coils shall be circuited and sized for a
minimum of 5 degrees F subcooling and full pumpdown capacity. Coil shall
be factory leak and pressure tested after assembly in accordance with
ASHRAE 15 & 34. Provide coil with corrosion resistant coating as indicated
in this section.

2.5.9 Receivers

Receiver shall bear a stamp certifying compliance with
ASME BPVC SEC VIII D1 and shall meet the requirements of ASHRAE 15 & 34.
Inner surfaces shall be thoroughly cleaned by sandblasting or other
approved means. Each receiver shall have a storage capacity not less than
20 percent in excess of that required for the fully-charged system. Each receiver shall be equipped with inlet, outlet drop pipe, drain plug, purging valve, relief valves of capacity and setting required by ASHRAE 15 & 34, and two bull's eye liquid-level sight glasses. Sight glasses shall be in the same vertical plane, 90 degrees apart, perpendicular to the axis of the receiver, and not over 3 inches horizontally from the drop pipe measured along the axis of the receiver. In lieu of bull's eye sight glass, external gauge glass with metal glass guard and automatic closing stop valves may be provided.

2.5.10 Electric Motors and Starters

Provide induction electrical motors conforming to NEMA MG 1. Fan motor bearings shall be permanently lubricated. Compressor starters shall be variable frequency drive; standard of chiller manufacturer, condenser fan motors shall each be equipped with variable frequency drive motor starters or be ECM type motors with variable speed control commanded from chiller control system. Provide phase failure, over voltage and low voltage protection.

2.5.11 Differential Pressure Switches

Chiller manufacturer shall furnish a switch for each evaporator and verify field-mounting location before installation. Pressure Differential Switches:

a. Construction: Wetted parts of body and trim constructed of Type 316 stainless steel.

b. Performance: Switch shall withstand, without damage, the full-pressure rating of the heat exchanger applied to either port and exhibit zero set-point shift due to variation in working pressure.

c. Set Point: Screw type, field adjustable. Furnish switch range with mid-adjustment point equivalent to respective evaporator/condenser pressure drop.

d. Electrical Connections: Internally mounted screw-type terminal blocks.

e. Switch Enclosure: Epoxy coated to meet NEMA 4.

f. Switch Action: Double-pole, double-throw switch with one pole field wired to the chiller control panel and the other pole field wired to the Direct Digital Control System.

g. Subject to compliance with requirements, pressure switches manufactured by United Electric Controls; 400 Series will meet requirements.

2.6 ACCESSORIES

2.6.1 Refrigerant Signs

2.6.1.1 Installation Identification

Each new refrigerating system shall be provided with a refrigerant sign which indicates the following as a minimum:
2.6.1.2 Controls and Piping Identification

Refrigerant systems containing more than 110 lb of refrigerant shall be provided with refrigerant signs which designate the following as a minimum:

a. Valves or switches for controlling the refrigerant flow and the refrigerant compressor(s).

b. Pressure limiting device(s).

2.7 FABRICATION

2.7.1 Salt Spray Tests

Unless otherwise specified, chiller equipment and component items, when fabricated from ferrous metal, shall be factory finished with weather resistant finishes that will withstand 3000 hours exposure to the salt spray test specified in ASTM B 117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.7.2 Corrosion Resistant Coatings

Where stipulated in equipment specifications of this Section, coat finned tube coils of the affected equipment as specified below. Apply coating at the premises of a company specializing in such work. Degrease and prepare for coating in accordance with the coating applicator's procedures for the type of metals involved. Completed coating shall show no evidence of softening, blistering, cracking, crazing, flaking, loss of adhesion, or "bridging" between the fins. Factory applied coatings shall certified by the National Coil Coating Association.

2.7.2.1 Phenolic Coating

Provide a resin base thermosetting phenolic coating. Apply coating by electrolytic immersion dipping of the entire coil. Provide a minimum of two coats. Bake or heat dry coils following immersions. After final immersion and prior to final baking, spray entire coil with particular emphasis given to building up coating on sheared edges. Total dry film thickness shall be 2.5 to 3.0 mils.

2.7.3 Field Applied Insulation

Chiller shall be provided with field installed insulation on surfaces subject to sweating including the water cooler, suction line piping, economizer, and cooling lines. Insulation on heads of coolers shall be
installed to provide easy removal and replacement of heads without damage to the insulation. Where motors are the gas-cooled type, factory installed insulation shall be provided on the cold-gas inlet connection to the motor per manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84. On all surfaces to be insulated, provide minimum two inch thick flexible cellular foam insulation with integral jacket. All insulation shall be coated with a UV inhibitor. Insulation shall comply with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Provide insulation after the installation of heat trace cable.

2.8 SUPPLEMENTAL COMPONENTS/SERVICES

2.8.1 Chilled Water Piping and Accessories

Chilled water piping and accessories shall be provided and installed in accordance with Section 23 64 26 CHILLED AND HEATING HOT WATER PIPING SYSTEMS.

2.8.2 Temperature Controls

Chiller control packages shall be fully coordinated with and integrated into the temperature control system specified in Section 23 09 23.13 20 BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

2.9 MECHANICAL IDENTIFICATION MATERIALS

General: Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.9.1 Engraved Plastic Laminate Signs

Provide engraving stock melamine plastic laminate, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Thickness: 1/16 inch for units up to 40 sq. in. or 8 inch length; 1/4 inch for larger units. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.9.2 Plastic Equipment Markers

Provide manufacturer's standard laminated plastic, color coded equipment markers. Include terminology matching equipment schedules as closely as
possible. Provide approximate 2-1/2 x 4 inch markers for control devices, and 4-1/2 x 6 inch for equipment. Identify equipment and electrical devices furnished under this section.

2.9.3 Plasticized Tags

Provide pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3 inch x 6 inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.9.4 Lettering and Graphics

Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Chiller CH/1).

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION PREPARATION

Provide storage for chiller at the project site. Chiller shall be shipped with weatherproof wrapping and palletized crating to prevent pre-installation damage.

3.2 EQUIPMENT INSTALLATION

Installation of water chiller systems including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the manufacturer's written installation instructions, including the following: Provide clearance for inspection, repair, replacement, and service. Electrical work shall conform to NFPA 70 and Division 26, "Electrical." Coordinate installed chiller height with installers of any Architectural screen wall elements surrounding the chiller to enable the chiller topmost discharge element heights to exceed the height of the surrounding screen wall elements.

3.2.1 Air Cooled Chillers

Install unit on reinforced concrete pad with anchor bolts; quantity, size and location as recommended by the chiller manufacturer. Start-up chiller in the presence of a factory authorized representative. In addition to the factory start-up checklist, the manufacturer representative shall advise on the following:

a. Examine areas and conditions, with chiller Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

b. Examine rough-in for hydronic piping and electrical to verify actual locations of connections prior to installation. Do not proceed until unsatisfactory conditions have been corrected.
c. Install equipment level and plumb, in accordance with manufacturer's written instructions.

d. Support unit on concrete foundation. Secure units with anchor bolts.

3.2.2 Piping Installation Requirements

Specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:

a. Arrange piping installations adjacent to units to allow unit servicing and maintenance. Verify that adequate piping supports are in place so that piping loads do not bear on chiller connections.

3.2.3 Refrigeration System

3.2.3.1 Equipment

Refrigeration equipment and the installation thereof shall conform to ASHRAE 15 & 34. Necessary supports shall be provided for all equipment, appurtenances, and pipe as required, including frames or supports for chillers and similar items. Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.2.3.2 Field Refrigerant Charging

a. Initial Charge: Upon completion of all the refrigerant pipe tests, the vacuum on the system shall be broken by adding the required charge of dry refrigerant for which the system is designed, in accordance with the manufacturer's recommendations. Contractor shall provide the complete charge of refrigerant in accordance with manufacturer's recommendations. Upon satisfactory completion of the system performance tests, any refrigerant that has been lost from the system shall be replaced. After the system is fully operational, service valve seal caps and blanks over gauge points shall be installed and tightened.

b. 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 shall be pumped into the system receiver or other suitable container. The refrigerant shall not be discharged into the atmosphere. The leak shall be repaired, the chiller evacuated and re-charged in accordance with the manufacturer's recommendations.

c. Contractor's Responsibility: The Contractor shall, 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
3.2.3.3 Oil Charging

Except for factory sealed units, two complete charges of lubricating oil for each compressor crankcase shall be furnished. One charge shall be used during the performance testing period, and upon the satisfactory completion of the tests, the oil shall be drained and replaced with the second charge.

3.2.4 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09 90 00 PAINTS AND COATINGS.

3.3 IDENTIFICATION OF PIPING, EQUIPMENT AND PHYSICAL HAZARDS

Identify equipment and physical hazards in accordance with 29 CFR 1910.144, ANSI A13.1, ANSI Z53.1 and as required by this specification. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment. Identify each piping system and item of equipment indicated on contract drawings.

3.3.1 Mechanical Equipment

Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device. Provide minimum 1/4 inch high lettering for name of unit where viewing distance is less than 36 inches, 1/2 inch high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering. In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.4 MANUFACTURER'S FIELD SERVICE

The services of a factory-trained representative shall be provided for a minimum of two days at two different travel intervals to site during installation and start-up, plus additional site visits for commissioning as determined by the Commissioning Agent. The representative shall supervise the installation, adjustment, testing and commissioning of the equipment. The representative shall advise on the following:

a. Hermetic machines:

   (1) Testing hermetic water-chilling unit under pressure for refrigerant leaks; evacuation and dehydration of machine to an absolute pressure of not over 300 microns.

   (2) Charging the machine with refrigerant.
(3) Starting the machine.

(4) Troubleshooting chiller operational failures.

(5) Verifying chiller operation with the variable-primary chilled water pumping system.

The chiller manufacturer shall maintain service capabilities no more than 50 miles from the job site. The manufacturer shall furnish complete submittal wiring diagrams of the chiller starter(s) and associated components like pumps, interlocks, etc. as applicable for field maintenance and service. Provide the services of factory trained and authorized technicians to cooperatively work with the TAB's Contractor and the DDC representatives to enable operation of the chillers with the variable-primary chilled water system. Provide personnel at times and intervals necessary to calibrate all chilled water system setpoints, troubleshoot (if necessary) issues resulting after start-up, and make any additional software/hardware modifications to enable the chiller to operate in accordance with the sequence of operation indicated on the Contract Drawings. Note that as a minimum the representative shall be available for three separate 8-hour workdays; interval and time determined by the Contracting Officer and Installing Contractor.

3.5 CLEANING AND ADJUSTING

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. System shall be maintained in this clean condition until final acceptance. Miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. At least one week before the official equipment warranty start date, all condenser coils on air-cooled water chillers shall be cleaned in accordance with the chiller manufacturer's instructions. This work covers two coil cleanings. The condenser coils shall be cleaned with an approved coil cleaner by a service technician, factory trained by the chiller manufacturer. The condenser coil cleaner shall not have any detrimental affect on the materials or protective coatings on the condenser coils. Testing, adjusting, and balancing shall be as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING.

3.6 FIELD ACCEPTANCE TESTING

3.6.1 Test Plans

a. Manufacturer's Test Plans: Within 120 calendar days after contract award, submit the following plans:

(1) Water chiller - field acceptance test plan.

Field acceptance test plans shall be developed by the chiller manufacturer detailing recommended field test procedures for that particular type and size of equipment. Field acceptance test plans developed by the installing Contractor, or the equipment sales agency furnishing the equipment, will not be acceptable.

The Contracting Officer will review and approve the field acceptance test plan for each of the listed equipment prior to commencement of field testing of the equipment. The approved field acceptance tests of the absorption chiller and subsequent test reporting.
b. Coordinated testing: Indicate in each field acceptance test plan when work required by this section requires coordination with test work required by other specification sections. Furnish test procedures for the simultaneous or integrated testing of tower system controls which interlock and interface with controls factory prewired or external controls for the equipment provided under Section 23 09 23.13 20, BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

c. Prerequisite testing: Chillers for which performance testing is dependent upon the completion of the work covered by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING must have that work completed as a prerequisite to testing work under this section. Indicate in each field acceptance test plan when such prerequisite work is required.

d. Test procedure: Indicate in each field acceptance test plan each equipment manufacturers published installation, start-up, and field acceptance test procedures. Include in each test plan a detailed step-by-step procedure for testing automatic controls provided by the manufacturer.

