

HARRIMAN

Gould Restaurant  
Portland, Maine

Project No. 12752

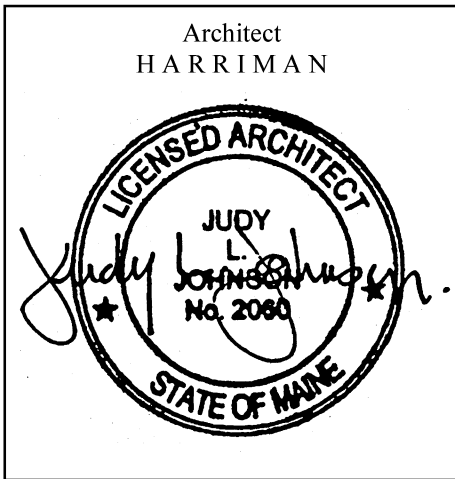
May 31, 2013

Issued for Construction

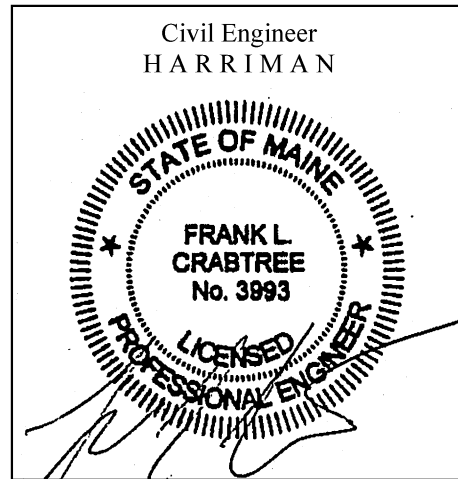


PROFESSIONAL SEAL PAGE

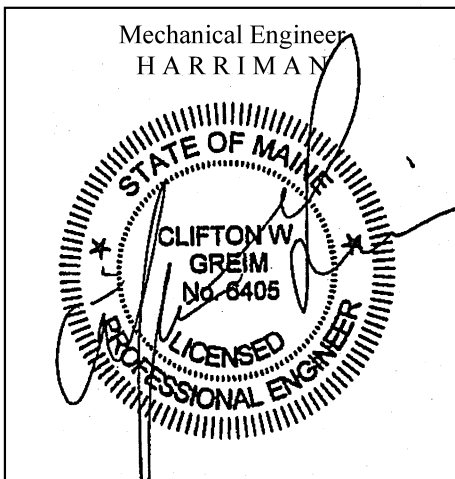
Architect  
HARRIMAN



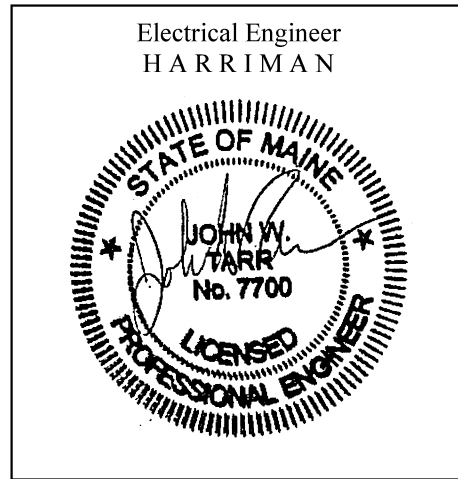
Civil Engineer  
HARRIMAN



Mechanical Engineer  
HARRIMAN



Electrical Engineer  
HARRIMAN





GOULD RESTAURANT  
PORTLAND, MAINE

TABLE OF CONTENTS

LIST OF DRAWINGS

DIVISION 00 - PROCUREMENT AND CONTRACTION REQUIREMENTS  
Contractor to Provide

DIVISION 02 - EXISTING CONDITIONS

024119 - Selective Demolition

DIVISION 04 - MASONRY

040110 - Masonry Cleaning  
040120.63 - Brick Masonry Repair

DIVISION 05 - METALS

055213 - Pipe & Tube Railings

DIVISION 06 - WOOD, PLASTICS, & COMPOSITES

061000 - Rough Carpentry  
061600 - Sheathing  
062023 - Interior Finish Carpentry  
064300 - Wood Stairs and Railings  
064600 - Wood Trim  
064800 - Wood Frames  
066400 - Plastic Paneling

DIVISION 07 - THERMAL & MOISTURE PROTECTION

072100 - Thermal Insulation

DIVISION 08 - OPENINGS

081113 - Hollow Metal Doors and Frames  
081416- Flush Wood Doors  
087100 - Door Hardware  
088000 - Glazing

DIVISION 09 - FINISHES

092900 - Gypsum Board

093100 - Tile

099000 - Painting

DIVISION 10 - SPECIALTIES

102800 - Toilet, Bath & Laundry Accessories

DIVISION 21 -

210500 - Common Work Results for Fire Suppression

211313 - Wet-Pipe Sprinkler Systems

DIVISION 22 -

220500 - Common Work Results for Plumbing

220519 - Meters and Gages for Plumbing Piping

220523 - General-Duty Valves for Plumbing Piping

220529 - Hangers and Supports for Plumbing Piping and Equipment

220553 - Identification for Plumbing Piping and Equipment

220700 - Plumbing Insulation

221116 - Domestic Water Piping

221119 - Domestic Water Piping Specialties

221316 - Sanitary Waste and Vent Piping

221319 - Sanitary Waste Piping Specialties

221613 - Facility Natural-Gas Piping

223500 - Domestic Water Heat Exchangers

224000 - Plumbing Fixtures

DIVISION 23 -

230500 - Common Work Results for HVAC

230513 - Common Motor Requirements for HVAC Equipment

230519 - Meters and Gauges for HVAC Piping

230529 - Hangers and Supports for HVAC Piping and Equipment

230553 - Identification for HVAC Piping and Equipment

230593 - Testing, Adjusting, and Balancing for HVAC

230713 - Duct Insulation

230716 - HVAC Equipment Insulation

230719 - HVAC Piping Insulation

230900 - Instrumentation and Control for Mechanical Systems

232113 - Hydronic Piping

232118 - Hydronic Specialties  
232123 - Hydronic Pumps  
232500 - HVAC Water Treatment  
233113 - Metal Ducts  
233300 - Air Duct Accessories  
233400 - HVAC Fans  
233433 - Air Curtains  
233700 - Air Outlets and Inlets  
234100 - Particulate Air Filtration  
235100 - Breechings, Chimneys and Stacks  
235216 - Condensing Boilers  
236200 - Packaged Compressor and Condenser Units  
237300 - Indoor Central Station Air Handling Units  
238200 - Convection Heating and Cooling Units  
238216 - Air Coils

DIVISION 26 -

260010 - Basic Electrical Requirements  
260111 - Conduit  
260123 - Wire and Cable  
260130 - Boxes  
260141 - Wiring Devices  
260170 - Grounding and Bonding  
260180 - Equipment Wiring  
260195 - Electrical Identification  
260420 - Service Entrance  
260440 - Disconnect Switches  
260470 - Panelboards  
260510 - Luminaires  
260535 - Emergency Lighting Equipment  
260721 - Fire Alarm Systems

DIVISION 31 -

312000 - Earth Moving

DIVISION 32 -

321216 - Asphalt Paving

DIVISION 33 -

331000 - Water Distribution Piping

333000 - Sanitary Sewers



## LIST OF DRAWINGS

### CIVIL DRAWINGS

C00.1 SITE PLAN

### ARCHITECTURAL DRAWINGS

A00.1 ABBREVIATIONS AND LEGENDS

A05.1 DEMOLITION PLAN AND NOTES

A05.2 DEMOLITION PLANS

A10.1 FLOOR PLAN AND PARTITION TYPES

A10.2 FLOOR PLANS AND EQUIPMENT SCHEDULE

A10.3 FLOOR PLANS, DOOR SCHEDULE AND DETAILS

A20.1 EXTERIOR ELEVATIONS

A35.1 STAIR SECTIONS AND DETAILS

A70.1 REFLECTED CEILING PLANS

A71.1 ROOM FINISH SCHEDULE AND FINISH PLAN

A80.1 STANDARD INTERIOR DETAILS

A81.1 INTERIOR ELEVATIONS

A81.2 INTERIOR ELEVATIONS

### STRUCTURAL DRAWINGS

S10.1 FOUNDATION PLAN, NOTES AND DETAILS

S20.1 FIRST AND SECOND FLOOR FRAMING PLANS

S60.1 STRUCTURAL DETAILS

### PLUMBING DRAWINGS

P00.1 LEGEND, NOTES AND SCHEDULE

P05.1 DEMOLITION PLANS PLUMBING

P10.1 DRAINAGE PLANS

P20.1 SUPPLY PLANS

#### FIRE PROTECTION DRAWINGS

F10.1 FIRE PROTECTION PLANS

#### MECHANICAL DRAWINGS

M00.1 LEGEND AND GENERAL NOTES

M10.0 BASEMENT AND FIRST FLOOR PLAN HVAC

M10.1 SECOND, THIRD, AND FOURTH FLOOR PLAN HVAC

M30.1 DETAILS

M31.1 SECTIONS

M40.1 SCHEDULES

#### ELECTRICAL DRAWINGS

E00.1 ELECTRICAL LEGEND AND SCHEDULES

E05.1 ELECTRICAL PART PLANS EXISTING CONDITIONS

E10.1 ELECTRICAL PART PLANS LIGHTING

E10.2 ELECTRICAL PART PLANS LIGHTING

E20.1 ELECTRICAL PART PLANS POWER & SYSTEMS

E20.2 ELECTRICAL PART PLANS POWER & SYSTEMS

## SECTION 024119 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

#### 1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

#### 1.3 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at 414 Fore St., Portland, ME 04101, time to be determined.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Predemolition Photographs or Video: Submit before Work begins.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

## 1.6 QUALITY ASSURANCE

## 1.7 FIELD CONDITIONS

- A. Owner's tenant will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's tenant's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
  - 1. Before selective demolition, Owner will remove the following items:
- C. Artwork, furniture and appliances. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. Hazardous materials will be removed by Owner before start of the Work.
  - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
  - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
  - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

## 1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
  - 1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. Arrange to shut off indicated utilities with utility companies.
  - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

### 3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  - 4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  - 5. Dispose of demolished items and materials promptly
- B. Removed and Salvaged Items:
  - 1. Clean salvaged items.
  - 2. Pack or crate items after cleaning. Identify contents of containers.
  - 3. Store items in a secure area until delivery to Owner.
  - 4. Transport items to Owner's storage area designated by Owner.
  - 5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119





## SECTION 040110 - MASONRY CLEANING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes cleaning the following:
  - 1. Unit masonry surfaces.
  - 2. Stone surfaces.

#### 1.2 DEFINITIONS

- A. Low-Pressure Spray: [100 to 400 psi (690 to 2750 kPa); Medium-Pressure Spray: [400 to 800 psi (2750 to 5510 kPa)High-Pressure Spray: [800 to 1200 psi (5510 to 8250 kPa);

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at 414 Fore Street, Portland, ME, 04101

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.5 QUALITY ASSURANCE

- A. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Cleaning: Clean an area approximately 25 sq. ft. (2.3 sq. m)] for each type of masonry and surface condition.
    - a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
    - b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.

## PART 2 - PRODUCTS

### 2.1 PAINT REMOVERS

- A. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming, alkaline paste or gel formulation, for removing paint from masonry; containing no methylene chloride.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABR Products, Inc.; 800 Fast Acting Grip 'N Strip.
    - b. Diedrich Technologies Inc., a division of Sandell Construction Solutions; 404 Rip-Strip.
    - c. Dumond Chemicals, Inc.; Peel Away 1.
- B. Solvent-Type Paste Paint Remover: Manufacturer's standard water-rinseable, solvent-type paste or gel formulation, for removing paint from masonry.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Diedrich Technologies Inc., a division of Sandell Construction Solutions; 505 Special Coatings Stripper.
    - b. Hydrochemical Techniques, Inc.; HydroClean HT-300 Solvent Paint Remover.
    - c. PROSOCO, Inc.; Sure Klean Fast Acting Stripper.
- C. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation, for removing paint coatings from masonry; containing no methanol or methylene chloride.
1. Products: Subject to compliance with requirements, provide one of the following
    - a. ABR Products, Inc.; ABR Citrus Paint Removers].
    - b. Cathedral Stone Products, Inc.; [-301
    - c. Dumond Chemicals, Inc.; Peel Away 7 without paper covering
    - d. EaCo Chem, Inc.; InStrip.
    - e. PROSOCO, Inc.; Enviro Klean SafStrip

### 2.2 CLEANING MATERIALS

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).
- C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.
- D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

- E. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.
  - 1. Products: Subject to compliance with requirements, provide the following

## 2.3 CHEMICAL CLEANING SOLUTIONS

- A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.
- B. Acidic Cleaner Solution for Unpolished Stone: Dilute acidic cleaner with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended in writing by chemical-cleaner manufacturer.
  - 1. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.

## PART 3 - EXECUTION

### 3.1 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
  - 1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.

### 3.2 CLEANING MASONRY, GENERAL

- A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 50 feet (15 m) away by Architect.
- B. Proceed with cleaning in an orderly manner; work from bottom to top of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
- C. Use only those cleaning methods indicated for each masonry material and location.
  - 1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.

2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.
  - a. Equip units with pressure gages.
  - b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
  - c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
  - d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.
- D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.
- E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.
- F. Water-Spray Application Method: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
- G. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush[or spray] application. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- H. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
  1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

### 3.3 PRELIMINARY CLEANING

- A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.
- B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.

1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
2. Remove paint and calking with alkaline paint remover .
  - a. Comply with requirements in "Paint Removal" Article.
  - b. Repeat application up to two times if needed.
3. Remove asphalt and tar with solvent-type paste paint remover.
  - a. Comply with requirements in "Paint Removal" Article.
  - b. Apply paint remover only to asphalt and tar by brush without pre-wetting.
  - c. Allow paint remover to remain on surface for 10 to 30 minutes.
  - d. Repeat application if needed.

### 3.4 PAINT REMOVAL

- A. Paint-Remover Application, General: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- B. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:
  1. Remove loose and peeling paint using lowpressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
  2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
  3. Apply cover according to manufacturer's written instructions.
  4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
  5. Scrape off paint and remover.
  6. Rinse with coldwater applied by lowpressure spray to remove chemicals and paint residue.
  7. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended by chemical-cleaner or afterwash manufacturer.
  8. Rinse with cold water applied by lowpressure spray to remove chemicals and soil.
  9. Retreat spots of remaining paint.
- C. Paint Removal with Solvent-Type Paste Paint Remover:
  1. Remove loose and peeling paint using lowpressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
  2. Apply thick coating of paint remover to painted surface with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
  3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
  4. Rinse with coldwater applied by pressure spray to remove chemicals and paint residue.

### 3.5 CLEANING MASONRY

#### A. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer >.
4. Rinse with cold water applied by low pressure spray to remove chemicals and soil. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

END OF SECTION 040110

## SECTION 055213 - PIPE AND TUBE RAILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Steel pipe railings.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

##### B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

##### C. Samples: For each type of exposed finish required.

##### D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.3 INFORMATIONAL SUBMITTALS

##### A. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

##### A. Steel Pipe and Tube Railings:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
  - a. Wagner, R & B, Inc.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.

## 2.3 METALS, GENERAL

- A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
  - 1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

## 2.4 STEEL AND IRON

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Tubing: ASTM A 500 (cold formed)
- C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations and where indicated.

## 2.5 FASTENERS

- A. General: Provide the following:
  - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
  - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.



3. .

- B. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

## 2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services) "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

## 2.7 FABRICATION

- A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- B. Form work true to line and level with accurate angles and surfaces.
- C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

- D. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- E. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- F. Form changes in direction by inserting prefabricated elbow fittings.
- G. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- H. Close exposed ends of railing members with prefabricated end fittings.
- I. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

## 2.8 STEEL AND IRON FINISHES

- A. Galvanized Railings:
  - 1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
  - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
  - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
- B. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
  - 1. Do not apply primer to galvanized surfaces.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
  3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

### 3.2 ATTACHING RAILINGS

- A. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets and railing end flanges to building construction as follows:
1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  2. For hollow masonry anchorage, use toggle bolts.
  3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

### 3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055213



## SECTION 061000 - ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Shear wall panels.
4. Rooftop equipment bases and support curbs.
5. Wood blocking and nailers.
6. Wood furring.
7. Wood sleepers.
8. Plywood backing panels.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of process and factory-fabricated product.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

#### 1.3 INFORMATIONAL SUBMITTALS

##### A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

##### B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Powder-actuated fasteners.
7. Expansion anchors.
8. Metal framing anchors.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

- A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship" for the following:
1. Dimension lumber framing.
  2. Laminated-veneer lumber.
  3. Parallel-strand lumber.
  4. Prefabricated wood I-joists.
  5. Rim boards.
  6. Miscellaneous lumber.
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
  2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece
  3. Provide dressed lumber, S4S, unless otherwise indicated.
- C. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.
- D. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

### 2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry or concrete.
  - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
  - 4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
  - 5. Wood floor plates that are installed over concrete slabs-on-grade.

### 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  - 1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
  - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat items indicated on Drawings, and the following:
  - 1. Framing for raised platforms.
  - 2. Framing for stages.
  - 3. Concealed blocking.

4. Framing for non-load-bearing partitions.
5. Framing for non-load-bearing exterior walls.
6. Roof construction.
7. Plywood backing panels.

## 2.4 DIMENSION LUMBER FRAMING

### A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

1. Application: Interior partitions not indicated as load-bearing.
2. Species:
  - a. Mixed southern pine; SPIB.
  - b. Northern species; NLGA.
  - c. Eastern softwoods; NeLMA.
  - d. Western woods; WCLIB or WWPA.

### B. Framing Other Than Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

1. Application: Framing other than interior partitions not indicated as load-bearing.
2. Species:
  - a. Hem-fir (north); NLGA.
  - b. Southern pine; SPIB.
  - c. Douglas fir-larch; WCLIB or WWPA.
  - d. Mixed southern pine; SPIB.
  - e. Spruce-pine-fir; NLGA.
  - f. Douglas fir-south; WWPA.
  - g. Hem-fir; WCLIB or WWPA.
  - h. Douglas fir-larch (north); NLGA.
  - i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

### C. Framing Other Than Non-Load-Bearing Interior Partitions: Any species and grade with a modulus of elasticity of at least 1,500,000 psi (10 350 MPa) and an extreme fiber stress in bending of at least 1000 psi (6.9 MPa) for 2-inch nominal (38-mm actual) thickness and 12-inch nominal (286-mm actual) width for single-member use.

1. Application: Framing other than interior partitions not indicated as load-bearing.

## 2.5 MISCELLANEOUS LUMBER

### A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.



6. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.
- C. For concealed boards, provide lumber with 15 percent maximum moisture content and the following species and grades:
  1. Mixed southern pine; No. 2 grade; SPIB.
  2. Eastern softwoods; No. 2 Common grade; NeLMA.
  3. Northern species; No. 2 Common grade; NLGA.
  4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

## 2.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC in thickness indicated or, if not indicated, not less than **3/4-inch (19-mm)** nominal thickness.
  1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M
- B. Power-Driven Fasteners: NES NER-272.
- C. Bolts: Steel bolts complying with **ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)**; with **ASTM A 563 (ASTM A 563M)** hex nuts and, where indicated, flat washers.

## 2.8 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. [Cleveland Steel Specialty Co.](#)
  2. [KC Metals Products, Inc.](#)
  3. [Phoenix Metal Products, Inc.](#)
  4. [Simpson Strong-Tie Co., Inc.](#)
  5. [USP Structural Connectors.](#)

- C. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer that meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- D. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
  - 1. Use for interior locations unless otherwise indicated.
- E. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
  - 1. Use for wood-preserved-treated lumber and where indicated.

## 2.9 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- D. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.
- F. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

- G. Do not splice structural members between supports unless otherwise indicated.
- H. Comply with AWP4 M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
  - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

### 3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000



## SECTION 061600 - SHEATHING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Wall sheathing.
  2. Roof sheathing.
  3. Composite nail base insulated roof sheathing.
  4. Subflooring.
  5. Underlayment.
  6. Sheathing joint and penetration treatment.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.
  2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For following products, from ICC-ES:
1. Preservative-treated plywood.
  2. Fire-retardant-treated plywood.
  3. Foam-plastic sheathing.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

## 2.2 WOOD PANEL PRODUCTS

- A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
  - 1. Plywood.
  - 2. Oriented strand board.
  - 3. Particleboard underlayment.
  - 4. Hardboard underlayment.
- C. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.
- D. Oriented Strand Board: DOC PS 2.

## 2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings.

## 2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  - 1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
  - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat all plywood unless otherwise indicated.

## 2.5 WALL SHEATHING

- A. Plywood Wall Sheathing: Exterior, Structural Sheathing.
- B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.
- C. Cementitious Backer Units: ASTM C 1325, Type A.
  1. Thickness: [1/2 inch (12.7 mm)] [5/8 inch (15.9 mm)]

## 2.6 SUBFLOORING AND UNDERLAYMENT

- A. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exposure 1, Underlayment single-floor panels.

## 2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M

## 2.8 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
  1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
  - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
- D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

### 3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
  - 1. Combination Subfloor-Underlayment:
    - a. Glue and nail to wood framing.
    - b. Screw to cold-formed metal framing.
    - c. Space panels **1/8 inch (3 mm)** apart at edges and ends.
  - 2. Subflooring:
    - a. Glue and nail to wood framing.
    - b. Screw to cold-formed metal framing.
    - c. Space panels **1/8 inch (3 mm)** apart at edges and ends.
  - 3. Wall and Roof Sheathing:
    - a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
    - b. Screw to cold-formed metal framing.
    - c. Space panels **1/8 inch (3 mm)** apart at edges and ends.
  - 4. Underlayment:



- a. Nail or staple to subflooring.
  - b. Space panels **1/32 inch (0.8 mm)** apart at edges and ends.
  - c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.
- C. Seal sheathing joints according to sheathing manufacturer's written instructions.
- 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
  - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

### 3.3 CEMENTITIOUS BACKER UNIT INSTALLATION

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

END OF SECTION 061600



## SECTION 062023 - INTERIOR FINISH CARPENTRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Interior trim.
  - 2. Shelving
  - 3. Interior stairs
  
- B. Related Requirements:
  - 1. Section 064214 "Stile and Rail Wood Paneling."
  - 2. Section 064300 "Wood Stairs and Railings."
  - 3. Section 064400 "Ornamental Woodwork."

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
  
- B. Samples: For each type of paneling.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS, GENERAL

- A. Regional Materials: The following wood products shall be manufactured within **500 miles (800 km)** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
  - 1. Interior trim.
  - 2. Shelving.
  - 3. Interior stairs.
  
- B. Certified Wood: The following wood products shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
  - 1. Interior trim.
  - 2. Shelving
  - 3. Interior stairs
  
- C. Low-Emitting Materials: Composite wood products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing

of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Lumber: DOC PS 20.

1. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
  - a. For exposed lumber, mark grade stamp on end or back of each piece

E. Softwood Plywood: DOC PS 1.

F. Hardboard: AHA A135.4.

G. MDF: ANSI A208.2, Grade 130 >, made with binder containing no urea-formaldehyde resin.

## 2.2 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent respectively.

B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed lumber and plywood indicated to receive a stained or natural finish, mark back of each piece.

C. Application: Where indicated.

## 2.3 INTERIOR TRIM

A. Softwood Lumber Trim:

B. Hardwood Lumber Trim:

1. Species and Grade: Red oak Clear NHLA.
2. Maximum Moisture Content: 9 percent.

C. Hardwood Moldings for Transparent Finish (Stain or Clear Finish): WMPA HWM 2, N-grade wood moldings made to patterns included in WMPA HWM 1.

1. Species: Red oak.
2. Maximum Moisture Content: 9 percent.

D. Molding Patterns:

## 2.4 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels

## 2.5 SHELVING

A. Shelving: Made from the following material **3/4 inch (19 mm)** thick.

1. MDF with solid-wood front edge.

## 2.6 STAIRS AND RAILINGS

A. Treads: **1-1/16-inch (27-mm)**, clear, kiln-dried, edge-glued, red oak stepping with half-round nosing.

B. Risers: **13/16-inch (21-mm)**, clear, kiln-dried, edge-glued red oak stock.

## 2.7 MISCELLANEOUS MATERIALS

A. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.

1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

### 3.2 INSTALLATION, GENERAL

- A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
  - 1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
  - 2. Countersink fasteners, fill surface flush, and sand unless otherwise indicated.
  - 3. Install to tolerance of **1/8 inch in 96 inches (3 mm in 2438 mm)** for level and plumb. Install adjoining interior finish carpentry with **1/32-inch (0.8-mm)** maximum offset for flush installation and **1/16-inch (1.5-mm)** maximum offset for reveal installation.
  - 4. Install stairs with no more than **3/16-inch (4.7-mm)** variation between adjacent treads and risers and with no more than **3/8-inch (9.5-mm)** variation between largest and smallest treads and risers within each flight.

### 3.3 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.

### 3.4 SHELVING INSTALLATION

- A. Cut shelf cleats at ends of shelves about **1/2 inch (13 mm)** less than width of shelves and sand exposed ends smooth.
- B. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled. Space fasteners not more than **16 inches (400 mm)** o.c.
- C. Install shelf brackets according to manufacturer's written instructions, spaced not more than **36 inches (900 mm)** o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
- D. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled. Install shelves, fully seated on cleats, brackets, and supports.
- E. Cantilever Wall Shelving to be installed using brackets bolted to wall. Toggle bolts to be used in gypsum board wall, metal anchors to be used in masonry.

### 3.5 STAIR AND RAILING INSTALLATION

- A. Treads and Risers at Interior Stairs: Secure treads and risers by gluing and nailing to rough carriages.
  - 1. Open Stringers: Miter risers and stringer at open stringers. Extend tread over open stringers and finish with bullnose edge.

END OF SECTION 062023

## SECTION 064300 - WOOD STAIRS AND RAILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Wood stairs
  - 2. Shop finishing of wood stairs and railings.

#### 1.2 ACTION SUBMITTALS

- A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- B. Samples:
  - 1. Shop-applied transparent finishes.
  - 2. Shop-applied opaque finishes.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

#### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wood stairs and railings until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 WOODWORK FABRICATORS

### 2.2 WOOD STAIRS AND RAILINGS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
  - 1. Provide labels from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
- B. Grade: Custom
- C. Regional Materials: Stairwork and rails shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- D. Regional Materials: Stairwork and rails shall be manufactured within 500 miles (800 km) of Project site.
- E. Certified Wood: Stairwork and rails shall be produced from wood certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- F. Wood for Transparent Finish: Red oak, quarter sawn Quarter-sawn, red-oak treads
- G. Wood for Opaque Finish: Eastern white pine, sugar pine, or western white pine. Finishes for Stair Parts: As follows:
  - 1. Treads: Transparent
  - 2. Risers: Transparent.
  - 3. Stringers: Transparent.
  - 4. Scotia, Cove, and Other Moldings: Transparent.

### 2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
  - 1. Wood Moisture Content: 4 to 9 percent.

### 2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.



- B. Rough Carriages for Stairs: Laminated veneer lumber, made with an exterior-type adhesive complying with ASTM D 2559, and with the following allowable design values as determined according to ASTM D 5456:
  - 1. Extreme Fiber Stress in Bending, Edgewise: 3100 psi (21.3 MPa for 12-inch nominal- (286-mm actual-) depth members.
  - 2. Modulus of Elasticity, Edgewise: 2,000,000 psi (13 800 MPa).
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- D. Adhesives: Do not use adhesives that contain urea formaldehyde.
- E. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - 1. Wood Glues: 30 g/L.
  - 2. Multipurpose Construction Adhesives: 70 g/L.
  - 3. Structural Wood Member Adhesive: 140 g/L.

## 2.5 FABRICATION

- A. Fabricate wood stairs and railings to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Corners of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
- B. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- C. Cut carriages to accurately fit treads and risers. Glue treads to risers, and glue and nail treads and risers to carriages.
  - 1. Fabricate stairs with treads and risers no more than 1/8 inch (3 mm) from indicated position and no more than 1/16 inch (1.5 mm) out of relative position for adjacent treads and risers.