Each test plan shall include the required test reporting forms to be completed by the Contractor's testing representatives. Procedures shall be structured to test the chiller controls and variable-primary pumping controls through all modes of control to confirm that the controls are performing with the intended sequence of operation.

Controllers shall be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.

e. Performance variables: Each test plan shall list performance variables that are required to be measured or tested as part of the field test.

Include in the listed variables performance requirements indicated on the equipment schedules on the design drawings. Chiller manufacturer shall furnish with each test procedure a description of acceptable results that have been verified.

Chiller manufacturer shall identify the acceptable limits or tolerance within which each tested performance variable shall acceptably operate.

f. Job specific: Test plans shall be job specific and shall address the particular cooling towers and particular conditions which exist in this contract. Generic or general preprinted test procedures are not acceptable.

g. Specialized components: Test plans shall include procedures for field testing and field adjusting specialized components, such as control valves, or differential pressure transducers.

3.6.2 Testing

a. Each water chiller system shall be field acceptance tested in
compliance with its approved field acceptance test plan and the resulting following field acceptance test report submitted for approval:

1. Water chiller - field acceptance test report

b. Manufacturer's recommended testing: Conduct the manufacturer's recommended field testing in compliance with the approved test plan. Furnish a factory trained field representative authorized by and to represent the equipment manufacturer at the complete execution of the field acceptance testing.

c. Operational test: Conduct a continuous 48 hour operational test for each chiller. Equipment shutdown before the test period is completed shall result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every two hours. Use the test report forms for logging the operational variables.

d. Notice of tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.

e. Report forms: Type data entries and writing on the test report forms. Completed test report forms for each item of equipment shall be reviewed, approved, and signed by the Contractor's test director. The manufacturer's field test representative shall review, approve, and sign the report of the manufacturer's recommended test. Signatures shall be accompanied by the person's name typed.

f. Deficiency resolution: The test requirements acceptably met; deficiencies identified during the tests shall be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

3.7 SYSTEM PERFORMANCE TESTS

3.7.1 General Requirements

Before each chilled water system is accepted, tests to demonstrate the general operating characteristics of the chiller and associated pumping system shall be conducted by a registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Water chiller testing shall be observed by the Commissioning Agency. Tests shall cover a period of not less than 48 hours for each system and shall demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made as necessary and tests shall be re-conducted to demonstrate that the water chiller system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points shall be installed and tightened. Any refrigerant lost during the system startup shall be replaced. If tests do not demonstrate satisfactory system performance, deficiencies shall be corrected and the system shall be retested. Tests shall be
conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. Field tests shall be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING.

3.7.2 Test Report

The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

a. Date and outside weather conditions.

b. The load on the system based on the following:
   
   (1) The refrigerant used in the system.
   (2) Condensing temperature and pressure.
   (3) Suction temperature and pressure.
   (4) Running current, voltage and proper phase sequence for each phase of all motors.
   (5) The actual on-site setting of all operating and safety controls.
   (6) Chilled water pressure, flow and temperature in and out of the chiller.

3.8 COMMISSIONING

Provide the services of a supervisory level technician, in responsible charge of the work in this section, and factory authorized start-up and service technicians; for each major component or system in this section, to participate in the work specified in Section 23 08 02.00 50 COMMISSIONING OF HVAC SYSTEMS. Refer to Section 23 08 02.00 50, COMMISSIONING OF HVAC SYSTEMS for description of work.

3.9 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field posted instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

3.10 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 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)


ASME INTERNATIONAL (ASME)

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)


AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2004) Specification for Filler Metals for Brazing and Braze Welding


AWS Z49.1     (2005) Safety in Welding, Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME B1.20.1  (1983; R 2006) Pipe Threads, General Purpose (Inch)


ASME B16.18   (2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.21   (2005) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22 (2001; R 2010) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings


ASME B31.9 (2008) Building Services Piping

ASME B40.100 (2005) Pressure Gauges and Gauge Attachments

ASME BPVC SEC VIII D1 (2007; Addenda 2008; Addenda 2009) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)


ASTM A 733 (2003; R 2009e1) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples


ASTM D 3308 (2006) PTFE Resin Skived Tape

ASTM D 520 (2000; R 2005) Zinc Dust Pigment
ASTM D 596 (2001; R 2006) Reporting Results of Analysis of Water

ASTM F 1199 (1988; R 2010) Cast (All Temperatures and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)

CSA AMERICA, INC. (CSA/AM)


HYDRAULIC INSTITUTE (HI)

HI 1.1-1.2 (2008) Rotodynamic (Centrifugal) Pump for Nomenclature and Definitions

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110 (2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends


MSS SP-67 (2002a; R 2004) Standard for Butterfly Valves

MSS SP-69 (2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application


MSS SP-72 (2010) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-80 (2008) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2009) Motors and Generators

1.2 SYSTEM DESCRIPTION

Provide the water systems having the minimum service (design) temperature-pressure rating indicated. Provision of the piping systems, including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the required and advisory provisions of ASME B31.9 except as modified or supplemented by this specification section or design drawings. This specification section covers the water systems piping which is located within, on, and adjacent to building(s) as indicated on Contract Drawings.

1.3 SUBMITTALS

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

SD-02 Shop Drawings

Chilled and Heating Hot Water Piping Systems; G

Submit dimensioned shop drawings of piping showing both the accurately scaled piping and its relationship to space enclosure. Provide in accordance with Section 01 33 00, SUBMITTAL PROCEDURES and as modified by this section. Illustration shall be drawn to a minimum scale of 1/4 inch per foot. Drawings shall indicate actual plan dimensions and elevations above finished floor. Provide illustrations including sections to clarify elevations of equipment, equipment connections, piping, and piping accessories. Drawings shall conform to standard drafting industry procedures. Include contractors name, project title, date and phone number in title block. Include as a minimum the following:

a. Chilled water piping.
b. Hot water piping (heating).
c. Valves.
d. Floor drains.
e. Water chillers.
f. Relief drain and make-up piping.
g. Piping floor roof and wall penetrations.

h. Expansion tanks.

i. Air separators.

j. Pumps.

k. Air handling units.

l. Equipment supports; floor and roof type.

m. Fans.

n. Electrical panels, starters and disconnect switches.

o. Condensate Drain Piping

p. Pipeline accessories such as flow meters and strainers.

SD-03 Product Data

Steel Piping; G

Copper Tubing; G

Dielectric Fittings; G

Valves; G

Gaskets; G

Soldering metals; G

Pump motors; G

Pumps; G

Motor starters; G

Tanks; G

Air vent valves; G

Expansion Tanks; G

Piping Accessories; G

Air Separator Tanks; G

Mechanical Identification; G

For valves, submit valve manufacturer's published ratings and maximum operating pressure differential. For relief valves, also submit manufacturer's published discharge capacity ratings. For pumps, include pump speed and characteristic curves for performance of impeller selected for each pump. Curves shall indicate capacity versus head, efficiency, and brake horsepower for full range, from shutoff to free delivery. Provide family of
curves for each pump submitted indicating multiple impeller sizes with operating point noted. Computer generated curves indicating a single impeller size are not acceptable. For all separator tanks include efficiency curves.

**Water Treatment Systems**

Proposed water treatment plan including a layout, control scheme, a list of existing make-up water conditions including the items listed in paragraph "Water Analysis", a list of chemicals, the proportion of chemicals to be added, the final treated water conditions, and a description of environmental concerns for handling the chemicals.

**SD-06 Test Reports**

Water analysis; G

Piping welds NDE report; G

Pressure tests reports; G

Report shall be provided in bound 8-1/2 by 11 inch booklets. In the reports, document all phases of the tests performed. Include initial test summaries, all repairs/adjustments made, and the final test results.

**SD-07 Certificates**

Employer's Record Documents (For Welding)

Welding Procedures and Qualifications
Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

- Fittings
- Unions
- Flanges
- Gaskets
- Bolting

**SD-08 Manufacturer's Instructions**

Lesson plan for the Instruction Course; G

**SD-10 Operation and Maintenance Data**

Requirements for data packages are specified Section 01 78 23 OPERATION AND MAINTENANCE SUPPLY DATA, except as supplemented and modified by this specification section.

Submit spare parts data for each different item of equipment specified, with operation and maintenance data packages. Include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

Submit a list of qualified permanent service organizations with
operation and maintenance data packages. Include service organization addresses and service area or expertise. 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.

Water Treatment Systems; G


A maintenance manual in bound 8-1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide.

Manual Balancing Valves, Data Package 3; G
Water Pressure Reducing Valve, Data Package 3; G
Pressure Relief Valve, Data Package 2; G
Combination Pressure and Temperature Relief Valves, Data Package 2; G
Pumps, Data Package 3; G
Expansion Tanks, Data Package 2; G
Air Separator Tanks, Data Package 2; G

1.4 MODIFICATIONS TO REFERENCES

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his
administrative cognizance and the FAR.

1.5 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

1.6 DELIVERY, STORAGE, AND HANDLING

Equipment and components shall be delivered and stored with protective crating and weatherproof wrapping to provide protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter. Any porous materials found to be contaminated with mold or mildew will be replaced at the Contractor's expense. Non-porous materials found to be contaminated with mold or mildew will be disinfected and cleaned prior to installation.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.7.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.7.3 Accessibility

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

1.8 QUALITY ASSURANCE

1.8.1 Coordination of Trades

The Contract Drawings indicate engineered solutions and design intent for the chilled and hot water piping systems and equipment. If through the coordination effort it is required to shift equipment components or accessories from the locations indicated to enable the installation of adjacent trades, the materials required to coordinate the final locations shall be provided as work of this Section. Provide piping offsets, fittings, and accessories as required to provide a complete installation.
and to eliminate interference with adjacent construction. Coordinate equipment locations with space required for trades in the adjacent installation area.

1.8.2 Pump Design Criteria

Pumps design and manufacturer shall conform to Hydraulic Institute Standards. Pump sizes, capacities, pressures, operating characteristics and efficiency shall be as scheduled. Head capacity curves shall slope up to maximum head at shut off. Select pumps near the midrange of the curve, so the design capacity falls to the left of the best efficiency point, to allow a cushion for the usual drift to the right in operation, without approaching the pump curve end point and possible cavitation and unstable operation. Select pumps for open systems so that required net positive suction head (NPSHR) does not exceed the net positive head available (NPSHA). The head for pumps submitted for pumping through chillers and through chilled water coils shall be increased, if necessary, to match the equipment approved for the project. Pumps shall be non-overloading at any point on the head capacity curve including one pump operation in a parallel or series pumping installation. Provide pumps with motors, impellers, drive assemblies, bearings, coupling guard and other accessories specified. Statically and dynamically balance all rotating parts. Furnish each pump and motor with a nameplate giving the manufacturers name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current and motor efficiency. Factory test all pumps before shipment. The manufacturer shall certify all pump ratings. After completion of balancing, provide replacement of impellers or trim impellers to provide specified flow at actual pumping head, as installed. Furnish one spare seal and casing gasket for each pump to the Contracting Officer.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening.

The two 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 shall 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. System components shall be environmentally suitable for the indicated locations.

The equipment items shall be supported by service organizations. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
2.2 STEEL PIPING

Except where noted otherwise, water vent and drain piping shall be black steel pipe. Provide steel piping with an ANSI/ASME Class 125 service rating, which for 150 degrees F, the pressure rating is 175 psig. Steel piping shall conform to ASTM A 53/A 53M and ASTM A 106/A 106M, Grade B, Schedule 40 for sizes up to and including 10 inches, standard weight for sizes 12 inches and greater.

2.2.1 Pipe

Steel pipe, conform to ASTM A 53/A 53M, Schedule 40, Type E or S, Grades A or B. Do not use Type F pipe.

2.2.2 Fittings and End Connections (Joints)

Piping and fittings 1 inch and smaller shall have threaded connections. Piping and fittings larger than 1 inch and smaller than 3 inches shall have either threaded, or welded connections. Piping and fittings 3 inches and larger shall have grooved, welded, or flanged connections. The manufacturer of each fitting shall be permanently identified on the body of the fitting in accordance with MSS SP-25.

2.2.2.1 Threaded Connections


2.2.2.2 Flanged Connections

Flanges shall conform to ASME B16.1, Class 150. Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. These gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). Bolts, nuts, and bolt patterns shall conform to ASME B16.1.

2.2.2.3 Welded Connections

Welded valves and pipe connections (both butt-welds and socket-welds types) shall conform to ASME B31.9. Butt-welded fittings shall conform to ASME B16.9. Socket-welded fittings shall conform to ASME B16.11. Welded fittings shall be identified with the appropriate grade and marking symbol.

2.2.2.4 Dielectric Waterways and Flanges

Provide dielectric waterways with a water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall be able to withstand a 600-volt breakdown test. Provide dielectric waterways constructed of galvanized steel and have threaded end connections to match connecting piping. Dielectric waterways shall be suitable for the required operating pressures and temperatures. Provide dielectric flanges with the same pressure ratings as standard flanges and provide complete electrical isolation between connecting pipe and/or equipment as described herein for dielectric waterways.
2.3 COPPER TUBING

Provide copper tubing and fittings with a ANSI/ASME Class 125 service rating, which for 150 degrees F., the pressure rating is 175 psig.

2.3.1 Tube

Use copper tube conforming to ASTM B 88, Type L for aboveground tubing, and Type K for buried tubing.

2.3.2 Fittings and End Connections (Solder and Flared Joints)

Wrought copper and bronze solder joint pressure fittings, including unions and flanges, shall conform to ASME B16.22 and ASTM B 75. Provide adapters as required. Cast copper alloy solder-joint pressure fittings, including unions and flanges, shall conform to ASME B16.18. ASTM B 42 copper pipe nipples with threaded end connections shall conform to ASTM B 42.

Copper tubing of sizes larger than 2 inches shall have 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.

2.3.3 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.

2.4 VALVES

Provide valves with a ANSI/ASME Class 125 service rating, which for 150 degrees F., the pressure rating is 175 psig.

2.4.1 Gate Valve

Gate valves 2-1/2 inches and smaller shall conform to MSS SP-80 Class 125 and shall be bronze with wedge disc, rising stem and threaded, soldered, or flanged ends. Gate valves 3 inches and larger shall conform to MSS SP-70, Class 125, cast iron with bronze trim, outside screw and yoke, and flanged or threaded ends.

2.4.2 Check Valve

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80. Check valves 3 inches and larger shall conform to MSS SP-71, Class 125. Furnish swing check valves in horizontal piping and spring loaded check valves in vertical piping, and at pump discharge locations. Spring loaded check valves shall be Class 150, cast steel with flanged connections, single disc, Type 316 stainless steel disc material, Type 316 stainless steel trim including center guiding rod, with Buna N seat seals.

2.4.3 Butterfly Valve

Butterfly valves shall conform to MSS SP-67, Type 1 and shall be either the wafer or lug type. Valves smaller than 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable
balance return stops and position indicators. Butterfly valves shall be lug wafer type, and shall be bubble-tight at 150 psig. Valve bodies shall be cast iron, malleable iron, or steel. ASTM A 167, Type 404 or Type 316, stainless steel stems, Type 316 stainless steel discs and synthetic EPDM rubber seats vulcanized into valve body shall be provided. Valves in insulated lines shall have extended neck to accommodate insulation thickness. Valves with aluminum or other metallic seat backer rings or bushings are not acceptable.

2.4.4 Ball Valve

Full port design. Two piece body ball valves 1/2 inch and larger shall conform to MSS SP-72 or MSS SP-110 and shall be cast iron or bronze with threaded, soldered, or flanged ends.

2.4.5 Manual Balancing Valves

Copper alloy or cast iron body, copper alloy or stainless internal working parts. Provide valve calibrated so that flow can be determined when the temperature and pressure differential across valve is known. Valve shall have an integral pointer which registers the degree of valve opening. Valve shall function as a service valve when in fully closed position. Valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation.

Provide valve bodies with tapped openings and pipe extensions with positive shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable differential pressure meter connections to verify the pressure differential. Provide metal tag on each valve showing the gallons per minute flow for each differential pressure reading. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

2.4.6 Water Pressure Reducing Valve

Valve, ASSE 1003 for water service, copper alloy body, automatic re-seating, with test lever.

2.4.7 Pressure Relief Valve

Valve shall prevent excessive pressure in the piping system when the piping system reaches its maximum heat buildup. Valve, CSA/AM Z21.22 and shall have cast iron bodies with corrosion resistant internal working parts. The discharge pipe from the relief valve shall be the size of the valve outlet unless otherwise indicated.

2.4.8 Air Vents

2.4.8.1 Manual Air Vents

Manual air vents shall be 1/4 inch brass or bronze ball valve suitable for the pressure rating of the piping system and furnished with threaded plugs or caps.

2.4.9 Drain Valves

Ball valves conforming to MSS SP-110, manually operated 3/4 inch pipe size
and above, with threaded ends. Provide hose nipple adapters for connecting a hose to lead to a convenient floor drain.

2.5 PIPING ACCESSORIES

2.5.1 Strainer

Strainer, ASTM F 1199, except as modified and supplemented in this specification. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. Strainer bodies shall be fabricated of cast iron with bottoms drilled, and tapped. Strainers of sizes 2 inches and smaller may be bronze body. Provide blowoff outlet with pipe nipple, ball valve, and discharge pipe nipple for stainless steel 2 inches and larger. The bodies shall have arrows clearly cast on the sides indicating the direction of flow.

Provide strainer with removable cover and sediment screen. The screen shall be made of minimum 22 gauge monel, or corrosion-resistant steel, with small perforations numbering not less than 400 per square inch to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.5.2 Cyclonic Separator

Metal-bodied, with removal capability of removing solids 45 microns/325 mesh in size and heavier than 1.20 specific gravity, maximum pressure drop of 5 psid, with cleanout connection. Provide at each end-suction base mounted pump.

2.5.3 Combination Strainer and Pump Suction Diffuser

Angle type body with removable strainer basket and internal straightening vanes, a suction pipe support, and a blowdown outlet and plug. Strainer shall be in accordance with ASTM F 1199, except as modified and supplemented by this specification. Unit body shall have arrows clearly cast on the sides indicating the direction of flow.

Strainer screen shall be made of minimum 22 gauge corrosion-resistant steel, with small perforations numbering not less than 400 per square inch to provide a net free area through the basket of at least 3.30 times that of the entering pipe. Flow shall be into the screen and out through the perforations. Provide an auxiliary disposable fine mesh strainer which shall be removed 30 days after start-up. Provide warning tag for operator indicating scheduled date for removal.

Casing shall have connection sizes to match pump suction and pipe sizes, and be provided with adjustable support foot or support foot boss to relieve piping strains at pump suction. Provide unit casing with blowdown port and plug. Provide a magnetic insert to remove debris from system.

2.5.4 Flexible Pipe Connectors

Provide nylon reinforced, synthetic spherical configuration connectors with dual spheres. Equip flanged assemblies with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners,
compatible with circulating medium, shall be provided when recommended by the manufacturer. Provide covers to protect the bellows where indicated.

2.5.5 Pressure and Vacuum Gauges

Gauges, ASME B40.100 with throttling type needle valve or a pulsation dampener and shut-off valve. Provide gauges with 4.5 inch dial, liquid filled, brass or aluminum case, bronze tube, and siphon. Gauge shall have a minimum of with a range from 0 psig to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range. Furnish Simplex or compound types as indicated.

2.5.6 Temperature Gauges

Temperature gauges, shall be the industrial duty type and be provided for the required temperature range. Provide gauges with fixed thread connection, and an accuracy within 2 percent of scale range. Gauges shall have Fahrenheit scale in 2 degree graduations scale (black numbers) on a white face. Rigid stem type temperature gauges shall be provided in thermal wells.

2.5.6.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

2.5.6.2 Pressure/Temperature Test Ports

Pressure/Temperature Test ports shall have brass body and EPDM and/or Neoprene valve seals. Ports shall be rated for service between 35 and 275 degrees F and up to 500 psig. Ports shall be provided in lengths appropriate for the insulation thickness specified in Section 23 07 00, THERMAL INSULATION FOR MECHANICAL SYSTEMS, and installed to allow a minimum of 12 inches of access for probe insertion. Provide with screw-on cap attached with a strap or chain to prevent loss when removed. Ports shall be dia. 1/2 inch NPT and accept 1/8 inch diameter probes.

2.5.7 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports: To MSS SP-58 and MSS SP-69.

2.5.8 Escutcheons

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Secure plates in place by internal spring tension or set screws. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

2.5.9 Thermal Well

Provide thermal wells for pipeline sensors in Section 23 09 23.13 20, BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC. Thermal wells shall be type 304 stainless steel and be of length required for each sensor. Locate where directed by controls installer.
2.6 PUMPS

Pumps shall be the electrically driven, non-overloading, centrifugal type which conform to HI 1.1-1.2. Pumps shall be selected at head and flow indicated. Pump curve shall rise continuously from maximum capacity to shutoff. Pump motor, as a minimum, shall conform to NEMA MG 1, be totally enclosed, and have sufficient horsepower for the service required. Pump motor shall have the required capacity to prevent overloading with pump operating at any point on its characteristic curve. Pump speed shall not exceed 1,750 rpm. Furnish pump motors 2 horsepower and greater with premium efficiency motors. Provide motors indicated for use with variable frequency drive motor starters with listing for inverter duty.

2.6.1 Base Mounted End Suction Pumps

Each pump casing shall be designed to withstand the discharge head specified plus the static head on system plus 50 percent of the total, but not less than 125 psig. Pump casing and bearing housing shall be close grained cast iron. High points in the casing shall be provided with manual air vents; low points shall be provided with drain plugs. Provide threaded suction and discharge pressure gage tapping with square-head plugs.

Impeller shall be statically and dynamically balanced. Impeller, impeller wearing rings, glands, casing wear rings, and shaft sleeve shall be bronze. Shaft shall be carbon or alloy steel, turned and ground. Bearings shall be ball-bearings, roller-bearings, or oil-lubricated bronze-sleeve type bearings, and be efficiently sealed or isolated to prevent loss of oil or entrance of dirt or water.

Pump and motor shall be mounted on a common cast iron base having lipped edges and tapped drainage openings or structural steel base with lipped edges or drain pan and tapped drainage openings. Pump shall be provided with steel shaft coupling guard. Base-mounted pump, coupling guard, and motor shall each be bolted to a fabricated steel base which shall have bolt holes for securing base to supporting surface. Pump shall be accessible for servicing without disturbing piping connections. Shaft seals shall be mechanical-seals.

2.6.2 Mechanical Shaft Seals

Seals shall be single, inside mounted, end-face-elastomer bellows type with stainless steel spring, brass or stainless steel seal head, carbon rotating face, and tungsten carbide or ceramic sealing face. Glands shall be bronze and of the water-flush design to provide lubrication flush across the face of the seal. Bypass line from pump discharge to flush connection in gland shall be provided, with cyclonic particle separator in line.

2.7 EXPANSION TANKS

Tank shall be welded steel, constructed for, and tested to pressure-temperature rating of 125 psi at 150 degrees F. Provide tanks precharged to the minimum operating pressure. Tank shall have a replaceable polypropylene or butyl lined diaphragm which keeps the air charge separated from the water; shall be the captive air type.

Tanks shall accommodate expanded water of the system generated within the...
normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. Each tank air chamber shall be fitted with a drain, fill, an air charging valve, and system connections. Tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The only air in the system shall be the permanent sealed-in air cushion contained within the expansion tank.