## 2.6 SHOP FINISHING

- A. General: Finish wood stairs and railings at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

- B. Finish Materials: Use finish materials that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork.
- D. Transparent Finish:
  - 1. Grade: Custom.
  - 2. Finish: System - 11, catalyzed polyurethane.
  - 3. Sheen: Flat, 15-30 gloss units measured on 60-degree gloss meter per ASTM D 523.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Before installation, condition wood stairs to average prevailing humidity conditions in installation areas.

#### 3.2 INSTALLATION

- A. Grade: Install wood stairs to comply with same grade as item to be installed.
- B. Stairs: Securely anchor carriages to supporting substrates. Install stairs with treads and risers no more than **1/8 inch (3 mm)** from indicated position.
- C. Railings:

END OF SECTION 064300

## SECTION 064600 - WOOD TRIM

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Exterior standing and running trim.
2. Interior standing and running trim.
3. Closet and utility shelving.
4. Wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.
5. Shop priming of wood trim.
6. Shop finishing of wood trim.

#### 1.2 ACTION SUBMITTALS

##### A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

##### B. Samples:

1. Lumber for transparent finish, for each species and cut, finished on one side and one edge.
2. Lumber and panel products with shop-applied opaque finish, for each finish system and color, with exposed surface finished.

#### 1.3 INFORMATIONAL SUBMITTALS

##### A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

#### 1.4 QUALITY ASSURANCE

##### A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program.

##### B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

#### 1.5 FIELD CONDITIONS

##### A. Weather Limitations for Exterior Work: Proceed with installation of exterior wood trim only when existing and forecasted weather conditions permit work to be performed and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.

- B. Environmental Limitations for Interior Work: Do not deliver or install interior wood trim until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 WOOD TRIM FABRICATORS

### 2.2 WOOD TRIM, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood trim indicated for construction, finishes, installation, and other requirements.
  - 1. Provide labels from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.

### 2.3 EXTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: Custom
- B. Regional Materials: Exterior trim for transparent finish shall be manufactured within **500 miles (800 km)** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- C. Certified Wood: Exterior trim for transparent finish shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- D. Wood Species: Red Oak.

### 2.4 EXTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

- A. Grade: Custom
- B. Regional Materials: Exterior trim for opaque finish shall be manufactured within **500 miles (800 km)** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- C. Certified Wood: Exterior trim for opaque finish shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- D. Wood Species: Red Oak

## 2.5 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: Custom
- B. Regional Materials: Interior trim for transparent finish shall be manufactured within **500 miles (800 km)** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- C. Regional Materials: Interior trim for transparent finish shall be manufactured within **500 miles (800 km)** of Project site.
- D. Certified Wood: Interior trim for transparent finish shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
  - 1. Species: Red oak
  - 2. Cut: Rift cut/rift sawn

## 2.6 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

- A. Grade: Custom
- B. Regional Materials: Interior trim for opaque finish shall be manufactured within **500 miles (800 km)** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- C. Regional Materials: Interior trim for opaque finish shall be manufactured within **500 miles (800 km)** of Project site.
- D. Certified Wood: Interior trim for opaque finish shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Wood Species: Red Oak

## 2.7 CLOSET AND UTILITY SHELVING

- A. Grade: Custom.
- B. Shelf Material: **3/4-inch (19-mm)** medium-density fiberboard with solid-lumber edge.
- C. Cleats: **3/4-inch (19-mm)** solid lumber.
- D. Wood Species: Red oak

## 2.8 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood trim and quality grade specified unless otherwise indicated.
  - 1. Wood Moisture Content for Exterior Materials: 7 to 12 percent.
  - 2. Wood Moisture Content for Interior Materials: 4 to 9 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of wood trim and quality grade specified unless otherwise indicated.
  - 1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
  - 2. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
  - 3. Medium-Density Fiberboard: ANSI A208.2, Grade 130 made with binder containing no urea formaldehyde.
- C. Water-Repellent Preservative Treated Materials: Comply with AWWA N1 (dip, spray, flood, or vacuum-pressure treatment) for exterior wood trim indicated to receive water-repellent preservative treatment.
  - 1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC), combined with an insecticide containing chloropyrifos (CPF).
  - 2. Extent of Water-Repellent Preservative Treatment: Treat all exterior wood trim unless otherwise indicated.

## 2.9 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
  - 1. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.
  - 1. For exterior applications, use materials that comply with testing requirements after being subjected to accelerated weathering according to ASTM D 2898.
  - 2. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.

## 2.10 MISCELLANEOUS MATERIALS

- A. Exterior Blocking, Shims, and Nailers: Softwood or hardwood lumber, pressure-preservative treated kiln dried to less than 15 percent moisture content.
  - 1. Preservative Treatment by Pressure Process: AWWPA U1; Use Category UC3b.
    - a. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.
    - b. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.
- B. Interior Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber kiln dried to less than 15 percent moisture content.
- C. Nails for Exterior Use: stainless steel.
- D. Screws for Exterior Use: stainless steel.
- E. Provide self-drilling screws for metal-framing supports.
- F. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- G. Adhesives: Do not use adhesives that contain urea formaldehyde.
- H. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- I. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - 1. Wood Glues: 30 g/L.
  - 2. Multipurpose Construction Adhesives: 70 g/L.
  - 3. Structural Wood Member Adhesive: 140 g/L.
  - 4. Architectural Sealants: 250 g/L.

## 2.11 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate wood trim to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Edges of Solid-Wood (Lumber) Members: **1/16 inch (1.5 mm)** unless otherwise indicated.
  - 2. Edges of Rails and Similar Members More Than **3/4 Inch (19 mm)** Thick: **1/8 inch (3 mm)**.

- C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members except for members with ends exposed in finished work.
- D. Assemble casings in shop except where shipping limitations require field assembly.

## 2.12 SHOP PRIMING

- A. Exterior Wood Trim for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099113 "Exterior Painting."
- B. Exterior Wood Trim for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."
- C. Interior Wood Trim for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099123 "Interior Painting."
- D. Interior Wood Trim for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."
- E. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood trim, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

## 2.13 SHOP FINISHING

- A. General: Finish wood trim at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for field finishing wood trim not indicated to be shop finished.
- C. Finish Materials: Use finish materials that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood trim, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim. Apply two coats to end-grain surfaces.



- E. Transparent Finish for Exterior Trim: Comply with Section 099300 "Staining and Transparent Finishing."
- F. Opaque Finish for Exterior Trim: Comply with Section 099113 "Exterior Painting."
- G. Transparent Finish for Interior Trim:
  - 1. Grade: Custom Economy.
  - 2. Finish: System - 11, catalyzed polyurethane.
  - 3. Staining: None required
  - 4. Sheen: Flat, 15-30gloss units measured on 60-degree gloss meter per ASTM D 523.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition wood trim to average prevailing humidity conditions in installation areas.

### 3.2 INSTALLATION

- A. Grade: Install wood trim to comply with same grade as item to be installed.
- B. Install wood trim level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches (3 mm in 2400 mm)**.
- C. Scribe and cut wood trim to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- E. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPAC M4.
- F. Anchor wood trim to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails[ or finishing screws] for exposed fastening, countersunk and filled flush with woodwork.
  - 1. For shop-finished items, use filler matching finish of items being installed.
- G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than **36 inches** long except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
  - 1. Install wall railings on indicated metal brackets securely fastened to wall framing.

2. Install standing and running trim with no more variation from a straight line than **1/8 inch in 96 inches** (3 mm in 2400 mm).

END OF SECTION 064600

## SECTION 064800 - WOOD FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Exterior frames and jambs.
  - 2. Interior frames and jambs.

#### 1.2 ACTION SUBMITTALS

- A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- B. Samples:
  - 1. Lumber for transparent finish, for each species and cut, finished on one side and one edge.
  - 2. Lumber with shop-applied opaque finish, for each finish system and color, with exposed surface finished.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates

#### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program
- B. Installer Qualifications: Fabricator of products.

#### 1.5 FIELD CONDITIONS

- A. Weather Limitations for Exterior Work: Proceed with installation of exterior wood frames only when existing and forecasted weather conditions permit work to be performed and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.
- B. Environmental Limitations for Interior Work: Do not deliver or install interior wood frames until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

### 2.1 WOOD FRAME FABRICATORS

### 2.2 WOOD FRAMES, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood frames indicated for construction, finishes, installation, and other requirements.
  - 1. Provide labels from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.

### 2.3 EXTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

- A. Grade: Custom
- B. Regional Materials: Exterior frames and jambs for opaque finish shall be manufactured within **500 miles (800 km)** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- C. Certified Wood: Exterior frames and jambs for opaque finish shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- D. Wood Species: Any closed-grain hardwood

### 2.4 INTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

- A. Grade: Custom
- B. Regional Materials: Interior frames and jambs for opaque finish shall be manufactured within **500 miles (800 km)** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- C. Regional Materials: Interior frames and jambs for opaque finish shall be manufactured within **500 miles (800 km)** of Project site.
- D. Certified Wood: Interior frames and jambs for opaque finish shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Wood Species: Any closed-grain hardwood.

## 2.5 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood frame and quality grade specified unless otherwise indicated.
  - 1. Wood Moisture Content for Exterior Materials: 7 to 12 percent.
  - 2. Wood Moisture Content for Interior Materials: 4 to 9 percent.

## 2.6 MISCELLANEOUS MATERIALS

- A. Exterior Blocking, Shims, and Nailers: Softwood or hardwood lumber pressure-preservative treated, kiln dried to less than 15 percent moisture content.
  - 1. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b.
    - a. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.
    - b. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.
- B. Interior Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- C. Nails for Exterior Use: stainless steel.
- D. Screws for Exterior Use: stainless steel.
- E. Provide self-drilling screws for metal-framing supports.
- F. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- G. Adhesives: Do not use adhesives that contain urea formaldehyde.
- H. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.7 FABRICATION

- A. Fabricate wood frames to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Edges of Solid-Wood (Lumber) Members: **1/16 inch (1.5 mm)** unless otherwise indicated.

## 2.8 SHOP PRIMING

- A. Exterior Wood Frames for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099113 "Exterior Painting."
- B. Exterior Wood Frames for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."
- C. Interior Wood Frames for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099123 "Interior Painting."
- D. Interior Wood Frames for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."
- E. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood frames, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

## 2.9 SHOP FINISHING

- A. General: Finish wood frames at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for field finishing wood frames not indicated to be shop finished.
- C. Finish Materials: Use finish materials that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood frames, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood frames. Apply two coats to end-grain surfaces.
- E. Transparent Finish for Exterior Frames: Comply with Section 099300 "Staining and Transparent Finishing."
- F. Opaque Finish for Exterior Frames: Comply with Section 099113 "Exterior Painting."
- G. Opaque Finish for Interior Frames:

1. Grade: Custom
2. Finish: System - 4, water-based latex acrylic
3. Color: As selected by Architect from manufacturer's full range
4. Sheen: Semigloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D 523

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition wood frames to average prevailing humidity conditions in installation areas.

### 3.2 INSTALLATION

- A. Grade: Install wood frames to comply with same grade as item to be installed.
- B. Install wood frames level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of **1/8 inch in 96 inches (3 mm in 2400 mm)**.
- C. Scribe and cut wood frames to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- E. Anchor wood frames to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
  1. For shop-finished items, use filler matching finish of items being installed.

END OF SECTION 064800





## SECTION 066400 - PLASTIC PANELING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes plastic sheet paneling.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling and trim accessories.

#### 1.3 QUALITY ASSURANCE

- A. Testing Agency: Acceptable to authorities having jurisdiction

### PART 2 - PRODUCTS

#### 2.1 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319. Panels shall be USDA accepted for incidental food contact.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide Standard FRP Panel or comparable product by one of the following:
    - a. Crane Composites, Inc.
    - b. Glasteel.
    - c. Marlite.
    - d. Newcourt, Inc.
    - e. Nudo Products, Inc.
    - f. Parkland Plastics, Inc.
  - 3. Low-Emitting Materials: Paneling shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  - 4. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.

- a. Flame-Spread Index: [25] [200] <Insert value> or less.
  - b. Smoke-Developed Index: 450 or less.
- 5. Nominal Thickness: Not less than [0.09 inch (2.3 mm).
  - 6. Surface Finish: Molded pebble texture.
  - 7. Color: Grey.

## 2.2 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
  - 1. Color: Grey.
- B. Adhesive: As recommended by plastic paneling manufacturer and with a VOC content of 50g/L or less.
- C. Adhesive: As recommended by plastic paneling manufacturer and that complies with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."
  - 1. Sealant shall have a VOC content of 250 g/L or less.
  - 2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- B. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- C. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches wide.

### 3.2 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install trim accessories with adhesive staples Do not fasten through panels.
- D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400



## SECTION 072100 - THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  1. Mineral-wool blanket insulation.
  2. Spray polyurethane foam insulation.
  - 3.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research/evaluation reports.

### PART 2 - PRODUCTS

#### 2.1 MINERAL-WOOL BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Fibrex Insulations Inc.
  2. Owens Corning.
  3. Roxul Inc.
  4. Thermafiber.
  - 5.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- C. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- D. Reinforced-Foil-Faced, Mineral-Wool Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

## 2.2 SPRAY POLYURETHANE FOAM INSULATION

- A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. BASF Corporation.
    - b. BaySystems NorthAmerica, LLC.
    - c. Dow Chemical Company (The).
    - d. ERSystems, Inc.
    - e. Gaco Western Inc.
    - f. Henry Company.
    - g. NCFI; Division of Barnhardt Mfg. Co.
    - h. SWD Urethane Company.
    - i. Volatile Free, Inc.
  2. Minimum density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).
- B. Open-Cell Polyurethane Foam Insulation: Spray-applied polyurethane foam using water as a blowing agent, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. BaySystems NorthAmerica, LLC.
    - b. Demilec (USA) LLC.
    - c. Gaco Western Inc.
    - d. Icynene Inc.
    - e. SWD Urethane Company.
  2. Minimum density of 0.4 lb/cu. ft. (6.4 kg/cu. m), thermal resistivity of 3.4 deg F x h x sq. ft./Btu x in. at 75 deg F (24 K x m/W at 24 deg C).

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

### 3.2 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  - 4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
  - 5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
  - 6. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:
    - a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.
    - b. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
  - 7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
    - a. Exterior Walls: Set units with facing placed toward interior of construction.
    - b. Interior Walls: Set units with facing placed toward areas of high humidity.
- C. 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. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.
- D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION 072100



## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes hollow-metal work.