2.8 AIR SEPARATOR TANKS

External air separation tank shall have an internal steel baffling and strainer element design, creating the required vortex and subsequent air and particulate separation. Tank shall be steel, constructed, tested, and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 125 psig. Air separator shall provide a minimum 97 percent efficiency level with a maximum velocity of 4 feet/second and a maximum pressure drop of 1 ft H2O. Tank shall have tangential inlets and outlets connections, threaded for 2 inches and smaller and flanged for sizes 2 1/2 inches and larger. Air released from a tank shall be vented as indicated. Tank shall be provided with a blow-down connection. Tank products without internal baffling and strainer devices are not acceptable.

2.9 WATER TREATMENT SYSTEMS

When water treatment is specified, the use of chemical-treatment products containing equivalent chromium (CPR) is prohibited.

2.9.1 Water Analysis

Provide a water analysis of the potable water at the project site. Report the following:

- Date of Sample
- Temperature: ____ degrees F.
- Silica (Sino 2): ____ pp (mg/1)
- Insoluble: ____ pp (mg/1)
- Iron and Aluminum Oxides: ____ pp (mg/1)
- Calcium (Ca): ____ pp (mg/1)
- Magnesium (Mg): ____ pp (mg/1)
- Sodium and Potassium (Nan and AK): ____ pp (mg/1)
- Carbonate (HO 3): ____ pp (mg/1)
- Sulfate (SO 4): ____ pp (mg/1)
- Chloride (JCL): ____ pp (mg/1)
- Nitrate (NO 3): ____ pp (mg/1)
- Turbidity: ____ unit
- pH: ____
- Residual Chlorine: ____ pp (mg/1)
- Total Alkalinity: ____ PM (me/1)
- Non-Carbonate Hardness: ____ PM (me/1)
- Total Hardness: ____ PM (me/1)
- Dissolved Solids: ____ pp (mg/1)
- Fluorine: ____ pp (mg/1)
- Conductivity: ____ McMahon/cm

2.9.2 Chilled and Heating Hot Water

Provide cleaning and treatment of installed piping systems. Water to be used in the chilled and heating hot water systems shall be treated with corrosion inhibitor chemical, and as recommended by the manufacturers of
the connected equipment. Chemicals shall meet all required federal, state, and local environmental regulations for the treatment of closed loop hydronic systems and direct discharge to the sanitary sewer.

2.9.3 Water Treatment Services

The services of a company regularly engaged in the treatment of chilled, and heating hot water systems shall be used to determine the correct chemicals required, the concentrations required, and the water treatment equipment sizes and flow rates required. The company shall maintain the chemical treatment and provide all chemicals required for the chilled, and heating hot water systems for a period of 1 year from the date of occupancy. The chemical treatment and services provided over the 1 year period shall meet the requirements of this specification as well as the recommendations from the manufacturers of the connected equipment. Acid treatment and proprietary chemicals shall not be used.

2.9.4 Chilled and Heating Hot Water Systems

A shot feeder shall be provided on both the chilled water piping and on each heating hot water piping system as indicated. Size and capacity of feeder shall be based on local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping. Furnish floor mounted shot feeder with support legs as indicated.

2.9.5 Piping Cleaning Chemical

Provide surfactant / copolymer / phosphate compound in solution form. Furnish accessories necessary to mix and charge into system.

2.9.6 Pipe Cleaning Accessories

Provide temporary piping loops at main ends, valves, temporary circulating pump, caps and blind flanges to permit pipe cleaning. Temporary circulating pump shall have water quantity sufficient to generate 8 feet/second water velocity through the largest pipe size indicated for each hydronic system.

2.10 ELECTRICAL WORK

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. 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, shall be provided. For packaged equipment, the manufacturer shall provide controllers including the required monitors and timed restart.

Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11.

Provide polyphase, squirrel-cage medium induction motors, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the
specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

2.11 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

2.11.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided. The factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 3000 hours in a salt-spray fog test.

Salt-spray fog test shall be in accordance with ASTM B 117, and for that test, the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of 0.125 inch on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen.

If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

2.11.2 Shop Painting Systems for Metal Surfaces

Clean, retreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where hot-dip galvanized steel has been cut, resulting surfaces with no galvanizing shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry
film thickness of one mil per coat.

b. Temperatures Between 120 and 400 degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

2.12 NAMEPLATES

Major equipment including pumps, pump motors, expansion tanks, heat exchangers, and air separator tanks shall have the manufacturer's name, type or style, model or serial number on a plate secured to the item of equipment. The nameplate of the distributing agent will not be acceptable. Plates shall be durable and legible throughout equipment life and made of anodized aluminum or stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.13 RELATED COMPONENTS/SERVICES

2.13.1 Drain and Make-Up Water Piping

Requirements for drain and make-up water piping and backflow preventer is specified in Section 22 00 70 PLUMBING SYSTEMS.

2.13.2 Field Painting

Requirements for painting of surfaces not otherwise specified, and finish painting of items only primed at the factory, are specified in Section 09 90 00 PAINTING, GENERAL.

2.13.2.1 Color Coding

Requirements for color coding for piping identification are specified in Section 09 90 00 PAINTING AND COATINGS.

2.14 MECHANICAL IDENTIFICATION MATERIALS

General: Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.14.1 Plastic Pipe Markers

Provide snap-on or adhesive type pipe markers with nomenclature that closely matches contract drawings. Comply with designations indicated on contract drawings for piping system nomenclature and abbreviate only as necessary for each application length. Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

a. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with
b. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.

c. Application: For exterior diameters greater than 6 inch (including insulation if any), provide continuous directional flow arrow tape around pipe circumference; two places, before and after pipe marker. Provide adhesive plastic pipe markers. For external diameters less than 6 inch (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

(1) Snap-on application of pre-tensioned semi-rigid plastic pipemarker.

(2) Adhesive lap joint in pipe marker overlap.

(3) Laminated or bonded application of pipe marker to pipe (or insulation).

2.14.2 Color Coding

Color code marking shall be of the color listed in Table I and the side listed in Table II. The arrows shall be installed adjacent to each band to indicate the direction of flow in the pipe. The legends shall be printed in upper-case black letters as listed in Table I. Letter sizes shall be as listed in Table II. Marking shall be painted or applied using colored, pressure-sensitive adhesive markers of standard manufacturer. Paint shall be as specified for insulated and uninsulated piping.

<table>
<thead>
<tr>
<th>Letters and Material</th>
<th>Band</th>
<th>Arrow</th>
<th>Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled water supply</td>
<td>Green</td>
<td>White</td>
<td>CHWS</td>
</tr>
<tr>
<td>Chilled water return</td>
<td>Green</td>
<td>White</td>
<td>CHWR</td>
</tr>
<tr>
<td>Heating water supply</td>
<td>Yellow</td>
<td>Black</td>
<td>HWS</td>
</tr>
<tr>
<td>Heating water return</td>
<td>Yellow</td>
<td>Black</td>
<td>HWR</td>
</tr>
<tr>
<td>Chemical feed</td>
<td>Yellow</td>
<td>Black</td>
<td>CF</td>
</tr>
<tr>
<td>Make-up water</td>
<td>Green</td>
<td>White</td>
<td>CW</td>
</tr>
<tr>
<td>Drain</td>
<td>Green</td>
<td>White</td>
<td>DR</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outside Diameter of Pipe Covering (in)</th>
<th>Width of Color Band (in)</th>
<th>Arrow Length X Width (in)</th>
<th>Size of Legend Letters and Numerals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1-1/2</td>
<td>8</td>
<td>8 x 2</td>
<td>1/2</td>
</tr>
<tr>
<td>1-1/2 to 2</td>
<td>8</td>
<td>8 x 2</td>
<td>3/4</td>
</tr>
<tr>
<td>2 to 6</td>
<td>12</td>
<td>8 x 2</td>
<td>1-1/4</td>
</tr>
<tr>
<td>8 to 10</td>
<td>24</td>
<td>12 x 3</td>
<td>2-1/2</td>
</tr>
<tr>
<td>Over 10</td>
<td>32</td>
<td>12 x 3</td>
<td>3</td>
</tr>
</tbody>
</table>
2.14.3 Valve Tags

Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 3/8 inch high letters and sequenced valve numbers 15 mm high, and with 1/8 inch hole for fastener, or 1/16 inch thick engraved plastic laminate valve tags, with piping system abbreviation in 3/8 inch high letters and sequenced valve numbers 1/2 inch high, and with 1/8 inch hole for fastener. Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose. Compile valve schedule for each service. For each page of valve schedule, provide laminated plastic coated cardboard stock sheets.

   a. Provide 1-1/2 inch diameter tags, except as otherwise indicated.
   b. Provide size and shape as specified or scheduled for each piping system.
   c. Fill tag engraving with black enamel.

2.14.4 Engraved Plastic Laminate Signs

Provide engraving stock melamine plastic laminate, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Thickness: 1/16 inch for units up to 40 sq. in. or 8 inch length; 1/4 inch for larger units. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.14.5 Plastic Equipment Markers

Provide manufacturer's standard laminated plastic, color coded equipment markers. Include terminology matching equipment schedules as closely as possible. Provide approximate 2-1/2 x 4 inch markers for control devices, and 4-1/2 x 6 inch for equipment. Identify equipment and electrical devices furnished under this section.

2.14.6 Plasticized Tags

Provide pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3 inch x 6 inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.14.7 Lettering and Graphics

Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Pump No. 3, Unit Heater No. 1H, Expansion
PART 3 EXECUTION
3.1 INSTALLATION

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 is not permitted without written approval. Cut pipe or tubing square, remove burrs by reaming, and fashion to permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers. Coordinate final locations of piping and system components with work of all trades adjacent to installation. Connections between ferrous and copper piping materials shall be made with isolating dielectric waterway fittings and isolating flange kits.

3.1.1 Welding

Provide welding work specified this section for chilled and heating hot water piping systems in conformance with ASME B31.9, as modified and supplemented by this specification section and the accompanying drawings. The welding work includes: qualification of welding procedures, welders, welding operators, brazers, brazing operators, and nondestructive examination personnel; maintenance of welding records, and examination methods for welds.

3.1.1.1 Employer's Record Documents (For Welding)

Submit for review and approval the following documentation. This documentation and the subject qualifications shall be in compliance with ASME B31.9.

a. List of qualified welding procedures that is proposed to be used to provide the work specified in this specification section.

b. List of qualified welders, brazers, welding operators, and brazing operators that are proposed to be used to provide the work specified in this specification section.

c. List of qualified weld examination personnel that are proposed to be used to provide the work specified in this specification section.

3.1.1.2 Welding Procedures and Qualifications

a. Specifications and Test Results: Submit copies of the welding procedures specifications and procedure qualification test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds. Submit this information on the forms printed in ASME BPVC SEC IX or their equivalent.

b. Certification: Before assigning welders or welding operators to the work, submit a list of qualified welders, together with data and certification that each individual is performance qualified as specified. Do not start welding work prior to submitting welder, and welding operator qualifications. The certification shall
3.1.1.3 Examination of Piping Welds

Conduct non-destructive examinations (NDE) on piping welds and brazing and verify the work meets the acceptance criteria specified in ASME B31.9. NDE on piping welds covered by ASME B31.9 is visual inspection only. Submit a piping welds NDE report meeting the requirements specified in ASME B31.9.

3.1.1.4 Welding Safety

Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

3.1.2 Directional Changes

Make changes in direction with fittings. Mitering or notching pipe or other similar construction to form elbows or tees is not permitted. Make changes in direction with factory fabricated threaded, solder joint or forged steel welding fittings. Mitering or notching pipe or other similar construction to form elbows or tees is not permitted. Forged steel branch outlet fittings are acceptable in lieu of forged steel welding tee fittings provided that the branch pipe size is a minimum of one size smaller than the main pipe. Unless noted otherwise, use long radius elbows.

3.1.3 Functional Requirements

Pitch horizontal supply mains down in the direction of flow as indicated. The grade shall not be less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Cap or plug open ends of pipelines and equipment during installation to keep dirt or other foreign materials out of the system.

Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 2 inches or less in diameter, and with flanges for pipe 2-1/2 inches and above in diameter. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric waterways or flanges.

Piping located in air plenums shall conform to NFPA 90A requirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance. Electric isolation waterway fittings and isolating flange kits shall be provided between dissimilar metals.

3.1.4 Fabrication and Assembly of Piping and Components

Welding, heating, and soldering metals shall conform to ASME B31.9 and as specified herein. Provide sufficient pitch to assure adequate drainage and venting. Drain valves at low points of piping system, and automatic air vent valves at high points where air pockets would occur. Piping shall follow general arrangement shown, cut accurately to measurements
established for the work by the Contractor, and worked into place without springing or forcing, except where cold-springing is indicated. Piping and equipment within buildings shall be entirely out of the way of electrical conduit, lighting fixtures, equipment and doors, windows, and other openings. Run overhead piping in buildings in the most inconspicuous positions. Provide adequate clearance from walls, ceilings, and floors to permit welding of joints; at least 6 inches for pipe sizes 4 inches and less, 10 inches for pipe sizes over 4 inches, and in corners provide sufficient clearance to permit the welder to work between pipe and one wall. Provide for expansion and contraction of pipe lines. Make changes in size of water lines with reducing fittings. Provide concentric reducers in vertical piping and eccentric reducers in horizontal piping. Eccentric reducer fittings shall have flat side on top. Do not conceal, or insulate piping until inspected, tested, and approved. Protect materials and equipment from weather. Run pipe to be insulated as shown and as required with sufficient clearance to permit application of insulation. Do not miter pipe to form elbows, or notch straight runs to form full-sized tees, or utilize any similar construction. Except where shown otherwise, run vertical piping plumb and straight and parallel to walls. Thoroughly clean each section of pipe, fittings, and valves to be free of foreign matter before erection. Prior to erection, hold each piece of pipe in an inclined position and thoroughly tap to loosen sand, mill scale, and foreign matter. Before final connections are made to apparatus, wash interior of piping thoroughly with water. Blow out piping with high pressure steam or compressed air to remove rust scale, oil, and debris. Plug or cap open ends of mains during shutdown periods. Do not leave lines open at any place where foreign matter might accidentally enter.

3.1.4.1 Insulation of Copper Tubing

Insulate copper tubing placed in cinder fill or run through cinder block foundation from cinder material to prevent sulphur corrosion by wrapping complete continuous tubing surface with protective tape.

3.1.4.2 Strainers

Provide strainers to protect orifices, coils, motor actuated valves, and pumps and compressor from foreign materials. Locate strainers close to equipment to be protected. Install strainers with screen drum and in direction of flow, as marked on strainer body. Strainers shall have isolating service valves to permit servicing strainer with minimum loss of fluid. Install strainers with basket side down. Provide clearance for removal and replacing of strainer screens. Strainers shall have screens of ample net free area and be composed of materials which shall be compatible with fluid being used. Provide reducer fittings for changes in pipeline sizes and strainer connection sizes. Provide a pressure gage with valved connection to inlet and outlet sides of strainer for determining pressure drop through strainer, for indicating need for cleaning strainer screen. For strainers 2 inches and larger, provide 3/4 inch blowdown piping with shutoff valve and union at strainer. Extend blowdown piping and terminate above nearest floor drain.

3.1.4.3 Equipment Clearance

Provide shutoff valves in water lines to vessels to permit servicing without draining system. Locate valves so as not to interfere with coil and internal component removal. Where water boxes are provided, water piping connections may be made directly to covers. Provide piping with
mechanical piping connections adjacent to covers, and water shutoff valves located so as not to interfere with tube cleaning or pulling operations after pipe sections have been removed. Maintain working space for removal of heads, and on one end of vessel provide a clear space at least equal to overall length, breadth, and depth of the tube bundle for tube removal. A door opening, window, or wall opening, may be utilized for this purpose.

3.1.4.4 Piping, Chilled Water and Heating Hot Water Coils

Provide coils with a counterflow piping arrangement. Connect supply piping at bottom of coil and connect return piping at top of coil. Provide supply piping to coil connection valves and accessories indicated. Provide return piping from coil connection with valves and accessories indicated. Provide unions and flanges as necessary to permit removal of coil and motor actuated valves. Piping and fittings shall not interfere with access to equipment.

3.1.4.5 Pumps

Support, anchor, and guide so that no strains are imposed on pump by weight or thermal movement of piping. Pumps shall be installed level and plumb. Provide air vent valve on pump casing. Pipe drain outlets on pump bases to nearest floor or other acceptable drains, with clean-out tees. Provide rigid pipe with fittings for pressure gages on suction and discharge and control accessories at pumps, water chillers and boilers.

3.1.4.6 Make-up Water and Expansion Tanks

Provide chilled and heating water systems with automatic water makeup, and relief valves to drain with air gap between relief outlets and drains. Pneumatically pressurize tanks during charging of water, so that system is fully charged with water and with level in expansion tanks at normal level at normal operating conditions.

3.1.5 Fittings and End Connections

3.1.5.1 Threaded Connections

Threaded connections shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

3.1.5.2 Brazed Connections

Brazing, AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Do not use brazing flux. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Piping shall be supported prior to brazing and not be sprung or forced.

3.1.5.3 Welded Connections

Branch connections shall be made with welding tees or forged welding branch outlets. Pipe shall be thoroughly cleaned of all scale and foreign
matter before the piping is assembled. During welding, the pipe and fittings shall be filled with an inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.9. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with AWS D1.1/D1.1M or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.5.4 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for the intended application.

3.1.6 Valves

Isolation gate, butterfly or ball valves as indicated shall be installed on each side of each piece of equipment, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purpose. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above. For line sizes 2 inches and smaller, provide ball valves for shutoff duty.

3.1.7 Air Vents

Air vents shall be provided at all high points, on all water coils, and where indicated to ensure adequate venting of the piping system.

3.1.8 Drains

Drains shall be provided at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of ball valve with 3/4 inch hose outlet connection unless otherwise indicated.

3.1.9 Flexible Pipe Connectors

Connectors shall be attached to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.

3.1.10 Temperature Gauges and Test Ports

Temperature gauges shall be located on coolant supply and return piping at each boiler and chiller, at each automatic temperature control device without an integral thermometer, and where indicated. Pressure/temperature test ports for insertion thermometers shall extend beyond thermal insulation surface not less than 1 inch.
3.1.11 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as supplemented and modified in this specification section. 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. Provide dielectric isolation between ferrous and copper materials at all pipe hanger and support locations. For copper piping with ferrous hangers, provide felt lined galvanized steel compression bushings.

3.1.11.1 Hangers

Type 3 shall not be used.

3.1.11.2 Inserts

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

3.1.11.3 C-Clamps

Type 19 and 23 C-clamps shall be torqued per 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.

3.1.11.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.1.11.5 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.

3.1.11.6 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 50 pounds shall have the excess hanger loads suspended from panel points.

3.1.11.7 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.
3.1.11.8 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.

3.1.11.9 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. Supports shall not be attached to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer. 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. Material used for support shall be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.1.12 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

3.1.13 Pipe Anchors

Anchors shall be provided where indicated. Unless indicated otherwise, anchors shall comply with the requirements specified. 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.

3.1.14 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Except as indicated otherwise piping sleeves shall comply with requirements specified. Unless otherwise indicated, provide sleeves passing through concrete and masonry walls, and concrete floors with pipe sleeves fitted into place at the time of construction. Sleeves shall be fabricated of black steel pipe; ASTM A 53/A 53M, Standard weight. Extend each sleeve through its respective wall or floor and cut flush with each surface, except in floors; extend sleeves above slab at least 2 inches. Unless indicated to be equipped with a modular mechanical sealing assembly, or otherwise indicated on Contract Drawings, provide sleeves large enough to provide a minimum clearance of 1/4 inch all around the pipe/insulation penetrating the sleeve. For insulated piping, insulation
shall be continuous through the sleeve. Do not install sleeves in structural members except where indicated or approved. Sleeves in interior gypsumboard partitions are generally not required unless specifically indicated on the Architectural Drawing partition details.

3.1.14.1 Fire-Rated/Smoke-Rated Penetrations

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. Details are indicated on the Architectural Drawings indicating conditions for penetrations through fire and smoke rate assemblies. Provide sleeved or non-sleeved installation as indicated. Seal the annular space between the pipe and sleeve with fire-stopping material and sealant that meet the requirement of Section 07 84 00, FIRESTOPPING.

3.1.14.2 Waterproof Penetrations

Sleeves in exterior below grade masonry walls, below grade concrete walls and slab-on-grade floors shall be equipped with an integral steel plate waterstop welded perpendicular to sleeve. Waterstop shall be positioned at the centerline of the substrate. Sleeves in exterior masonry and concrete walls below and above grade, and slab-on-grade floors shall be with a modular mechanical type sealing assembly. Seal shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

3.1.14.3 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 from floors, escutcheons shall not be used. Escutcheon shall be secured to pipe or pipe covering.

3.1.15 Access Panels

Access panels shall be provided in non-accessible general construction substrates for all concealed valves, vents, controls, and additionally for items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.
3.2 ELECTRICAL INSTALLATION

Install electrical equipment in accordance with NFPA 70 and manufacturers instructions. Provide thermal overload heaters in motor starters, sized for actual summer ambient temperature, and equipment operating conditions.

3.3 CLEANING AND ADJUSTING

a. Install temporary piping loops and temporary circulating pump on piping systems to be cleaned. Temporary circulating pump shall be sized to deliver a volume of water that will result in a minimum fluid velocity of eight feet per second. Use of the permanent pumps is prohibited. Close all shutoff valves to equipment coils. Fill system with potable water. Circulate water for minimum 24 hour period. Drain and flush system until solids are not present.

b. Fill system with potable water; vent air from system. Introduce cleaning chemical at solution volume recommended by chemical manufacturer. Circulate solution for 24 hours. Drain and flush system until drain water is clear.

c. Fill system with potable water; vent air from system. Introduce cleaning chemical at solution volume recommended by chemical manufacturer. Open all shutoff valves to heat transfer coils and equipment. Circulate solution for period recommended by chemical manufacturer. Drain and flush system until drain water is clear. Clean all strainer baskets.

d. Fill system with potable water; vent air from system. Provide permanent chemical treatment. Coordinate testing of water in system with chemical treatment representative. Obtain written confirmation of acceptable water quality from hospital treatment representative. Submit confirmation; include in maintenance manuals.

3.3.1 Safety Procedure

Ventilate work area, avoiding skin contact by using solvent-resistant gloves. Observe precautions and warnings on the manufacturer's product labels. Conform to requirements of 29 CFR 1910.1200.

3.4 EQUIPMENT INSTALLATION

Locate equipment foundations where indicated on Contract Drawings. Install equipment on foundations in accordance with equipment manufacturer recommendations. Anchor equipment on concrete foundations before installing piping connections. Install piping in such a manner as to not impose a strain on the connected equipment. Do not bolt flanged joints tight unless the bolt-hole centerlines match.

3.4.1 General

Examine areas and conditions, with piping Installers present for compliance with requirements for installation tolerances and other conditions affecting the performance of equipment. Examine rough-in locations for piping systems to verify actual connection locations prior to installation. Arrange piping adjacent to equipment to allow for servicing and maintenance.
3.5 IDENTIFICATION

Identify piping equipment and physical hazards in accordance with 29 CFR 1910.144, ANSI A13.1, ANSI Z53.1. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment. Identify each piping system and item of equipment indicated on contract drawings. HVAC air outlets and inlets do not require identification. HVAC fan coil units do not require identification.

3.5.1 Piping System Identification

Install plastic pipe markers on each system, and include arrows to show normal direction of flow. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, plenums) and exterior non-concealed locations.

a. Near each valve and control device.

b. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

d. At access doors, manholes and similar access points which permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.

f. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.

3.5.2 Valves

Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, HVAC terminal devices and similar rough-in connections of end-use units. List each tagged valve in valve schedule for each piping system. Turn valve schedules over to Contracting Officer.

3.5.3 Mechanical Equipment

Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device. Provide minimum 3/8 inch high lettering for name of unit where viewing distance is less than 2 feet, 1/2 inch high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering. In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and
improper operations.