#### 1.2 DEFINITIONS

- A. **Minimum Thickness:** Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

#### 1.3 ACTION SUBMITTALS

- A. **Product Data:** For each type of product.
- B. **Shop Drawings:** Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. **Samples for Initial Selection:** For units with factory-applied color finishes.
- D. **Samples for Verification:** For each type of exposed finish required.
- E. **Schedule:** Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
  1. Amweld International, LLC.
  2. Apex Industries, Inc.
  3. Ceco Door Products; an Assa Abloy Group company.
  4. Commercial Door & Hardware Inc.
  5. Concept Frames, Inc.
  6. Curries Company; an Assa Abloy Group company.
  7. Custom Metal Products.

8. Daybar.
9. Deansteel.
10. de La Fontaine Industries.
11. DKS Steel Door & Frame Sys. Inc.
12. Door Components, Inc.
13. Fleming-Baron Door Products.
14. Gensteel Doors Inc.
15. Greensteel Industries, Ltd.
16. HMF Express.
17. Hollow Metal Inc.
18. Hollow Metal Xpress.
19. J/R Metal Frames Manufacturing, Inc.
20. Karpen Steel Custom Doors & Frames.
21. L.I.F. Industries, Inc.
22. LaForce, Inc.
23. Megamet Industries, Inc.
24. Mesker Door Inc.
25. Michbi Doors Inc.
26. MPI Group, LLC (The).
27. National Custom Hollow Metal.
28. North American Door Corp.
29. Philipp Manufacturing Co (The).
30. Pioneer Industries, Inc.
31. Premier Products, Inc.
32. Republic Doors and Frames.
33. Rocky Mountain Metals, Inc.
34. Security Metal Products Corp.
35. Shanahans Manufacturing Ltd.
36. Steelcraft; an Ingersoll-Rand company.
37. Steward Steel; Door Division.
38. Stiles Custom Metal, Inc.
39. Titan Metal Products, Inc.
40. Trillium Steel Doors Limited.
41. West Central Mfg. Inc.

## 2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
  1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

## 2.3 INTERIOR DOORS AND FRAMES

- A. Standard-Duty Doors and Frames: SDI A250.8, Level 1. At locations indicated in the Door and Frame Schedule
  - 1. Physical Performance: Level C according to SDI A250.4.
  - 2. Frames:
    - a. Materials: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
    - b. Construction: Knocked down.
  - 3. Exposed Finish: Prime

## 2.4 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.

## 2.5 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25percent.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- G. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.

## 2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical,

fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

- B. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  - 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  - 4. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
      - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
      - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
      - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
  - 5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
  - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

## 2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  - 1. Shop Primer: SDI A250.10.
- B. Factory Finish: SDI A250.3.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-rated openings, install frames according to NFPA 80.
    - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - c. Install frames with removable stops located on secure side of opening.
    - d. Install door silencers in frames before grouting.
    - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - g.
  2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post installed expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.
  3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
  4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
  5. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
  6. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

### 3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace

defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

## SECTION 081416 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Solid-core doors with wood-veneer faces.
  - 2. Hollow-core doors with wood-veneer faces.
  - 3. Factory finishing flush wood doors.
  - 4. Factory fitting flush wood doors to frames and factory machining for hardware.
- B. Related Requirements:
  - 1. Section 083473.16 "Wood Sound Control Door Assemblies" for acoustic flush wood doors.
  - 2. Section 088000 "Glazing" for glass view panels in flush wood doors.
  - 3. Section 134900 "Radiation Protection" for lead-lined flush wood doors.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
  - 1. Dimensions and locations of blocking.
  - 2. Dimensions and locations of mortises and holes for hardware.
  - 3. Dimensions and locations of cutouts.
  - 4. Undercuts.
  - 5. Requirements for veneer matching.
  - 6. Doors to be factory finished and finish requirements.
  - 7. Fire-protection ratings for fire-rated doors.
- C. Samples: For factory-finished doors.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is a certified participant in AWI's Quality Certification Program.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Algoma Hardwoods, Inc.
  2. Ampco.
  3. Chappell Door Co.
  4. Eggers Industries.
  5. General Veneer Manufacturing Co.
  6. Graham Wood Doors; an Assa Abloy Group company.
  7. Haley Brothers, Inc.
  8. Ipik Door Company.
  9. Lambton Doors.
  10. Marlite.
  11. Marshfield Door Systems, Inc.
  12. Mohawk Doors; a Masonite company.
  13. Oshkosh Door Company.
  14. Poncraft Door Company.
  15. Vancouver Door Company.
  16. VT Industries, Inc.

### 2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with Architectural Woodwork Standards."
1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
- B. Regional Materials: Flush wood doors shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- C. Regional Materials: Flush wood doors shall be manufactured within 500 miles (800 km) of Project site.
- D. Certified Wood: Flush wood doors shall be certified as "FSC Pure" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."
- E. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.
- F. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that comply with the testing and product requirements of the California Department of Health



Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.
  - a. Screw Withdrawal, Face: 700 lbf (3100 N).
  - b. Screw Withdrawal, Edge: 400 lbf (1780 N).

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Custom (Grade A faces).
2. Species: Red oak.
3. Cut: Rotary cut.
4. Match between Veneer Leaves: Pleasing match.
5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Core: Either glued or nonglued wood stave or structural composite lumber.
7. Construction: Seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
8. Construction: Seven plies, either bonded or nonbonded construction.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
- C. Openings: Factory cut and trim openings through doors.
1. Light Openings: Trim openings with moldings of material and profile indicated.
  2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
  3. Louvers: Factory install louvers in prepared openings

2.5 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors that are indicated to receive transparent finish.

- C. Use only paints and coatings that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Transparent Finish:
  - 1. Grade: Custom.
  - 2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 5, conversion varnish.
  - 3. Finish: WDMA TR-4 conversion varnish.
  - 4. Staining: None required.
  - 5. Effect: Filled finish.
  - 6. Sheen: Satin.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
  - 1. Install fire-rated doors according to NFPA 80.
  - 2. Install smoke- and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  - 1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
    - a. Comply with NFPA 80 for fire-rated doors.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 081416

## SECTION 087100 - DOOR HARDWARE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
  - 1. Mechanical door hardware for the following:
    - a. Swinging doors.
    - b. Sliding doors.
    - c. Folding doors.
  - 2. Cylinders for door hardware specified in other Sections.
- B. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.
  - 1. Thresholds to be installed under other Sections.
  - 2. Permanent lock cores to be installed by Owner.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Other Action Submittals:
  - 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
    - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
    - b. Content: Include the following information:
      - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
      - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
      - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
      - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
  - 2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

### 1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

### 1.4 QUALITY ASSURANCE

- A. **Installer Qualifications:** Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
- B. **Architectural Hardware Consultant Qualifications:** A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
  - 1. For door hardware, an Architectural Hardware Consultant (AHC).
- C. **Fire-Rated Door Assemblies:** Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- D. **Smoke- and Draft-Control Door Assemblies:** Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
  - 1. **Air Leakage Rate:** Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- E. **Means of Egress Doors:** Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- F. **Accessibility Requirements:** For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
  - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
  - 2. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
    - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
    - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
  - 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

- G. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- B. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
    - a. Manual Closers: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled on Drawings to comply with requirements in this Section.
  - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
  - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
  - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

### 2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Baldwin Hardware Corporation.
  - b. Bommer Industries, Inc.
  - c. Cal-Royal Products, Inc.
  - d. Hager Companies.
  - e. IVES Hardware; an Ingersoll-Rand company.
  - f. Lawrence Hardware Inc.
  - g. McKinney Products Company; an ASSA ABLOY Group company.
  - h. PBB, Inc.
  - i. Stanley Commercial Hardware; Div. of The Stanley Works.

B. Pin-and-Barrel-Type Hinges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
  - a. Hager Companies.
  - b. IVES Hardware; an Ingersoll-Rand company.
  - c. Lawrence Hardware Inc.
  - d. Markar Architectural Products, Inc.; a subsidiary of Adams Rite Manufacturing Co.
  - e. McKinney Products Company; an ASSA ABLOY Group company.
  - f. Select Products Limited.
  - g. Zero International.

### 2.3 MECHANICAL LOCKS AND LATCHES

A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

B. Bored Locks: BHMA A156.2; Grade 1 Series 4000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Arrow USA; an ASSA ABLOY Group company.
  - b. Best Access Systems; Div. of Stanley Security Solutions, Inc.
  - c. Cal-Royal Products, Inc.
  - d. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group Company.

- e. Falcon Lock; An Ingersoll-Rand Company.
- f. K2 Commercial Hardware; a Black & Decker Corp. company.
- g. Marks USA.
- h. Medeco Security Locks, Inc.; an ASSA ABLOY Group company.
- i. PDQ Manufacturing.
- j. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
- k. Schlage Commercial Lock Division; an Ingersoll-Rand company.
- l. Weiser Lock Corp.; a Black & Decker Corp. company.
- m. Yale Security Inc.; an ASSA ABLOY Group company.

C. Mortise Locks: BHMA A156.13; Operational Grade 1 stamped steel case with steel or brass parts; Series 1000.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
  - a. Accurate Lock & Hardware Co.
  - b. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
  - c. Arrow USA; an ASSA ABLOY Group company.
  - d. Best Access Systems; Div. of Stanley Security Solutions, Inc.
  - e. Cal-Royal Products, Inc.
  - f. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
  - g. Falcon Lock; an Ingersoll-Rand company.
  - h. Marks USA.
  - i. PDQ Manufacturing.
  - j. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
  - k. Schlage Commercial Lock Division; an Ingersoll-Rand company.
  - l. Yale Security Inc.; an ASSA ABLOY Group company.

## 2.4 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

- 1. Manufacturer: Same manufacturer as for locking devices.
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following
- 3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated schedule or comparable product by one of the following:
  - a. Arrow USA; an ASSA ABLOY Group company.
  - b. ASSA, Inc.; An ASSA ABLOY Group Company.
  - c. Best Access Systems; Div. of Stanley Security Solutions, Inc.
  - d. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
  - e. Falcon Lock; an Ingersoll-Rand company.
  - f. Medeco Security Locks, Inc.; an ASSA ABLOY Group company.
  - g. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
  - h. Schlage Commercial Lock Division; an Ingersoll-Rand company.
  - i. Yale Security Inc.; an ASSA ABLOY Group company.

- B. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

## 2.5 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
  - 1. Master Key System: Change keys and a master key operate cylinders.
- B. Keys: Brass.
  - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
    - a. Notation: "DO NOT DUPLICATE".
  - 2. Quantity: In addition to one extra key blank for each lock, provide the following:
    - a. Master Keys: Five.

## 2.6 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; bronze, unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Burns Manufacturing Incorporated.
    - b. Don-Jo Mfg., Inc.
    - c. Forms + Surfaces.
    - d. Hager Companies.
    - e. Hiawatha, Inc.
    - f. IVES Hardware; an Ingersoll-Rand company.
    - g. Rockwood Manufacturing Company.
    - h. Trimco.

## 2.7 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
  - a. Arrow USA; an ASSA ABLOY Group company.
  - b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
  - c. DORMA Architectural Hardware; Member of The DORMA Group North America.
  - d. Dor-O-Matic; an Ingersoll-Rand company.
  - e. K2 Commercial Hardware; a Black & Decker Corp. company.
  - f. LCN Closers; an Ingersoll-Rand company.
  - g. Norton Door Controls; an ASSA ABLOY Group company.
  - h. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
  - i. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
  - j. Yale Security Inc.; an ASSA ABLOY Group company.

## 2.8 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; bronze, base metal.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
    - a. Architectural Builders Hardware Mfg., Inc.
    - b. Baldwin Hardware Corporation.
    - c. Burns Manufacturing Incorporated.
    - d. Cal-Royal Products, Inc.
    - e. Don-Jo Mfg., Inc.
    - f. Door Controls International, Inc .
    - g. Hager Companies.
    - h. Hiawatha, Inc.
    - i. IVES Hardware; an Ingersoll-Rand company.
    - j. Rockwood Manufacturing Company.
    - k. Stanley Commercial Hardware; Div. of The Stanley Works.
    - l. Trimco.

## 2.9 SLIDING DOOR HARDWARE

- A. Sliding Door Hardware: BHMA A156.14; consisting of complete sets including rails, hangers, supports, bumpers, floor guides, and accessories indicated.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
    - a. Cox, Arthur, & Sons, Inc.
    - b. Hager Companies.
    - c. Henderson, PC Inc.
    - d. Johnson, L. E., Products, Inc.
    - e. Stanley Commercial Hardware; Div. of The Stanley Works.

f. Leatherneck Hardware, Inc. #402 Flat Track Hanger Door Assembly – 3' Door

2.10 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  2. Fire-Rated Applications:
    - a. Wood or Machine Screws: For the following:
      - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
      - 2) Strike plates to frames.
      - 3) Closers to doors and frames.
    - b. Steel Through Bolts: For the following unless door blocking is provided:
      - 1) Surface hinges to doors.
      - 2) Closers to doors and frames.
      - 3) Surface-mounted exit devices.
  3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
  4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
  5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.11 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
- C. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Custom Steel Doors and Frames: HMMA 831.
  - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
  - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- E. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- F. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- G. Lock Cylinders: Install construction cores to secure building and areas during construction period.
  - 1. Replace construction cores with permanent cores as directed by Owner.
  - 2. Furnish permanent cores to Owner for installation.
- H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant.
- I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- J. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

### 3.2 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

### 3.3 DOOR HARDWARE SCHEDULE

#### HW1

Doors A105 & A204

Each door to have: Sliding Barn Door Hardware, Privacy Set

#### HW2

Door A001

Door to have: Hinges, Lockset (Function 2), Wall Stop, Silencers

#### HW3

Door A101A

Door to have: Hinges, Passage Set (Function 3), Closer, Kick Plate, Wall Stop, Silencers

Doors A101 & A202

Existing Hardware to Remain

END OF SECTION 087100

## SECTION 088000 - GLAZING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
  - 1. Glass for storefront framing.
  - 2. Glazing sealants and accessories.

#### 1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Preconstruction adhesion and compatibility test report.

#### 1.5 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

#### 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

## 1.7 WARRANTY

A. **Manufacturer's Special Warranty for Coated-Glass Products:** Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. **Manufacturer's Special Warranty for Laminated Glass:** Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to 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.