3.5.4 Color Coding Scheme for Locating Hidden Utility Components

For areas where main, sub-main and sectional valves are located above ceilings, provide color coding scheme that identifies points of access for maintenance and operation of components and equipment that are not visible from the finished space and are accessible from the ceiling grid or access panels, consisting of a color code identification table and colored metal disks. Make each colored metal disk approximately 3/8 inch diameter and secure to removable ceiling panels with fasteners. Insert each fastener into the ceiling panel or access door so as to be concealed from view. Provide fasteners that are manually removable without the use of tools and that do not separate from the ceiling panels when the panels are dropped from ceiling height. Make installation of colored metal disks follow completion of the finished surface on which the disks are to be fastened. Provide colored identification code table to correspond to the colored disks. Make the table of hard card stock; laminated in plastic, for mounting in the facility managers area. Make the color code symbols approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters.

3.6 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of all foreign matter. A temporary bypass shall be provided for all water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from all water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed.

3.7 FIELD TESTS

Field tests and pipe cleaning shall be conducted in the presence of the QC Manager or his designated representative to verify systems compliance with specifications. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. Start-up and testing of pumps shall be conducted by factory authorized representatives.

3.7.1 Equipment and Component Isolation

Prior to testing, equipment and components that cannot withstand the tests shall be properly isolated.

3.7.2 Pressure Tests

Each piping system shall be hydrostatically tested at a pressure not less than 150 psig for period of time sufficient to inspect every joint in the system and in no case less than 4 hours. Test pressure shall be monitored by a currently calibrated test pressure gauge. Leaks shall be repaired and piping retested until test requirements are met. No leakage or reduction in gage pressure shall be allowed.

Leaks shall be repaired by rewelding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping
shall be tested in place before concealing.

Submit for approval pressure tests reports covering the above specified piping pressure tests; describe the systems tested, test results, defects found and repaired, and signature of the pressure tests' director. Obtain approval from the QC Manager before concealing piping or applying insulation to tested and accepted piping.

3.7.3 Test of Backflow Prevention Assemblies

Backflow prevention assemblies shall be tested in accordance with Section 22 00 70 PLUMBING, HEALTHCARE FACILITIES.

3.7.4 Water Quality Test Reports

The chilled and heating hot water systems shall each be analyzed by the water treatment company a minimum of once a month for a period of one year after system acceptance. Submit for approval the following water quality test reports. The analysis and resulting reports shall include the following information recorded in accordance with ASTM D 596.

<table>
<thead>
<tr>
<th>Date of Sample</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>degrees F.</td>
</tr>
<tr>
<td>Silica (SiO2)</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Insoluble</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Iron and Aluminum Oxides</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Sodium and Potassium (Na and K)</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Carbonate (HCO3)</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Sulfate (SO4)</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Chloride (Cl)</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Nitrate (NO3)</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Turbidity</td>
<td>unit</td>
</tr>
<tr>
<td>pH</td>
<td></td>
</tr>
<tr>
<td>Residual Chlorine</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Total Alkalinity</td>
<td>epm (meq/l)</td>
</tr>
<tr>
<td>Non-Carbonate Hardness</td>
<td>epm (meq/l)</td>
</tr>
<tr>
<td>Total Hardness</td>
<td>epm (meq/l)</td>
</tr>
<tr>
<td>Dissolved Solids</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Fluorine</td>
<td>ppm (mg/l)</td>
</tr>
<tr>
<td>Conductivity</td>
<td>micromho/cm</td>
</tr>
</tbody>
</table>

3.7.5 Related Field Inspections and Testing

3.7.5.1 Piping Welds

Examination of Piping Welds is specified in the paragraph above entitled "Examination of Piping Welds".

3.7.5.2 HVAC TAB

Requirements for testing, adjusting, and balancing (TAB) of HVAC water piping, and associated equipment is specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Coordinate with the TAB team, and provide support personnel and equipment as specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC to assist TAB team to meet the TAB work requirements.
3.8 TESTING, ADJUSTING AND BALANCING

Except as specified herein, testing, adjusting, and balancing shall be in accordance with Section 23 05 93 TESTING, ADJUSTING, and BALANCING for HVAC.

a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the system toward completing TAB. Provide the TAB any needed unique instruments for setting valves and instruct TAB in their use.

b. Provide a qualified technician to operate the systems to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

3.8.1 System Calibration and Adjustments

System calibration shall be performed for chilled, and heating water systems. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform calibration and testing of the HVAC control system with Section 23 05 93 TESTING, ADJUSTING and BALANCING for HVAC Contractor. All instrumentation and controls shall be calibrated and the specified accuracy shall be verified using test equipment with calibration traceable to NIST standards. Mechanical control devices shall be adjusted to operate as specified. Controllers on packaged equipment shall be pretested off-site as a functioning assembly ready for field connections, calibration and adjustment of the operational systems. Control parameters and logic (virtual) points including control loop setpoints, gain constants, and integral constraints, shall be adjusted before the system is placed on line. Written notification of any planned calibration and testing of the systems shall be given to the Government at least 14 calendar days in advance.

3.9 MANUFACTURER’S SERVICES

Provide the services of a manufacturer's representatives who are experienced in the installation, adjustment, and operation of the pumps and variable speed drives specified shall be provided. The representative shall supervise the installation, start-up adjustment, and testing of the equipment.

3.10 COMMISSIONING

Provide the services of a supervisory level technician in responsible charge of the work in this section, and a factory authorized representative of the packaged pump system to participate in the work specified in Section 23 08 02.00 50, COMMISSIONING OF MECHANICAL SYSTEMS. Refer to Section 23 08 02.00 50, COMMISSIONING OF MECHANICAL SYSTEMS for description of work. Refer to Section 01 91 13.00 50, GENERAL COMMISSIONING REQUIREMENTS for additional commissioning requirements.

3.11 INSTRUCTION TO GOVERNMENT PERSONNEL

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 chilled and heating hot water piping systems. Instructors shall be thoroughly familiar with all parts of the installation and shall be instructed in operating theory as well as practical operation and maintenance work.
Submit a lesson plan for the instruction course for approval. The lesson plan and instruction course shall be based on the approved operation and maintenance data and maintenance manuals.

Conduct a training course for the operating staff and maintenance staff selected by the Contracting Officer. Give the instruction during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be one man-day. Use approximately half of the time for classroom instruction and the other time for instruction at the location of 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.

3.12 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
PART 1   GENERAL

1.1  REFERENCES

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

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)


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


ASHRAE 52.2  (2010; Errata 2010) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

ASHRAE 55  (2010; Errata) Thermal Environmental Conditions for Human Occupancy


ASME INTERNATIONAL (ASME)


ASTM INTERNATIONAL (ASTM)


ASTM D 1654  (2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D1654  (2008) Evaluation of Painted or Coated
Specimens Subjected to Corrosive Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1  

NEMA ICS 2  
(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 6  
(1993; R 2006) Enclosures

NEMA MG 1  
(2014) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70  
(2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code

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

29 CFR 1910.144  
Safety Color Code for Marking Physical Hazards

UNDERWRITERS LABORATORIES (UL)

UL 1995  
(2005; Reprint Jul 2009) Heating and Cooling Equipment

1.2 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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
Piping System; G
Point-to-Point System; G

SD-03 Product Data
VRF Ductless Fan Coil Units; G
VRF Air Cooled Heat Pump Condensing Units; G
Filters; G
Room Sensors and Master/Slave Controllers; G
Refrigerant: Provide MSDS sheets for all refrigerants; G
VRF Refrigerant Pipe Fittings; G
Coatings for Finned Tube Coils; G
Manufacturer Warranties; G

SD-06 Test Reports
Salt-Spray Tests; G
Start-Up and Initial Operational Tests; G

SD-08 Manufacturer's Instructions
VRF Ductless Fan Coil Units; G
VRF Air Cooled Heat Pump Condensing Units; G Data Package 3.

SD-10 Operation and Maintenance Data
VRF Ductless Fan Coil Units; G, Data Package 3
VRF Air Cooled Condensing Units; G, Data Package 3
Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals
Energy Efficient Equipment for Unitary Air Conditioning Equipment; S
Ozone Depleting Substances; S
Indoor Air Quality During Construction; S

1.4 QUALITY ASSURANCE

1.4.1 Modification of References
Accomplish work in accordance with the referenced publications, except as modified by this section. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "the Authority having jurisdiction," "the Administrative Authority," "the Owner," or "the Design Engineer" to mean the Contracting Officer.

1.4.2 Piping Systems
Submit dimensioned shop drawings of piping showing both the accurately scaled piping and its relationship to space enclosure. Provide in
accordance with Section 01 33 00, SUBMITTAL PROCEDURES and as modified by this section. Illustration shall be drawn to a minimum scale of 1/4 inch per foot. Drawings shall indicate actual plan dimensions and elevations above finished floor. Provide illustrations including sections to clarify elevations of equipment, equipment connections, piping, and piping accessories. Drawings shall conform to standard drafting industry procedures. Include contractors name, project title, date and phone number in title block. Refer to Section 23 23 00 REFRIGERANT PIPING, for additional requirements. For each split-system and variable refrigerant flow system, submit evidence that the system manufacturer concurs with the piping configuration, pipe sizing and locations of piping system accessories.

1.4.3 Point-to-Point System Electrical and Cooling Wiring Diagrams

Point to point wiring diagrams including wiring between multiple indoor and outdoor units, electrical power connections and points of connection to facility direct digital control system.

1.4.4 Safety

Design, manufacture, and installation of unitary air conditioning equipment shall conform to ANSI/ASHRAE 15 & 34.

1.4.5 Coordination of Trades

The Contract Drawings indicate engineered solutions and design intent for the unitary air conditioning equipment systems. If through the coordination effort it is required to shift equipment from the locations indicated to enable the installation of adjacent trades, the materials required to coordinate the final locations shall be provided as work of this Section. Provide piping, offsets, fittings, and accessories as required to provide a complete installation and to eliminate interference with adjacent construction. Coordinate equipment locations with space required for trades in the adjacent installation area.

1.4.6 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.4.7 Delivery Storage and Handling

Equipment shall be delivered and stored with protective crating and weatherproof wrapping to provide protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter. Any porous materials found to be contaminated with mold or mildew will be replaced at the Contractor's expense. Non-porous materials found to be contaminated with mold or mildew will be disinfected and cleaned prior to installation.

1.4.8 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. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required hangers, supports, piping offsets, fittings, and accessories to meet such conditions.

1.4.9 Installer Qualifications

Installers of systems specified in Section shall have successfully completed a factory authorized training course conducted by the equipment manufacturer furnished under this Section, which includes all system installation requirements including, piping systems, condensing units, related indoor units and control systems.

1.5 REFRIGERANTS

Refrigerants shall have an Ozone Depletion Potential (ODP) of 0.0. The ODP shall be in accordance with the "Montreal Protocol On Substances That Deplete The Ozone Layer," September 1987, sponsored by the United Nations Environment Programme. CFCs and HCFCs and Halons shall not be permitted. Refrigerant shall be an approved alternative refrigerant per EPA's Significant New Alternative Policy (SNAP) listing.

1.6 ENVIRONMENTAL REQUIREMENTS

For proper Indoor Environmental Quality, maintain positive pressure within the building. Ventilation shall meet or exceed ASHRAE 62.1 and all published addenda. Meet or exceed filter media efficiency as tested in accordance with ASHRAE 52.2. Thermal comfort shall meet or exceed ASHRAE 55.

1.7 WARRANTY

In addition to the warranty requirements specified in Division 00, CONTRACT REQUIREMENTS, the following major components of the condensing units in this section shall be covered by a parts and labor warranty for a period of five years: compressors.

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 for Unitary Air Conditioning Equipment

Provide unitary air conditioning equipment meeting the efficiency requirements as stated within this section and provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph ENERGY EFFICIENT EQUIPMENT.

2.1.2 Ozone Depleting Substances

Unitary air conditioning equipment must not use CFC-based refrigerants, and must have an Ozone Depletion Potential (ODP) no greater than 0.0, with exception to R-123, in conformance with this section. Provide documentation in conformance with Section 01 33 29 SUSTAINABILITY
REPORTING paragraph OZONE DEPLETING SUBSTANCES.

2.2 VARIABLE REFRIGERANT FLOW SYSTEMS

2.2.1 Description

Each system shall consist of a single or multiple VRF Ductless Fan Coil Units, the manufacturer recommended pipe joining methods and headers, a two-pipe refrigerant piping system, and a single or multiple VRF Air Cooled Heat Pump Condensing Units. The condensing unit shall include variable speed inverter driven compressors using R-410A refrigerant. Each indoor fan coil unit shall be capable of operating independently with individual temperature control. Operation of the system shall permit either cooling or heating of all of the indoor units simultaneously. Systems shall be capable of up to 540 feet (640 feet equivalent) of linear piping between the condensing unit and furthest located indoor unit. Systems shall be capable of up to 3,280 feet total "one-way" piping in the piping network. Systems shall have a vertical (height) separation of up to 295 feet between the condensing unit and the indoor units. Systems shall be capable of up to 295 feet from the first branch point. The condensing unit shall have the ability to connect an indoor unit evaporator capacity of up to 200 percent of the condensing unit capacity. Systems shall be capable of 49 feet distance between indoor units. T style refrigerant pipe fittings are not acceptable.

2.3 VRF DUCTLESS FAN COIL UNIT

Furnish units consisting of MERV 8 inlet filter, supply fan(s), evaporator coil, insulated drain pan and unit housing. Furnish housing constructed of heavy gage impact resistant plastic with integral inlet and discharge grilles. Interior of housing shall be lined with polystyrene insulation. Front of enclosure shall be removable for access to integral components. Evaporator supply fan(s) shall be double-width, double inlet, forward curved, backward inclined, or airfoil blade, centrifugal DWDI type balanced on a common shaft with direct drive motor. Filter shall be accessed through an individual access door located in the cabinet front. Furnish with evaporator coil and insulated drain pan.

2.3.1 Evaporator Coil

Coils shall be constructed of copper tubes of 3/8 inch minimum diameter with aluminum fins that are mechanically bonded or soldered to the tubes. Coil casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be prohibited. Coils shall be tested in accordance with ANSI/ASHRAE 15 & 34 at the factory and be suitable for the working pressure of the installed system. Evaporator coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Refrigerant flow system control devices shall be a factory installed thermostatic expansion valve with superheat adjustment.

2.3.2 Filter

Panel type, pleated media, one inch thick, reinforced cardboard frame, disposable. Filters shall have a minimum efficiency reporting value of MERV 8 when tested in accordance with ASHRAE 52.2.
2.3.3 Unit/System Controls

Provide a system master control panel for indoor mounting, consisting of a programmable logic controller and LCD touch-screen display housed on an impact resistant plastic enclosure. Master controller shall provide 24 hour/day, 7 day/week programming capability for each indoor unit and the related outdoor unit(s), with multiple event action each day and automatic heating/cooling changeover based on indoor unit requirements. Include terminal blocks for control and power wiring. Furnish one LCD touch-screen controller for each piped group of indoor unit(s) and outdoor unit(s). Provide a remote temperature sensor for each indoor unit location, installed in an impact resistant plastic enclosure located within the space served. Provide dry contacts.

2.4 VRF AIR COOLED CONDENSING UNITS

Unit shall be rated in accordance with AHRI 460 and conform to the requirements of UL 1995. Unit shall be factory fabricated, tested, packaged, and self-contained. Unit shall be complete with casing, compressor, propeller fans, heat rejection coils, connecting piping, contactors and wiring, and all necessary appurtenances. Condenser or outdoor fans shall be propeller type. Refrigerant-containing components shall comply with ANSI/ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Refrigerant charging valves and connections, and pumpdown valves shall be provided. Filter-drier shall be provided in liquid line and be reversible-flow type. Refrigerant flow system control devices shall be a factory installed solenoid controlled, leak-tight, four-way refrigerant flow reversing valve. To ensure the liquid refrigerant does not flash when supplying to the connected indoor units, the circuit shall be provided with a sub-cooling feature. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation. Each system shall maintain continuous heating during oil return operation. Reverse cycle (cooling mode) oil return during heating operation shall not be permitted due to the potential reduction in space temperature.

2.4.1 Condenser Coil

Coils shall have copper tubes of 3/8 inch minimum diameter with aluminum fins that are mechanically bonded or soldered to the tubes. Casing shall be galvanized steel or aluminum. Contact of dissimilar metals shall be avoided. Coils shall be tested in accordance with ANSI/ASHRAE 15 & 34 at the factory and be suitable for the working pressure of the installed system. Each coil shall be dehydrated and sealed after testing and prior to evaluation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Unit shipped with a holding charge shall be field charged.

2.4.2 Compressor

Unit shall be equipped with a single or multiple compressor(s). Each compressor shall be direct drive, digital hermetic scroll type, equipped with a variable speed drive controller, capable of changing the speed to follow the variations in total cooling and heating load as determined by suction gas pressure of the connected evaporator coils, as measured in the condensing unit. In addition, the control system shall interrogate each evaporator and the condenser temperatures in order that the high/low pressures are detected every 20 seconds. With each reading, the compressor capacity shall be controlled to meet the target value. Each
compressor shall be capable of a capacity range between 6 percent and 100 percent. Each compressor shall be provided with vibration isolators, crankcase heater, thermal overloads, high and low pressure safety cutoffs and protection against short cycling.

2.4.3 Unit Controls

Unit mounted control panels or enclosures shall be constructed in accordance with applicable requirements of NFPA 70 and housed in NEMA ICS 6, Class 1A or 3A enclosures. Controls shall include control transformer, fan motor starters, time delay start-up, overload protective devices, compressor safety devices interface with local and remote components, and inter-component wiring to terminal block points. Unit shall be internally prewired with a 24 volt control circuit powered by an internal transformer. Include low ambient control for stable system operation down to 8 degree F ambient.

2.4.4 Manufacturer Warranties

In addition to the warranty requirements specified in Division 00, Contract Requirements, the following major components shall be covered by a warranty of a duration period of five years: Compressor and Refrigerant.

2.5 FINISHES

Provide steel surfaces of equipment including, condensing units and indoor sections of split systems, that do not have a zinc coating conforming to ASTM A123/A123M, or a duplex coating of zinc and paint, with a factory applied coating or paint system. Provide a coating or paint system on actual equipment identical to that on salt-spray test specimens with respect to materials, conditions of application, and dry-film thickness.

2.6 SOURCE QUALITY CONTROL

2.6.1 Salt Spray Tests

Salt-spray test the factory-applied coating or paint system of equipment including packaged terminal units, heat pumps, and air conditioners in accordance with ASTM B117, ASTM B 117. Conduct test for 1000 hours for equipment installed outdoors, or 125 hours for equipment installed indoors. Test specimens shall have a standard scribe mark as defined in ASTM D1654. Upon completion of exposure, evaluate and rate the coating or paint system in accordance with procedures A and B of ASTM D 1654. Rating of failure at the scribe mark shall not be less than six, average creepage not greater than 1/8 inch. Rating of the unscribed area shall not be less than 10, no failure.

2.7 MECHANICAL IDENTIFICATION

General: Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.7.1 Engraved Plastic Laminate Signs

Provide engraving stock melamine plastic laminate, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color)
except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Thickness: 1/16 inch for units up to 40 sq. in. or 8 inch length; 1/4 inch for larger units. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.7.2 Plastic Equipment Markers

Provide manufacturer's standard laminated plastic, color coded equipment markers. Include terminology matching equipment schedules as closely as possible. Provide approximate 2-1/2 x 4 inch markers for control devices, and 4-1/2 x 6 inch for equipment. Identify equipment and electrical devices furnished under this section.

2.7.3 Plasticized Tags

Provide pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3 inch x 6 inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.7.4 Lettering and Graphics

Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Heat Pump condensing unit No. 3, Air Supply No. 1H.

2.8 COATINGS FOR FINNED TUBE COILS

Where stipulated in equipment specifications of this section, coat finned tube coils of air cooled condensing units as specified below. Apply coating at the premises of a company specializing in such work. Degrease and prepare for coating in accordance with the coating applicator's procedures for the type of metals involved. Completed coating shall show no evidence of softening, blistering, cracking, crazing, flaking, loss of adhesion, or "bridging" between the fins.

2.8.1 Phenolic Coating

Provide a resin base thermosetting phenolic coating. Apply coating by electrolytic immersion dipping of the entire coil. Provide a minimum of two coats. Bake or heat dry coils following immersions. After final immersion and prior to final baking, spray entire coil with particular emphasis given to building up coating on sheared edges. Total dry film thickness shall be 2.5 to 3.0 mils.

2.9 MOTORS AND STARTERS

NEMA MG 1, NEMA ICS 1, and NEMA ICS 2. Motors less than 1 hp shall meet NEMA High Efficiency requirements. Motors 1 hp and larger shall meet NEMA Premium Efficiency requirements. Determine specific motor characteristics
to ensure provision of correctly sized starters and overload heaters. Provide motors to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating. Motor size shall be sufficient for the duty to be performed and shall not exceed its full load nameplate current rating when driven equipment is operated at specified capacity under the most severe conditions likely to be encountered. When motors and equipment furnished, exceed the wiring and electrical distribution characteristics indicated on the electrical contract drawings, the Contractor shall make the necessary adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

2.10 REFRIGERANT PIPING AND ACCESSORIES

Provide accessories as specified in this section. Provide suction line accumulators as recommended by equipment manufacturer's installation instructions. Provide a filter-drier in the liquid line. Provide in accordance with Section 23 23 00, Refrigerant Piping.

2.11 WIRING

Provide complete electrical wiring for the equipment and system accessories in this Section. Unless indicated otherwise, provide all wiring in electric metallic tubing. Control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 volts shall as a minimum be in accordance with Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Run all circuits in metallic tubing or covered metal raceways with the exception that raceways with wiring to Room Sensors on stud walls may terminate immediately interior to the studwork space. All raceways used as work of this Section shall be furnished factory coated with blue exterior color.

2.11.1 Power Wiring

The following requirements are for field-installed wiring:

a. Wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.

b. Wiring for 120 V circuits shall be insulated copper 14 AWG minimum and rated for 600 VAC service.

2.12 ROOF EQUIPMENT SUPPORTS

Factory-fabricated sheet-steel structural members. Provide minimum 2 inches x 4 inches factory-installed wood nailers, and fully mitered end sections. Provide welded 18 gage galvanized steel shell, base plate, and counterflashing and provide stiffness required to eliminating deflection. Furnish to suit roof slopes so that supported equipment installed rests dead level. Provide curbs in configurations indicated, with lengths to exceed dimensions of roof mounted equipment and pipe support racks.

2.13 FINISHES

Provide steel surfaces of air cooled condensing units, with a factory applied coating or paint system. Provide a coating or paint system on actual equipment identical to that on salt-spray test specimens with respect to materials, conditions of application, and dry-film thickness.
2.14 SOURCE QUALITY CONTROL

2.14.1 Salt-Spray Tests

Salt-spray test the factory-applied coating or paint system of equipment including air cooled condensing units in accordance with ASTM B117. Conduct test for 1000 hours for equipment installed outdoors, or 125 hours for equipment installed indoors. Test specimens shall have a standard scribe mark as defined in ASTM D1654. Upon completion of exposure, evaluate and rate the coating or paint system in accordance with procedures A and B of ASTM D1654. Rating of failure at the scribe mark shall not be less than six, average creepage not greater than 1/8 inch. Rating of the unscribed area shall not be less than 10, no failure.

PART 3 EXECUTION

3.1 CONSTRUCTION-RELATED SUSTAINABILITY CRITERIA

Perform and document the following:

3.1.1 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 33 29 SUSTAINABILITY REPORTING paragraph INDOOR AIR QUALITY DURING CONSTRUCTION.