1. Warranty Period: Five years from date of Substantial Completion.

C. **Manufacturer's Special Warranty for Insulating Glass:** Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to 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. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. **Basis-of-Design Glass Product:** Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:

1. AGC Glass Company North America, Inc.
2. Berkowitz, JE, LP.
3. Cardinal Glass Industries.
4. Cristacurva Glass.
5. Dlubak Corporation.
6. Gardner Glass Products, Inc.
7. General Glass International.
8. Glasswerks LA, Inc.
9. Glaz-Tech Industries.
10. Guardian Industries Corp.

11. Hartung Glass Industries.
12. Northwestern Industries, Inc.
13. Oldcastle BuildingEnvelope.
14. Pilkington North America Inc.
15. PPG Industries, Inc.
16. Saint-Gobain Corporation.
17. Schott North America, Inc.
18. Tecnoglass S. A.
19. Trulite Glass & Aluminum Solutions.
20. Viracon, Inc.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.
  1. Design Wind Pressures: As indicated on Drawings.
  2. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
  3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Windborne-Debris-Impact Resistance: Exterior glazing shall comply with basic protection testing requirements in ASTM E 1996 for Wind Zone 3 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.
  1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
  2. Small-Missile Test: For glazing located more than 30 feet (9.1 m) above grade.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  1. 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 (W/sq. m x K).
  2. 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.
  3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.3 GLASS PRODUCTS, GENERAL

- A. 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.
  - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
  - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
  - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.4 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

## 2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
  - 1. Sealing System: Dual seals.
  - 2. Spacer: Manufacturer's standard spacer material and construction

## 2.6 GLAZING SEALANTS

- A. General:
  - 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. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
  4. Sealants shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  5. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following
    - a. Dow Corning Corporation; 790.
    - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
    - c. May National Associates, Inc.; Bondaflex Sil 290.
    - d. Pecora Corporation; 890NST.
    - e. Sika Corporation U.S.; Sikasil WS-290.
    - f. Tremco Incorporated; Spectrem 1.
  2. Applications: <at three (3) existing openings at Wharf Street Level. >.
- C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following
    - a. Dow Corning Corporation; 995.
    - b. GE Advanced Materials - Silicones; Contractors N SCS1800May National Associates, Inc.; Bondaflex Sil 295.
    - c. Pecora Corporation; 864NST
    - d. Polymeric Systems, Inc.; PSI-641.
    - e. Sika Corporation U.S.; Sikasil WS-295.
    - f. Tremco Incorporated; Spectrem 2
  2. Applications: < At three (3) existing openings at Wharf Street Level. >.
- D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Bostik, Inc.; Chem-Calk 1250.
    - b. Dow Corning Corporation; 1199
    - c. GE Advanced Materials - Silicones; SilGlaze II SCS2811
    - d. May National Associates, Inc.; Bondaflex Sil 201 FC.

- e. Polymeric Systems, Inc.; PSI-631.
- f. Schnee-Morehead, Inc., an ITW company; SM5731 Poly-Glaze Plus.
- g. Sika Corporation U.S.; Sikasil-N Plus US.
- h. Tremco Incorporated; Tremsil 600.
- i. >.

2. Applications: < At three (3) existing openings at Wharf Street Level.>.

## 2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, 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 C 1281 and AAMA 800 for products indicated below:
  - 1. AAMA 804.3 tape, where indicated.
  - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. 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:
  - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  - 2. 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

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## PART 3 - EXECUTION

### 3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

### 3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.5 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

### 3.6 INSULATING GLASS SCHEDULE

A. Glass Type [GL-<1>]: Clear insulating glass.

1. Basis-of-Design Product: < Guardian Glass >.
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 3 mmOutdoor LiteFully tempered float glass.
4. Interspace Content: Argon.
5. Indoor Lite: Fully tempered float glass.
6. Safety glazing required.

END OF SECTION 088000

**This Page Intentionally Left Blank**

## SECTION 089119 - FIXED LOUVERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes fixed, formed-metal louvers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
- C. Samples: For each type of metal finish required.
- D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on tests performed according to AMCA 500-L.
- B. Windborne-debris-impact-resistance test reports.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
  - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

2. Wind Loads: Determine loads based on a uniform pressure of 20 lbf/sq. ft. (957 Pa acting inward or outward.
- C. Windborne-Debris-Impact Resistance: Louvers located within 30 feet (9.1 m) of grade shall pass basic protection, large-missile testing requirements in ASTM E 1996 for Wind Zone 3 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than louvers indicated for use on Project.
  - D. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
    1. Component Importance Factor: 1.0.
  - E. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

## 2.2 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Drainable-Blade Louver:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Air Balance Inc.; a Mestek company.
    - b. Air Flow Company, Inc.
    - c. Airolite Company, LLC (The).
    - d. All-Lite Architectural Products.
    - e. American Warming and Ventilating; a Mestek company.
    - f. Architectural Louvers; Harray, LLC.
    - g. Arrow United Industries; a division of Mestek, Inc.
    - h. Carnes Company, Inc.
    - i. Cesco Products; a division of Mestek, Inc.
    - j. Construction Specialties, Inc.
    - k. Dowco Products Group; Safe Air of Illinois.
    - l. Greenheck Fan Corporation.
    - m. Industrial Louvers, Inc.
    - n. Louvers & Dampers; a division of Mestek, Inc.
    - o. Metal Form Manufacturing, Inc.
    - p. NCA Manufacturing, Inc.
    - q. Nystrom, Inc.
    - r. Pottorff.
    - s. Reliable Products, Inc.
    - t. Ruskin Company; Tomkins PLC.
    - u. United Enertech.
    - v. Vent Products Co., Inc.
  3. Louver Depth: 4 inches (100 mm).



4. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm for blades and 0.080 inch (2.03 mm) for frames.
5. Mullion Type: Exposed.
6. Louver Performance Ratings:
  - a. Free Area: Not less than 8.0 sq. ft. (0.74 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
  - b. Point of Beginning Water Penetration: Not less than 900 fpm (4.6 m/s).
  - c. Air Performance: Not more than 0.10-inch wg (25-Pa static pressure drop at 700-fpm (3.6-m/s free-area intake velocity).
7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

### 2.3 LOUVER SCREENS

- A. General: Provide screen at each exterior louver
  1. Screen Location for Fixed Louvers: Interior face.
  2. Screening Type: Bird screening.
- B. Louver Screen Frames: Same type and form of metal as indicated for louver to which screens are attached.
- C. Louver Screening for Aluminum Louvers:
  1. Bird Screening: Aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.60-mm) wire.

### 2.4 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
  1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
  2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
  4. For fastening stainless steel, use 300 series stainless-steel fasteners.
  5. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.5 FABRICATION

- A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- B. Join frame members to each other and to fixed louver blades with fillet welds concealed from view threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

## 2.6 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611 or thicker.
  - 1. Color: Black
  - 2. Color: As selected by Architect from full range of industry colors and color densities.

## 2.7 GALVANIZED-STEEL SHEET FINISHES

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather tight connection.
- C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

## 3.2 ADJUSTING

- A. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION 089119

## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Interior gypsum board.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

#### 2.2 GYPSUM BOARD, GENERAL

- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- C. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site.

## 2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Gypsum.
  2. CertainTeed Corp.
  3. Georgia-Pacific Gypsum LLC.
  4. National Gypsum Company.
  5. USG Corporation.
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
1. Thickness: 5/8 inch (15.9 mm).
  2. Long Edges: Tapered.
- C. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
1. Core: 5/8 inch (15.9 mm), Type X.
  2. Long Edges: Tapered.
  3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; FiberCement Underlayment.
    - b. Custom Building Products; Wonderboard
    - c. James Hardie Building Products, Inc.; Hardiebacker.
    - d. National Gypsum Company, Permabase Cement Board.
    - e. USG Corporation; DUROCK Cement Board.
  2. Thickness: 5/8 inch (15.9 mm).
  3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- B. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed Corp.
    - c. Georgia-Pacific Gypsum LLC.
    - d. USG Corporation.
  2. Core: 5/8 inch (15.9 mm), Type X.

## 2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
- B. Aluminum Trim: ASTM B 221 (ASTM B 221M), Alloy 6063-T5.

## 2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  - 1. Interior Gypsum Board: Paper.
  - 2. Exterior Gypsum Soffit Board: Paper.
  - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
  - 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

## 2.7 AUXILIARY MATERIALS

- A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
  - 1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Laminating adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- C. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- D. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

## PART 3 - EXECUTION

### 3.1 APPLYING AND FINISHING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) 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.
- D. Install 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.
  - 1. Aluminum Trim: Install in locations as required.
  - 2. Control Joints: Install control joints at locations indicated on Drawings according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- E. Prefill open joints and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Where indicated on Drawings.
  - 3. Level 3: Where indicated on Drawings.
  - 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
  - 5. Level 5: Where indicated on Drawings.
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

END OF SECTION 092900

## SECTION 093100 – TILE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Quarry tile.
  - 2. Paver tile (porcelain tile).
  - 3. Waterproof membrane for thin-set tile installations.
  - 4. Crack-suppression membrane for thin-set tile installations.
  - 5. Cementitious backer units installed as part of tile installations.
  - 6. Tile underlayment.
  - 7. Metal edge strips installed as part of tile installations.
- B. Related Sections include the following:
  - 1. Division 02 Section "Selective Demolition and Alterations" for removing existing finishes.
  - 2. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
  - 3. Division 09 Section "Gypsum Board Assemblies" for moisture and mold-resistant board and glass-mat, water-resistant backer board.

#### 1.3 SUBMITTALS

- A. General: Submit in accordance with Division 01 Section "Submittal Procedures."
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- D. Samples for Verification:
  - 1. Full-size units of each type and composition of tile and for each color and finish required. For glass mosaic tile in color blend patterns, provide full sheets of each color blend.
  - 2. Metal edge strips in 6-inch lengths.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.
  - 1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
  - 1. Crack-suppression membrane.
  - 2. Metal edge strips.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
  - 1. Assemble all trades working at Project site to coordinate the work and to prevent workers from walking on newly installed tiles for required setting bed and grout cure times. Large tile will require additional time for the mortar bed to cure. Contractor to coordinate project schedule to complete work by other trades and vacate areas receiving floor coverings, stopping pedestrian traffic over newly installed flooring installation until curing and drying period is complete. Contractor shall conduct periodic coordination meetings with all trades to review schedule and procedures to prevent interference and damage during installation and curing and drying periods of floor coverings.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
  - 1. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient and substrate temperatures and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
  - 1. Maintain temperatures at 50 deg F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.
- B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.

#### 1.7 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.



1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, patter, and size indicated.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
  1. Products: Subject to compliance with requirements, provide one of the products specified.
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
  1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
  1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

### 2.3 TILE PRODUCTS

- A. Unglazed Quarry Tile [**QT-1**]: Square-edged flat tile as follows:
  1. Face Size: 66 by 6 inches<sup>6</sup>.
  2. Thickness: **1/2 inch**.
  3. Wearing Surface: **Nonabrasive, smooth**.
  4. Face: Flashed.
  5. Finish: Unfinished.
  6. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable **and matching characteristics of adjoining flat tile**. Provide shapes as follows, selected from manufacturer's standard shapes:
    - a. Base: Sanitary Coved with surface bullnose top edge(Q-3565U), face size 5 by 6 inches.
    - b.
  7. Products:

- a. American Olean – Quarry Naturals
  - b. Color: N56 Shadow Flash
  
- B. Trim Units for Ceramic Tile: Provide tile trim units to match characteristics of adjoining flat tile and to comply with the following requirements:
  - 1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
  - 2. Shapes: As follows, selected from manufacturer’s standard shapes:
    - a. Ceramic Tile Base: Internal coved corner, exterior bull-nosed corner.
      - 1) Sanitary Cove Base: S366C9T.
  
- C. Floor Tile (Porcelain Tile)CT-1: Flat tile as follows:
  - 1. Composition: Porcelain.
  - 2. Face Size: 6- by 24-inches. (304.8mm x 304.8 mm)
  - 3. Thickness: 3/8 inch (9.525 mm)
  - 4. Face: Plain with square edges.
  - 5. Product: American Olean: Avenue One.
    - a. Color: AU05 Brownstone.
  
- D. Stone Thresholds
  - 1. General: Provide stone thresholds that are uniform in color and finish, fabricated to sizes and profiles indicated to provide transition between tile surfaces and adjoining finished floor surfaces.
    - a. Fabricate thresholds minimum 5/8 inches thick with no more than ½ inch (12.7 mm) above adjoining finished floor surfaces, with transition edges beveled on a slope no greater than 1:2.

## 2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes. Provide stone that is uniform in color and finish.
  - 1. Bevel edges at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to 1/2 inch or less, and finish bevel to match face of threshold.
  
- B. Slate Thresholds: ASTM C 629, Classification **I Exterior**, with fine, even grain and honed finish.
  - 1. Description: Uniform, **black and unfading**.

## 2.5 CRACK ISOLATION MEMBRANE FOR THIN-SET TILE INSTALLATIONS

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
  
- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of a two-part, liquid rubber and fabric reinforcement, with a VOC content of 65 g/L or less when calculated according to South Coast Air Quality Management district (SCAQMD) Rule 1168 as amended January 7, 2005.
  - 1. Product: Laticrete International, Inc.; Laticrete Blue 92 Anti-Fracture Membrane.
    - a. Location: Use under entire porcelain and quarry tile installation.

## 2.6 SETTING AND GROUTING MATERIALS

- A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:
  - 1. Prepackaged dry-mortar mix combined with acrylic resin liquid-latex additive, with a VOC content of 65 g/L or less when calculated according to South Coast Air Quality Management district (SCAQMD) Rule 1168 as amended January 7, 2005.
    - a. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.
    - b. Provide white mortar for use with glass tile mosaics.
  - 2. Product: LATICRETE International Inc.; Laticrete 254 Platinum.
- B. Chemical-Resistant, Water-Cleanable, Grouting Epoxy: ANSI A118.3 , with a VOC content of 65 g/L or less when calculated according to South Coast Air Quality Management district (SCAQMD) Rule 1168 as amended January 7, 2005.
  - 1. Product: LATICRETE International Inc.; SpectaLOCK PRO Grout.
    - a. Grout Colors, GR-1, 2 & 3: As indicated on Materials Legend; in locations not indicated, as selected by Architect from manufacturer's full range of colors.