3.2 EQUIPMENT INSTALLATION

Install equipment and components in a manner to ensure proper and sequential operation of equipment and equipment controls. Install equipment not covered in this section, or in manufacturer's instructions, as recommended by manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, roof equipment supports concrete pads and pipe hangers. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise indicated. Set anchor bolts and sleeves using templates. Provide anchor bolts of adequate length, embedded in the concrete for concrete pad mounted equipment and/or secured to roof equipment supports. Level equipment bases, using steel shim plates. Locate equipment to allow working space for servicing including internal equipment removal, access to automatic controls, refrigerant charging, lubrication, oil draining and working clearance under overhead lines. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion. VRF System installations shall be performed by manufacturers certified contractor/installer. VRF System installers shall have completed the Manufacturers Certified Training Program from to VRF System installations.

3.2.1 Indoor Units

Install as indicated, in accordance with requirements of ANSI/ASHRAE 15 & 34, and the manufacturer's installation and operational instructions. Where indoor units are indicated to be wall mounted; coordinate locations with stud framing for attachment. Where indoor units are indicated to be suspended, provide threaded rod hangers attached to building structure.
3.2.2 Condensing Units

Install units on reinforced concrete pads and roof equipment supports as indicated. Start-up condensing units in the presence of a factory authorized representative.

a. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

b. Examine rough-in for refrigerant piping, controls and electrical to verify actual locations of connections prior to installation. Do not proceed until unsatisfactory conditions have been corrected.

c. Install equipment level and plumb, in accordance with manufacturer's written instructions.

d. Support floor-mounted units on reinforced concrete pads or roof equipment support as indicated. Secure units with anchor bolts.

e. Support suspended indoor units with threaded rods and vibration isolation devices.

3.2.3 Piping Installation Requirements

The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:

a. Arrange piping installations adjacent to units to allow unit servicing and maintenance.

b. Install piping on roof equipment supports where indicated. Provide rackwork for piping; anchor piping to rackwork with U-Bolts or suitable mechanical metallic clips.

c. Comply with Section 23 23 00, REFRIGERANT PIPING. Maintain dielectric isolation between ferrous and copper materials. Pipe sizes on Contract Drawings were based on one manufacturer's recommendations and are the minimum sizes required; coordinate and verify pipe sizes proposed for installation with manufacturer, prior to installation. Piping installation; limitations on lengths and heights, including connections at branch piping shall comply with manufacturer requirements. Maintain pitch of piping as recommended; installed piping system shall enable the flow of refrigerant between the indoor unit sections and condensing units, including oil return, to enable obtaining the system capacities scheduled.

d. Connect condensate drain pans; coordinate installation with Division 22 installer. Construct deep trap at connection to drain pan and install cleanouts at changes in direction. Provide traps and drain piping.

3.3 PIPING

Refer to Section 23 23 00, REFRIGERANT PIPING.

3.4 DRAIN CONNECTIONS, AND DRAIN LINES

Trap drain pans from the bottom to ensure complete pan drainage. Provide
drain lines full size of drain opening. Traps and piping to drainage disposal points shall conform to Section 22 00 70 PLUMBING, GENERAL PURPOSE.

3.5 ACCESS PANELS

Provide access panels for concealed valves, controls, dampers, and other fittings requiring inspection and maintenance.

3.6 AIR FILTERS

Allow access space for servicing filters. Install filters with suitable sealing to prevent bypassing of air.

3.7 IDENTIFICATION

Identify equipment and physical hazards in accordance with 29 CFR 1910.144, ASME A13.1, ANSI Z535.1. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment. Identify items of equipment indicated on contract drawings. For indoor portions of heat pumps, reduce tag size and install in an inconspicuous location.

3.7.1 Mechanical Equipment

Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device. Provide minimum 3/8 inch high lettering for name of unit where viewing distance is less than 2 feet, 1/2 inch high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering. In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.8 FIELD QUALITY CONTROL

3.8.1 Leak Testing

Upon completion of installation of air conditioning equipment, test factory- and field-installed refrigerant piping with an electronic-type leak detector. Use same type of refrigerant to be provided in the system for leak testing. When nitrogen is used to boost system pressure for testing, ensure that it is eliminated from the system before charging. Minimum refrigerant leak field test pressure shall be as specified in ANSI/ASHRAE 15 & 34, except that test pressure shall not exceed 150 psig on hermetic compressors unless otherwise specified as a low side test pressure on the equipment nameplate. If leaks are detected at time of installation or during warranty period, remove the entire refrigerant charge from the system, correct leaks, and retest system.

3.8.2 Evacuation, Dehydration, and Charging

After field charged refrigerant system is found to be without leaks or after leaks have been repaired on field-charged and factory-charged
systems, evacuate the system using a reliable gage and a vacuum pump capable of pulling a vacuum of at least one mm Hg absolute. Evacuate system in accordance with the triple-evacuation and blotter method or in accordance with equipment manufacturer's printed instructions and recharge system.

3.8.3 Start-Up and Initial Operational Tests

Test the air conditioning systems and systems components for proper operation. Adjust safety and automatic control instruments as necessary to ensure proper operation and sequence. Conduct operational tests for not less than 8 hours.

3.8.4 Performance Tests

Upon completion of evacuation, charging, startup, final leak testing, and proper adjustment of controls, test the systems to demonstrate compliance with performance and capacity requirements. Test systems for not less than 8 hours, record readings hourly. At the end of the test period, average the readings, and the average shall be considered to be the system performance. Record the following readings:

- Suction Pressure
- Condensing Pressure
- Ambient Temperature Outdoors
- Temperature Difference Across Each Evaporator Coil

3.9 TRAINING

Training of user's operation and maintenance personnel is required in cooperation with the Contracting Officer and manufacturer certified representative. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed VRF system. The instruction shall be scheduled in coordination with Contracting Officer after submission and approval of formal training plans.

3.9.1 Operation and Maintenance Training

Conduct a training course for the members of the operating staff as designated by the Contracting Officer. Training shall be conducted by a factory authorized representative specializing in the unitary equipment provided. The training period shall consist of a total of 8 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.

3.9.2 Operation and Maintenance Manuals

Submit manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data.
3.10 COMMISSIONING

Provide the services of a supervisory level technician in responsible charge of the work in this section, and factory authorized start-up and service technicians; for each major component or system in this section, to participate in the work specified in Section 23 08 02.00 50 COMMISSIONING OF HVAC. Refer to Section 23 08 02.00 50 COMMISSIONING OF HVAC for description of work.

3.11 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --
SECTION 23 82 00.00 20
TERMINAL HEATING UNITS
02/16

PART 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)


ASTM INTERNATIONAL (ASTM)


ASTM D1654  (2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2  (2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V

NEMA ICS 6  (1993; R 2011) Enclosures

NEMA MG 1  (2014) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70  (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013; Errata 2 2013; AMD 3 2014; Errata 3-4 2014; AMD 4-6 2014) National Electrical Code


1.2  RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL 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. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data
  Unit Heaters; G

SD-10 Operation and Maintenance Data
  Unit Heaters, Data Package 2
    Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals
  Energy Efficient Equipment for Heating; S

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 for Heating

Provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph ENERGY EFFICIENT EQUIPMENT that the heating units meet energy efficiency requirements as outlined in this section.

2.2 UNIT HEATERS

Self-contained and factory assembled, centrifugal fan types as indicated, with capacities expressed as Btu per hour output and cubic foot-per-minute air delivery, operating conditions, and mounting arrangements as indicated. Average fan bearing life must be minimum 200,000 hours at operating conditions. Provide fan motor with direct drive. Provide control equipment which complies with Section 23 09 23.13 20, BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

2.2.1 Cabinet Unit Heaters

Provide unit factory assembled, designed and tested. Units shall include single heating hot water coil, direct drive metallic centrifugal fans, three-speed split capacitor motors with integral thermal overload protection and filters. Provide minimum 20 gage furniture grade steel cabinet with baked enamel finish; color as selected by Contracting Officer. Provide integral motor contactors and unit mounted four position fan speed switch; off-low-medium-high.

  a. Filters: One inch thick, MERV 8 rating in accordance with ASHRAE
52.2, throwaway fiberglass filters.

b. Heating coils shall be of copper tubes and aluminum fins with threaded fittings one each end for connecting to external piping. The heating elements shall be free to expand or contract without developing leaks and shall be properly pitched for drainage. Heating coils shall be as specified in Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM under paragraph "Air Systems Equipment".

c. Controls shall be provided as specified in Section 23 09 23.13 20, BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

d. Vertical Units: Provide recessed and cabinet units where indicated. Provide unit levelers, subbases and removable front cover for access to filters and fan motors.

   1. Recessed Unit: Provide removable front cover for access to entire unit. Provide discharge air and return air grilles in front cover.
   2. Cabinet Unit: Provide removable front, side and top panels. Provide adjustable double deflection or stamped discharge grille as indicated.

2.2.2 Hot-Water Unit Heater

ASHRAE 33 tested for heating coils; UL listed for motor and controls.

2.2.2.1 Casing

Minimum 20 gage steel with removable access panels or means to remove, service, and maintain major components.

2.2.2.2 Coil

Fin-and-tube coil constructed of copper, tubes and aluminum fins. Provide capacities and operating characteristics scheduled on Contract Drawings.

2.2.2.3 Controls

Comply with Section 23 09 23.13 20, BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC.

2.3 FAN

Provide galvanized steel or aluminum fans with ball or roller bearings for motors over 1/8 horsepower (hp) and sleeve bearings for motors 1/8 hp and under. Provide sleeve bearings with grease fitting, if not permanently lubricated.

2.4 MOTOR AND STARTER

NEMA MG 1, and NEMA ICS 2, and NEMA ICS 6, respectively. Provide continuous-duty motor with built-in automatic reset thermal overload protection. Provide single-phase motor of permanent split capacitor or capacitor start. Limit motor speed at 1800 r/min. Wire motor to heater power supply source.

2.5 NOISE, VIBRATION AND CONTROLS

Section 23 05 48.00 40 VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT.
2.6 HOT WATER PIPING SYSTEM

Section 23 64 26 CHILLED AND HEATING HOT WATER SYSTEM.

2.7 SOURCE QUALITY CONTROL

Special protection is not required for equipment that has a zinc coating conforming to ASTM A123/A123M. Otherwise, protect affected equipment items by manufacturers' corrosion-inhibiting coating or paint system that has proved capable of withstanding salt-spray test in accordance with ASTM B117. Test indoor and outdoor equipment for 125 hours; test outdoor equipment used in a marine atmosphere for 500 hours. For each specimen, perform a scratch test as defined in ASTM D1654.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment where indicated and as recommended by manufacturer's recommendations, NFPA 90A. 

3.1.1 Suspensions of Equipment

Provide equipment supports including beam clamps, turnbuckles and twist links or weld-wire chains, wire ropes with rope clips and rope thimbles, threaded-eye rod hangers with lock nuts and heat-duct hangers, threaded-eye bolts with expansion screws, brackets, platform and mounting frame, and vibration isolators. Locate equipment in such a manner that working space is available for servicing, such as vacuum pump and burner removal, access to automatic controls, and lubrication. Provide electrical isolation of dissimilar metals. Clean interior of casings or cabinets before and after completion of installation.

3.1.2 General

Examine areas and conditions, with piping Installers present for compliance with requirements for installation tolerances and other conditions affecting the performance of unit heaters. Examine rough-in locations for piping systems to verify actual connection locations prior to installation. Arrange piping adjacent to equipment to allow for servicing and maintenance.

3.1.3 Electrical Work

NFPA 70 and Division 26, "ELECTRICAL."

3.2 COMMISSIONING

Provide the services of a supervisory level technician, in responsible charge of the work in this section, and factory authorized start-up and service technicians; for the unit heaters in this section, to participate in the work specified in Section 23 08 02.00 50 COMMISSIONING OF HVAC. Refer to Section 23 08 02.00 50 COMMISSIONING OF HVAC for description of work.

3.3 CONSTRUCTION WASTE MANAGEMENT

Comply with the Waste Management Plan specified in Section 01 74 19
CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT for additional requirements.

-- End of Section --