## 2.7 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."
  - 1. Use sealants that have a VOC content of 250 g/L or less when calculated according to South Coast Air Quality Management district (SCAQMD) Rule 1168 as amended January 7, 2005.
  - 2. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

## 2.8 MISCELLANEOUS MATERIALS

- A. Trowelable Under-layments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Polyethylene Membrane: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.08 perm.
- C. Metal Edge Strips: Stainless steel terrazzo strips, 1/8-inch wide at top edge with integral provision for anchorage to mortar bed or substrate unless otherwise indicated.
  - 1. Provide at tile to carpet locations and where indicated.
  - 2. Product: Schluter Systems L.P.; Schluter-Schiene E Series.
- D. Control Joints (CJ): Control joints for porcelain tile, thermoplastic movement joint with opposing metal profiles.
  - 1. Product: Schluter DILEX-KS.

- E. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

## 2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions, including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.
- B. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
  - 1. Check flatness of substrate by laser. Level floor to provide a base for thin set that allows for a smooth, flat floor without irregularities.
  - 2. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
  - 3. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
  - 4. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Shot blast existing concrete floors to remove existing adhesives.
- B. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

- C. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

### 3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.
- C. Lay tile in patterns indicated. When field conditions conflict with indicated pattern, notify Architect in writing prior to installation for review and approval of revisions.
- D. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- E. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile. Top setting of coved base is not permitted.
- F. Tile shall lay flat and each edge flush with adjacent tile, free of tilting and skewed tile. Provide additional setting material to shim accent tiles that are thinner than field tiles so face is in same plane.
- G. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
  - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
- H. Lay out tile wainscots to next full tile beyond dimensions indicated.
- I. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
  - 1. Locate expansion joints in accordance with approved Shop Drawings.
  - 2. Space joints no greater than 36 feet apart, 16 feet apart at areas exposed to direct sunlight.
  - 3. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

- J. Grout tile to comply with requirements of the following tile installation standards:
  - 1. For ceramic tile grouts (latex-portland cement grouts), comply with ANSI A108.10.

### 3.4 CRACK-SUPPRESSION MEMBRANE INSTALLATION

- A. Install crack-suppression membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.
  - 1. Seal perimeter of room by running crack-suppression membrane up wall 2 inches minimum and onto floor 4 inches minimum.

### 3.5 FLOOR TILE INSTALLATION

- A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.
  - 1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
    - a. Tile floors composed of tiles 8 by 8 inches or larger.
- B. Joint Widths: Install tile on floors with the following joint widths:
  - 1. Quarry Tile: **3/8 inch.**
  - 2. Floor Tile (Porcelain Tile): 1/8 inch.

### 3.6 CLEANING AND PROTECTING

- A. Remove and replace material that is stained or otherwise damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
  - 1. Remove latex-portland cement grout residue from tile as soon as possible.
  - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
- C. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- E. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

### 3.7 TILE INSTALLATION SCHEDULE

- A. Paver Tile (Porcelain Tile) Floor Tile over Concrete Floor: Thin-set latex portland cement mortar tile setting bed over anti-fracture membrane applied to saw cuts and random cracks; epoxy gout; TCA F125.
  - 1. At toilet and shower areas, seal perimeter of room by running anti-fracture membrane up wall 2 inches minimum and onto floor 2 inches minimum.
- B. Porcelain Wall Tile on Moisture- and Mold-Resistant Gypsum Wallboard: Latex portland cement mortar tile setting bed with epoxy grout, TCA W243.
- C. Porcelain Wall Tile on Glass-Mat, Water Resistant Backer Board: Latex portland cement mortar tile setting bed with epoxy grout, TCA W245.

END OF SECTION 093100

**This Page Intentionally Left Blank**



## SECTION 099000 - PAINTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  1. Exposed exterior items and surfaces with low VOC coatings complying with ME DEP regulations.
  2. Exposed interior items and surfaces with low VOC coatings complying with ME DEP regulations.
  3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Related Sections include the following:
  1. Division 06 Section "Finish Carpentry" for surface preparation of exterior standing and running trim, siding, and finish carpentry.
  2. Division 06 "Architectural Woodwork" for millwork and other millwork.
  3. Division 08 Section "Steel Doors and Frames" for factory priming steel doors and frames.
  4. Division 09 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.
  5. Review all sections for shop primed items requiring field painting.

#### 1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
  1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
  2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
  3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
  4. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
  5. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

#### 1.4 SUBMITTALS

- A. General: Submit in accordance with Division 01 Section "Submittal Procedures."
- B. Product Data: For each paint system indicated, including block fillers and primers.
  1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.

2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
3. Include printed statement of VOC content for each product.

C. Schedule: Provide schedule of all surfaces to be coated, with prime and finish coat material listed, and manufacturer's recommended wet film thickness.

#### 1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain primers and undercoat materials for each coating system from the same manufacturer as the finish coats.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of **45 deg F**. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly.
2. Remove oily rags and waste daily.
3. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

#### 1.7 PROJECT CONDITIONS

A. Apply paints only when temperatures of surfaces to be painted and surrounding air are between **45 and 95 deg F**.

B. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than **5 deg F** above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
2. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.

#### 1.8 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials unopened, factory sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner at project completion.

1. Quantity: Furnish the Owner with an additional 5 percent, but not less than 1 gallons (3.785 Liters) or 1 case, as appropriate, of each material, color, and gloss applied.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  1. Benjamin Moore & Company (Moore).
  2. ICI Dulux Paints (ICI).
  3. California Paint Co. (CAL)
  4. Sherwin-Williams Co. (S-W).
  5. Tnemec Company, Inc. (Tnemec).

### 2.2 COATINGS MATERIALS, GENERAL

- A. Material Compatibility: Provide primers, undercoats, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best quality coating material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
  1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers listed in the specification schedule. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
  2. Where schedule says no substitution, use proprietary product only. Do not propose substitution, as the products from the other manufacturers have been considered, and are not acceptable.
- C. VOC Compliance for Exterior and Interior Paints and Coatings: Provide the manufacturer's formulation for the products specified below that are VOC compliant with the State of Maine Department of Environmental Protection Regulation, "Chapter 151: Architectural and Industrial Maintenance (AIM) Coatings" and the following chemical restrictions expressed in grams per liter:
  1. Flat Paints and Coatings: VOC content of not more than 100 g/L.
  2. Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.
  3. Anticorrosive (Rust Preventative) Coatings: VOC content of not more than 400 g/L.
  4. Clear Wood Coatings:
    - a. Clear Brushing Lacquers: VOC content of not more than 680 g/L.
  5. Fire Retardant Coatings:
    - a. Opaque: VOC content of not more than 350 g/L.
  6. Industrial Maintenance Coatings (IMC): VOC content of not more than 340 g/L.
  7. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
  8. Quick-Dry Enamels: VOC content of not more than 250 g/L.
  9. Quick-Dry Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
  10. Specialty Primers, Sealers, and Undercoaters: VOC content of not more than 350 g/L.

11. Stains: VOC content of not more than 250 g/L.

D. Colors: Provide color selections made by the Architect.

E. EXECUTION

### 2.3 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator and drywall subcontractor present, under which painting will be performed for compliance with paint application requirements.

1. Inspect walls for dents and imperfections prior to painting. Inspect walls again after primer and first coat of paint applied, with Applicator, drywall subcontractor, and plaster subcontractor present. Drywall subcontractors shall touch-up their respective work as follows:
  - a. Touch-up visible plaster and gypsum board imperfections before priming of walls.
  - b. Touch-up imperfections found in field of gypsum plaster and gypsum boards and joints made visible from painting after first finish coat applied.
2. If unacceptable conditions are encountered, prepare written report, endorsed by Applicator, listing conditions detrimental to performance of work.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
4. Application of coating indicates Applicator's acceptance of surfaces and conditions within a particular area.
5. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of specified finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

### 2.4 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

- a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
  - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood.
  - c. If transparent finish is required, backprime with spar varnish.
  - 3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
    - a. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
    - b. Touch up bare areas and shop-applied prime coats that have been damaged. Clean with solvents recommended by paint manufacturer and SSPC SP2; and touch up with same primer as the shop coat.
  - 4. Galvanized Surfaces: Uniformly abrade galvanized surfaces with a palm sander and 60 grit aluminum oxide so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
    - a. Clean field welds with nonpetroleum-based solvents complying with SSPC's standards so surface is free of oil and surface contaminants.
  - 5. Existing Wood Surfaces: Scrape loose paint from surfaces indicated to be recoated. Sand edges of remaining paint to smooth out surface. Prior to sanding, test existing coatings for lead. If lead paint is found, notify Architect in writing for direction on how to proceed. Prime bare surfaces prior to recoating.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
- 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
  - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
  - 3. Use only thinners approved by paint manufacturer and only within recommended limits.

## 2.5 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
  - 1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
  - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
  - 3. Provide finish coats that are compatible with primers used.
  - 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
  - 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
  7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
  8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
  9. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
  2. Omit primer over metal surfaces that have been shop primed and touchup painted.
  3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
  4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Paint all exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
1. Painting includes field painting of exposed bare and covered pipes and ducts (including color-coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment at all locations except mechanical and electrical rooms.
- D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
1. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- E. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions. Walls shall have roller finish.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
  2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
- F. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

- G. Mechanical and Electrical Work: Painting of mechanical, plumbing, fire protection, and electrical work is limited to items exposed in occupied spaces (outside mechanical and electrical rooms).
- H. Mechanical, plumbing, and fire protection, items to be painted include, but are not limited to, the following:
  - 1. Piping, pipe hangers and supports.
  - 2. Ductwork, including interior of ductwork visible through air devices.
  - 3. Accessory items.
- I. Electrical items to be painted include, but are not limited to, the following:
  - 1. Conduit and fittings.
  - 2. Panelboards.
- J. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- K. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- L. Transparent (Clear or Stained) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
  - 1. Provide satin finish for final coats, unless otherwise noted.
- M. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- N. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- O. Exterior Ferrous Metal Items to Be Painted Include, but Are Not Limited To, the Following (New and Existing):
  - 1. Exposed structural steel and lintel plates.
    - a. Galvanized single angle lintels do not require painting.
  - 2. Steel doors and frames.
  - 3. Steel pipe railings.
  - 4. Metal Fabrications. See Section 05500.
  - 5. Factory primed louvers.
  - 6. Miscellaneous metal items, including galvanized steel.
- P. Interior Ferrous Metal Items to Be Painted Include, but Are Not Limited To, the Following:
  - 1. Steel doors and frames.
  - 2. Handrails and guardrails.
  - 3. Access panels (both sides).
  - 4. Metal fabrications. See Section 05500.
  - 5. Miscellaneous metal items.

## 2.6 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the Project site.
  - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

## 2.7 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
  - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

## 2.8 EXTERIOR PAINT SCHEDULE

- A. VOC Compliance, General: Provide the manufacturers' formulations for the products specified below that comply with the VOC requirements for the State of Maine Department of Environmental Protection in paragraph 2.2.C2.02.C of this Section.
- B. Wood Siding and Trim, Opaque Finish: Provide the following finish systems over smooth wood siding and other smooth, exterior wood surfaces:
  - 1. Flat Acrylic Finish: 2 finish coats over a primer.
    - a. Primer: Exterior, alkyd or latex, wood primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      - 1) Moore: Moorcraft Super Spec Alkyd Exterior Primer No. 176; 1.8 mils DFT.
      - 2) ICI: 2000-1200 Dulux Professional Exterior 100% Acrylic Latex Primer; 1.6 mils DFT.
      - 3) S-W: A-100 Exterior Latex Wood Primer B42W41; 1.4 mils DFT.
    - b. First and Second Coats: Flat, exterior, acrylic-emulsion paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      - 1) Moore: Moorcraft Super Spec Flat Latex House Paint No. 171; 2.4 mils DFT.
      - 2) ICI: 2200-XXXX Dulux Professional Exterior 100 Percent Acrylic Flat Finish; 2.6 mils DFT.
      - 3) S-W: SuperPaint Exterior Latex Flat A80 Series; 2.8 mils DFT.
  - 2. Low-Luster Acrylic Finish: 2 finish coats over a primer.
    - a. Primer (New and Bare Spots of Existing): Exterior, alkyd or latex, wood primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      - 1) Moore: Moorcraft Super Spec LatexAlkyd Exterior Primer No. 169176; 1.41.8 mils DFT.



- 2) ICI: 2000-1200 Dulux Professional Exterior 100% Acrylic Latex Primer; 1.6 mils DFT.
- 3) S-W: A-100 Exterior Latex Wood Primer B42W8041; 1.4 mils DFT.
- b. First and Second Coats: Low-sheen (eggshell or satin), exterior, latex paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
  - 1) Moore: Moorcraft Super Spec 100% Acrylic Latex Low Lustre Latex House Paint No. N185; 3.02.0 mils DFT.
  - 2) ICI: 2402-XXXX Dulux Professional Exterior 100% Acrylic Satin Finish; 2.8 mils DFT.
  - 3) S-W: SuperPaint Exterior Latex Satin A89-100 Series; 3.0 mils DFT.
3. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
  - a. Primer: Exterior, alkyd or latex, wood primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: Moorcraft Super Spec Alkyd Exterior Primer No. 176; 1.8 mils DFT.
    - 2) ICI: 2000-1200 Dulux Professional Exterior 100% Acrylic Latex Primer; 1.6 mils DFT.
    - 3) S-W: A-100 Exterior Latex Wood Primer B42W41; 1.4 mils DFT.
  - b. First and Second Coats: Semigloss, waterborne, exterior, acrylic enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: Moorcraft Super Spec Latex House & Trim Paint No. 170; 2.2 mils DFT.
    - 2) ICI: 4206-XXXX, Interior/Exterior Waterborne Acrylic Semi-Gloss Enamel; 3.0 mils DFT.
    - 3) S-W: SuperPaint Exterior Gloss Latex A84 Series; 3.0 mils DFT.
4. Full-Gloss, Acrylic-Enamel Finish: 2 finish coats over a primer.
  - a. Primer: Exterior, alkyd or latex, wood primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: Moorcraft Super Spec Alkyd Exterior Primer No. 176; 1.8 mils DFT.
    - 2) ICI: 2000-1200 Dulux Professional Exterior 100% Acrylic Latex Primer; 1.6 mils DFT.
    - 3) S-W: A-100 Exterior Latex Wood Primer B42W41; 1.4 mils DFT.
  - b. First and Second Coats: Full-gloss, waterborne, exterior, acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: Moore's IMC Acrylic Gloss Enamel M28; 4.0 mils DFT.
    - 2) ICI: Deflex 4218-XXXX, Direct-To-Metal Exterior Waterborne Enamel 2.0 mils DFT.
    - 3) S-W: DTM Acrylic Coating Gloss (Waterborne) B66W100 Series; 5.0 mils DFT.

C. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.

1. Flat/Low-Luster, Alkyd-Enamel Finish: 2 finish coats over a rust-inhibitive primer.

- a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
  - 1) Moore: IronClad Alkyd Low Lustre Metal & Wood Enamel C163; 1.5 mils DFT.
  - 2) S-W: Kem Kromik Universal Metal Primer B50WZ1; 3.0 mils DFT.
- b. First and Second Coats: Flat, exterior, alkyd enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
  - 1) Moore: Moore's Eggshell Finish House Paint C108; 2.8 mils DFT.
  - 2) S-W: ProMar Alkyd Flat Exterior Finish B-38 Series; 4.0 mils DFT.
2. Low-Luster Acrylic Finish: 2 finish coats over a rust-inhibitive primer.
  - a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: Moore's IMC M04 Acrylic Metal Primer; 2.0 mils DFT.
    - 2) ICI: Devflex 4020-1000, DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.2 DFT.
    - 3) S-W: Kem Kromik Universal Metal Primer B50WZ1; 3.0 DFT.
    - 4) Tnemec: Tnemec Primer, Series 10; 2.0 mils DFT.
  - b. First and Second Coat: Low-sheen (eggshell or satin), exterior, acrylic-latex paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: Moorcraft Super Spec Low Lustre Latex House Paint No. 185; 2.0 mils DFT.
    - 2) ICI: 2402-XXXX Dulux Professional Exterior 100 Percent Acrylic Satin Finish; 2.8 mils DFT.
    - 3) S-W: A-100 Exterior Latex Satin House & Trim Paint A82 Series; 3.0 mils DFT.
    - 4) Tnemec: Tneme-Cryl, Series 6; 4.0 mils DFT.
3. Semigloss, Acrylic-Enamel Finish: 2 IMC finish coats over a corrosion resistant rust-inhibitive primer.
  - a. Primer: Quick-drying, corrosion resistant, Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: IMC MP04 Acrylic Metal Primer; 2.0 mils DFT.
    - 2) ICI: IMC 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.5 mils DFT.
    - 3) S-W: IMC DTM Acrylic Primer/Finish/ B66W1; 2.5 mils DFT.
    - 4) Tnemec: Tnemec Primer, Series 10; 2.0 mils DFT.
  - b. First and Second Coats: Semigloss, exterior, IMC acrylic-latex enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: IMC DTM MP29 Acrylic Semigloss; 4.0 mils DFT.
    - 2) ICI: IMC 4216-XXXXV, High Performance Waterborne Acrylic Semi-Gloss Enamel; 8.0 mils DFT 4206-XXXX, Interior/Exterior Acrylic Semi-Gloss Enamel; 3.0 mils DFT.
    - 3) S-W: IMC DTM Acrylic Coating Semi-Gloss (Waterborne) B66W200 Series; 7.05.0 mils DFT.
    - 4) Tnemec: Tneme-Cryl SG, Series 7; 4.0 mils DFT.
4. Full-Gloss, Alkyd-Enamel Finish: 2 finish coats over a rust-inhibitive primer.

- a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: Moore's IMC Alkyd Metal Primer No. M06; 2.0 mils DFT.
    - 2) ICI: 4160-XXXX Devguard Multi-Purpose Tank & Structural Primer (2.0 mils DFT).
    - 3) S-W: Kem Kromik Universal Metal Primer B50WZ1; 3.0 mils DFT.
  - b. First and Second Coats: Full-gloss, exterior, alkyd enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: Moore's IMC Urethane Alkyd Enamel M22; 4.0 mils DFT.
    - 2) ICI: 4308-XXXX Devguard Alkyd Industrial Gloss Enamel; 4.0 mils DFT.
    - 3) S-W: Industrial Enamel B-54 Series; 4.0 mils DFT.
5. Full-Gloss, Acrylic-Enamel Finish: 2 finish coats over a rust-inhibitive primer.
- a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: Moore's IMC M04 Acrylic Metal Primer; 2.0 mils DFT.
    - 2) ICI: 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.2 mils DFT.
    - 3) S-W: DTM Acrylic Primer/Finish/B66W1; 2.5 mils DFT.
  - b. First and Second Coats: Full-gloss, waterborne, acrylic enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated.
    - 1) Moore: Moore's IMC DTM Acrylic Gloss Enamel M28; 4.0 mils DFT.
    - 2) ICI: 4218-XXXX, Deflex Direct-To-Metal Exterior Waterborne Enamel; 3.0 mils DFT.
    - 3) S-W: DTM Acrylic Coating Gloss (Waterborne) B66W100 Series; 5.0 mils DFT.

## 2.9 INTERIOR COATINGS

- A. VOC Compliance, General: Provide the manufacturers' formulations for the products specified below that comply with the VOC requirements in paragraph 2.2.C of this Section.
- B. Gypsum Board & Plaster: Provide the following finish systems over interior gypsum board surfaces:
  - 1. Flat Acrylic Finish, GPDW Ceilings: 2 finish coats over a primer.
    - a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      - 1) Moore: Ben Premium Interior Latex Primer No. W624; 1.1 mils DFT.
      - 2) ICI: 1000-1200, Prep & Prime Hi-Hide Wall Interior Water-Based Primer Sealer; 1.9 mils DFT.
      - 3) S-W: ProGreen 200 Low VOC Interior Latex Primer B28W600 Series; 1.5 mils DFT.
    - b. First and Second Coats: Flat, acrylic-latex-based, interior paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      - 1) Moore: Ben Acrylic Latex Flat No. W625; 2.4 mils DFT.

- 2) ICI: 1210-XXXX, Ultrahide Interior Flat Latex Wall & Trim Finish; 2.8 mils DFT.
  - 3) S-W: ProGreen 200 Low VOC Interior Latex Primer B28W600 Series; 1.5 mils DFT.
2. Low-Luster (Eggshell), Acrylic-Enamel Finish, Walls: 2 finish coats over a primer.
- a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: Ben Premium Interior Latex Primer No. W624; 1.1 mils DFT.
    - 2) ICI: 1000-1200, Prep & Prime Hi-Hide Wall Interior Water-Based Primer Sealer; 1.9 mils DFT.
    - 3) S-W: ProGreen 200 Low VOC Interior Latex Primer B28W600 Series; 1.5 mils DFT.
  - b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: Ben Interior Acrylic Latex Eggshell No. W626; 2.6 mils DFT.
    - 2) ICI: 1210-XXXXV, Ultrahide Latex Flat Interior Wall Paint; 2.8 mils DFT.
    - 3) S-W: ProGreen 200 Low VOC Interior Latex Eg-Shel B20-600 Series; 3.4 mils DFT.
- C. Natural-Finish Woodwork: Provide the following natural finishes over new, interior woodwork:
- 1. Waterborne, Satin-Polyurethane Finish: 3 finish coats of a waterborne, clear-satin varnish.
    - a. First, Second and Third Finish Coats: Waterborne, varnish finish applied at spreading rate recommended by the manufacturer.
      - 1) Moore: Benwood Stays Clear Acrylic Polyurethane No. 423.
      - 2) S-W: Minwax Polycrylic.
- D. Woodwork, Opaque Finish: Provide the following paint finish systems over new, interior wood surfaces:
- 1. Semigloss, Acrylic-Enamel Finish (Opaque Trim): 2 finish coats over a wood undercoater.
    - a. Primer: Stain-blocking, acrylic-latex-based, interior wood undercoater, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      - 1) Moore: Fresh Start All Purpose 100% Acrylic Primer No. 023; 1.1 mils DFT.
      - 2) ICI: 3210 Prep & Prime Gripper Multi-Purpose Acrylic Latex Primer; 1.5 mils DFT.
      - 3) S-W: ProGreen 200 Low VOC Interior Latex Primer B28W600 Series; 1.5 mils DFT.
    - b. First and Second Coats: Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
      - 1) Moore: Ben Interior Acrylic Latex Semi-Glass No. W627; 2.1 mils DFT.
      - 2) ICI: 1416-XXXXN Ultrahide Semi-Gloss Interior Wall & Trim Enamel; 3.0 mils DFT.

- 3) S-W: ProGreen 200 Low VOC Interior Latex Semi-Gloss Enamel B31-600 Series; 3.2 mils DFT.

E. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Semigloss, Acrylic-Enamel Finish: 2 IMC finish coats over a primer.
  - a. Primer: Quick-drying, corrosion resistant, acrylic primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: IMC Super Spec HP Acrylic Metal Primer P04; 2.0 mils DFT.
    - 2) ICI: IMC 4020-XXXX Devflex DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.2 mils DFT.
    - 3) S-W: IMC DTM Acrylic Primer/Finish, B66W1; 3.0 mils DFT.
  - b. First and Second Coats: IMC Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: IMC DTM Acrylic Semi-Gloss P29; 5.0 mils DFT.
    - 2) ICI: IMC 4216-XXXXV High Performance Waterborne Acrylic Semi-Gloss Enamel; 8.0 mils DFT .
    - 3) S-W: IMC DTM Acrylic Coating Semi-Gloss (Waterborne) B66W200 Series; 7.0 mils DFT.

F. Zinc-Coated Metal: Provide the following finish systems over zinc-coated metal:

1. Semigloss, Acrylic-Enamel Finish: 2 IMC finish coats over a primer.
  - a. Primer: Quick-drying, corrosion resistant, acrylic primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: IMC Super Spec HP Acrylic Metal Primer M04; 2.0 mils DFT.
    - 2) ICI: IMC 4020-XXXX DTM Flat Interior/Exterior Waterborne Primer & Finish; 2.2 mils DFT.
    - 3) S-W: IMC DTM Acrylic Primer/Finish, B66W1; 3.0 mils DFT.
  - b. First and Second Coats: IMC Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: IMC DTM Acrylic Semigloss P29; 5.0 mils DFT.
    - 2) ICI: IMC 4216-XXXXV High Performance Waterborne Acrylic Semi-Gloss Enamel 8.0 mils DFT.
    - 3) S-W: IMC DTM Acrylic Coating Semi-Gloss (Waterborne) B66W200 Series; 7.0 mils DFT.

G. Telecommunication and Electrical Backboards: Provide the following finish over plywood:

1. Flat Intumescent Finish: Two finish coats over a primer.
  - a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than indicated for product.
    - 1) Moore: Fresh Start All-Purpose 100% Acrylic Primer No. 023; 1.1 mils DFT.
    - 2) SW: ProGreen 200 Low VOC Interior Latex Primer B28W600 Series; 1.5 mils DFT

- b. First and Second Coats: Intumescent-type, fire-retardant paint applied at spreading rate recommended by manufacturer to achieve a total dry film thickness of not less than 4 mils; white color for telecommunication and black for electrical.
  - 1) Moore: M59 220 Latex Fire-Retardant Coating.
  - 2) FlameControl: 20-20A Flat Latex Intumescent Coating.

END OF SECTION 099000

## SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Public-use washroom accessories.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated.
  - 2. Identify products using designations indicated.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### 1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 15years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PUBLIC-USE WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. A & J Washroom Accessories, Inc.
  - 2. American Specialties, Inc.
  - 3. Bobrick Washroom Equipment, Inc.
  - 4. Bradley Corporation.
  - 5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
  - 6. Tubular Specialties Manufacturing, Inc.
- C. Grab Bar
  - 1. Basis-of-Design Product: <Bobrick 5800 Series >.
  - 2. Mounting: Flanges with concealed fasteners.
  - 3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
    - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area. Oiled Bronze color.
  - 4. Outside Diameter: 1-1/2 inches (38 mm).
  - 5. Configuration and Length: As indicated on Drawings.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

END OF SECTION 102800



## SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. The commercial areas of the building shall be protected by a wet pipe fire suppression system. The basement, first and second floors will be protected. The third and fourth floor living areas will not be protected.
- B. The fire protection system shall be installed in accordance with the 2010 edition of NFPA.
- C. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Sleeves.
  - 3. Escutcheons.
  - 4. Equipment installation requirements common to equipment sections.

#### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- D. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Mechanical sleeve seals.
  - 2. Escutcheons.
- B. Welding certificates.

## 1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.3 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

#### 2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Available Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Carbon steel . Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant of length required to secure pressure plates to sealing elements. Include one for each sealing element.

#### 2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. PVC Pipe: ASTM D 1785, Schedule 40.
- D. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

#### 2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated or white painted in finished spaces.
- D. One-Piece, Floor-Plate Type: Cast-iron floor plate.

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - c. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - d. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - e. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- K. Sleeves are not required for core-drilled holes.
- L. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.

- a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches (50 mm)** above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide **1/4 inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than **NPS 6 (DN 150)**.
    - b. Steel Sheet Sleeves: For pipes **NPS 6 (DN 150)** and larger, penetrating gypsum-board partitions.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- N. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for **1 inch (25-mm)** annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Joint Sealants" for materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.2 PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
  - B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  - C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  - D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

END OF SECTION 210500

## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  1. Pipes, fittings, and specialties.
  2. Fire-protection zone riser.
  3. Sprinklers.
  4. Exterior service piping to the service shut-off valve in the sidewalk.
  5. Hydrant Flow Test.
  6. Fire Department Connection.

#### 1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

#### 1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat destroys frangible (glass bulb) device. Hose connections are included if indicated.
- B. The sprinkler system shall be mounted as high as possible in the protected spaces.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
  1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventer.
  2. Sprinkler Occupancy Hazard Classifications:
    - a. Mechanical/Electrical Spaces: Ordinary Hazard, Group 2.
    - b. Public Areas: Light Hazard.
  3. Minimum Density for Automatic-Sprinkler Piping Design:

- a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m.)
- b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
- c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. (8.1 mm/min. over 139-sq. m) area.
- 4. Maximum Protection Area per Sprinkler:
  - a. Public Areas: 225 sq. ft. (20.9 sq. m.)
  - b. Storage Areas: 130 sq. ft. (12.1 sq. m.)
  - c. Mechanical/Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m.)
  - d. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- 5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
  - a. Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes

## 1.6 SUBMITTALS

- A. Product Data: For each type of product indicated
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
- C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- D. Fire-hydrant flow test report.
- E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.



- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."

## 1.8 PROJECT CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of sprinkler service.
  - 2. Do not proceed with interruption of sprinkler service without Owner's written permission.

## 1.9 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

## 1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

### 2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Pipe ends may be factory or field formed to match joining method.
- B. Thinwall Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- C. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.
- D. Cast-Iron Flanges: ASME 16.1, Class 125.

- E. Grooved-Joint, Steel-Pipe Appurtenances:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Victaulic Company.
  - 2. Pressure Rating: 175 psig (1200 kPa minimum).
  - 3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

### 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free.
  - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

### 2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
  - 1. Valves shall be UL listed or FM approved.
  - 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).
- B. Ball Valves:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
    - a. Victaulic Company.
  - 3. Standard: UL 1091 except with ball instead of disc.
  - 4. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
  - 5. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
  - 6. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.
- C. Check Valves:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
    - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    - b. Anvil International, Inc.
    - c. Crane Co.; Crane Valve Group; Crane Valves.
    - d. Crane Co.; Crane Valve Group; Jenkins Valves.
    - e. Crane Co.; Crane Valve Group; Stockham Division.
    - f. Globe Fire Sprinkler Corporation.
    - g. Kennedy Valve; a division of McWane, Inc.
    - h. Metraflex, Inc.

- i. Milwaukee Valve Company.
  - j. Mueller Co.; Water Products Division.
  - k. NIBCO INC.
  - l. Potter Roemer.
  - m. Reliable Automatic Sprinkler Co., Inc.
  - n. Tyco Fire & Building Products LP.
  - o. United Brass Works, Inc.
  - p. Victaulic Company.
  - q. Viking Corporation.
  - r. Watts Water Technologies, Inc.
- 3. Standard: UL 312.
  - 4. Pressure Rating: 250 psig (1725 kPa) minimum 300 psig (2070 kPa).
  - 5. Type: Swing check.
  - 6. Body Material: Cast iron.
  - 7. End Connections: Flanged or grooved.

D. Iron OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
  - a. American Valve, Inc.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Division.
  - e. Hammond Valve.
  - f. Milwaukee Valve Company.
  - g. Mueller Co.; Water Products Division.
  - h. NIBCO INC.
  - i. Tyco Fire & Building Products LP.
  - j. United Brass Works, Inc.
  - k. Watts Water Technologies, Inc.
- 3. Standard: UL 262.
- 4. Pressure Rating: 250 psig (1725 kPa) minimum
- 5. Body Material: Cast or ductile iron.
- 6. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
  - a. Anvil International, Inc.
  - b. Global Safety Products, Inc.
  - c. Kennedy Valve; a division of McWane, Inc.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Tyco Fire & Building Products LP.
  - g. Victaulic Company.

3. Standard: UL 1091.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Valves NPS 2 (DN 50) and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded.
6. Valves NPS 2-1/2 (DN 65) and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. End Connections: Flanged, grooved, or wafer.
7. Valve Operation: Integral indicating device.

## 2.5 TRIM AND DRAIN VALVES

- A. General Requirements:
  1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  2. Pressure Rating: 175 psig (1200 kPa) minimum.
- B. Angle Valves:
  1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Fire Protection Products, Inc.
    - b. United Brass Works, Inc.
- C. Ball Valves:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Anvil International, Inc.
    - b. Conbraco Industries, Inc.; Apollo Valves.
    - c. Fire Protection Products, Inc.
    - d. Kennedy Valve; a division of McWane, Inc.
    - e. Kitz Corporation.
    - f. Milwaukee Valve Company.
    - g. NIBCO INC.
    - h. Tyco Fire & Building Products LP.
    - i. Victaulic Company.
    - j. Watts Water Technologies, Inc.

## 2.6 SPECIALTY VALVES

- A. General Requirements:
  1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  2. Body Material: Cast or ductile iron.
  3. Size: Same as connected piping.
  4. End Connections: Flanged or grooved.
- B. Riser Zone Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
  - a. Globe Fire Sprinkler Corporation.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
3. Standard: UL 193.
4. Design: For horizontal or vertical installation.
5. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages and fill-line attachment with strainer.
6. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
7. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product name or designation or comparable product by one of the following:
  - a. AFAC Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
3. Standard: UL 1726.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Type: Automatic draining, ball check.
6. Size: NPS 3/4 (DN 20).
7. End Connections: Threaded. F

## 2.7 FIRE-DEPARTMENT CONNECTION

A. Exposed-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. Fire-End & Croker Corporation.
  - d. Fire Protection Products, Inc.
  - e. GMR International Equipment Corporation.
  - f. Guardian Fire Equipment, Inc.
  - g. Tyco Fire & Building Products LP.
  - h. Wilson & Cousins Inc.
2. Standard: UL 405.
3. Type: Storz, Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: One.
11. Escutcheon Plate Marking: Similar to "AUTO SPKR."
12. Finish: Aluminum.
13. Outlet Size: NPS 4 (DN 100).
14. Standard: UL 1474.
15. Pressure Rating: 175 psig (1200 kPa) minimum.

## 2.8 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Reliable Automatic Sprinkler Co., Inc.
  2. Tyco Fire & Building Products LP.
  3. Victaulic Company.
  4. Viking Corporation.
- B. General Requirements:
  1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  2. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
  1. Early-Suppression, Fast-Response Applications: UL 1767.
  2. Nonresidential Applications: UL 199.
  3. Residential Applications: UL 1626.
  4. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes:
  1. Finished Ceilings: Concealed white plate.
  2. Unfinished Spaces: Bronze upright or pendant.
  3. Finished spaces without ceilings: Bronze exposed upright or pendant type.
- E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed sprinklers are specified with sprinklers.
  1. Ceiling Mounting: White painted steel, two piece, concealed with vertical adjustment.
  2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Reliable Automatic Sprinkler Co., Inc.
    - b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
    - d. Viking Corporation.
  3. Standard: UL 199.

## 2.9 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Flow Indicators:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Potter Electric Signal Company.
  - 2. Standard: UL 346.
  - 3. Water-Flow Detector: Electrically supervised.
  - 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
  - 5. Type: Paddle operated.
  - 6. Pressure Rating: 250 psig (1725 kPa).
  - 7. Design Installation: Horizontal or vertical.
- C. Valve Supervisory Switches:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Potter Electric Signal Company.
  - 2. Standard: UL 346.
  - 3. Type: Electrically supervised.
  - 4. Components: Single-pole, double-throw switch with normally closed contacts.
  - 5. Design: Signals that controlled valve is in other than fully open position.

## 2.10 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AMETEK; U.S. Gauge Division.
  - 2. Ashcroft, Inc.
  - 3. Brecco Corporation.
  - 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.
- D. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum.
- E. Water System Piping Gage: Include "WATER" label on dial face.

## 2.11 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

- B. One-Piece, Stamped Steel or Plastic Split Escutcheons: Polished chrome-plated or white painted finish.

## 2.12 SLEEVES

- A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. PVC sleeves in first two paragraphs below may be prohibited by fire authorities having jurisdiction.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
  - 1. Underdeck Clamp: Clamping ring with set-screws.

## 2.13 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Metraflex, Inc.
  - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Stainless steel.
  - 3. Connecting Bolts and Nuts: steel of length required to secure pressure plates to sealing elements.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

### 3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to the existing water-service entrance to the building. Comply with requirements for exterior piping in Division 21 Section.
- B. Install a shutoff valve, double check valve backflow preventer, pressure gage, drain, and other accessories indicated at the connection to the existing water-service riser and piping. Comply with requirements for backflow preventers.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.



### 3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install alarm devices in piping systems.
- J. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- K. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- L. Fill sprinkler system piping with water.

### 3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

### 3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
  - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
  - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

### 3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in the center of acoustical ceiling panels.
- B. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

### 3.7 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
  - 1. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated or white painted finish.

2. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated or white painted finish.
3. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
4. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

### 3.8 SLEEVE INSTALLATION

- A. General Requirements: Sleeves are not required for sprinkler piping.
- B. For interior wall penetrations, seal annular space between wall and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- C. For exterior wall penetrations above grade, seal annular space between wall and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Through Penetration Firestop Systems."

### 3.9 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.10 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26.

### 3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

### 3.12 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

### 3.13 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain the system.

### 3.14 PIPING SCHEDULE

A. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight black-steel pipe with cutgrooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

B. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) shall be one of the following:

1. Standard-weight, black-steel pipe with cutgrooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

C. Standard-pressure, wet-pipe sprinkler system, NPS 5 (DN 125) and larger, shall be one of the following:

1. Standard-weight black-steel pipe with cutgrooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

### 3.15 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Bronze finish upright or pendant sprinklers
2. Hard ceilings (gypsum) and soffits: Concealed plate type sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Exposed upright pendant Sprinklers: Rough bronze.

END OF SECTION 211313

**This Page Intentionally Left Blank**

## SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  1. Piping materials and installation instructions common to most piping systems.
  2. Transition fittings.
  3. Dielectric fittings.
  4. Mechanical sleeve seals.
  5. Sleeves.
  6. Escutcheons.
  7. Equipment installation requirements common to equipment sections.
  8. Painting and finishing.
  9. Supports and anchorages.

#### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  1. ABS: Acrylonitrile-butadiene-styrene plastic.
  2. CPVC: Chlorinated polyvinyl chloride plastic.
  3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
  1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Mechanical sleeve seals.
  - 3. Escutcheons.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### 1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

#### 1.7 PERMITS

- A. Obtain Plumbing Permit and pay fee.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

#### 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

#### 2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.



- C. Solvent Cements for Joining Plastic Piping:
  1. CPVC Piping: ASTM F 493.
  2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  3. ABS Piping: ASTM D 2235.
- D. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## 2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser Industries, Inc.; DMD Div.
    - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    - d. JCM Industries.
    - e. Smith-Blair, Inc.
    - f. Viking Johnson.
  2. Underground Piping **NPS 2 (DN 50)** and Larger: AWWA C219, metal sleeve-type coupling.
  3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  1. Manufacturers:
    - a. Eslon Thermoplastics.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  1. Manufacturers:
    - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
  1. Manufacturers:
    - a. NIBCO INC.
    - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
  1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Fernco, Inc.
    - c. Mission Rubber Company.
    - d. Plastic Oddities, Inc.

## 2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. PVC Pipe: ASTM D 1785, Schedule 40.

## 2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to within 18" of the ceiling to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.

- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
- M. Sleeves are not required for core-drilled holes.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches (50 mm)** above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than **NPS 6 (DN 150)**.
    - b. Steel Sheet Sleeves: For pipes **NPS 6 (DN 150)** and larger, penetrating gypsum-board partitions.
      - 1) Seal space outside of sleeve fittings with grout.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Joint Sealants" for materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Nonpressure Piping: Join according to ASTM D 2855.
  - 3. ABS Non-Pressure Piping: ASTM D 2235.

### 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment.

### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

END OF SECTION 220500

## SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Thermometers.
  - 2. Gages.
- B. Related Sections:
  - 1. Division 22 Section "Domestic Water Piping".

#### 1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.

### PART 2 - PRODUCTS

#### 2.1 BIMETALLIC-ACTUATED DIAL THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Terrice H.O. Co. or comparable product by one of the following:
  - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
  - 2. Palmer - Wahl Instruments Inc.
  - 3. Terrice, H. O. Co.
  - 4. Weiss Instruments, Inc.
  - 5. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- C. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.
- D. Case: Dry type, stainless steel with 5-inch (127-mm) diameter.
- E. Element: Bimetal coil.

- F. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- G. Pointer: Red or other dark-color metal.
- H. Window: Glass .
- I. Ring: Metal, Brass or Stainless steel.
- J. Connector: Adjustable angle type.
- K. Stem: Metal, for thermowell installation and of length to suit installation.
- L. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

## 2.2 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Trerice H.O. Co. product indicated on Drawings or comparable product by one of the following:
  1. AMETEK, Inc.; U.S. Gauge Div.
  2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
  3. Palmer - Wahl Instruments Inc.
  4. Trerice, H. O. Co.
  5. Weiss Instruments, Inc.
  6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- C. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
  1. Case: Dry type, drawn steel or cast aluminum , 4-1/2-inch (114-mm) diameter.
  2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
  3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
  4. Movement: Mechanical, with link to pressure element and connection to pointer.
  5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
  6. Pointer: Red or other dark-color metal.
  7. Window: Glass or plastic .
  8. Ring: Metal, Brass or Stainless steel.
  9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
  10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
  11. Range for Fluids under Pressure: Two times operating pressure.
- D. Pressure-Gage Fittings:
  1. Valves: NPS 1/4 (DN 8) brass or stainless-steel needle type.
  2. Snubbers: ASME B40.5, NPS 1/4 (DN 8) brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

## PART 3 - EXECUTION

### 3.1 THERMOMETER APPLICATIONS

- A. Install direct-mounting, vapor-actuated dial thermometers in the outlet of each domestic, hot-water storage tank.
- B. Install dry -case-type, vapor -actuated dial thermometers at suction and discharge of each pump.
- C. Provide the following temperature ranges for thermometers:
  - 1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions (Minus 1 to plus 82 deg C, with 1-degree scale divisions).
  - 2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions (Minus 18 to plus 38 deg C, with 1-degree scale divisions).

### 3.2 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.
- B. Install dry-case-type pressure gages at suction and discharge of each pump.
- C. Pressure scale: 0 to 100 psi at 2 psi scale divisions.

### 3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- C. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.
- D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- E. Install remote-mounting pressure gages on panel.
- F. Install needle-valve and snubber fitting in piping for each pressure gage.
- G. Install permanent indicators on walls or brackets in accessible and readable positions.
- H. Install connection fittings for attachment to portable indicators in accessible locations.
- I. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.
- J. Adjust faces of thermometers and gages to proper angle for best visibility from the floor.

END OF SECTION 220519

**This Page Intentionally Left Blank**



## SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Bronze ball valves.
  - 2. Bronze swing check valves.
- B. Related Sections:
  - 1. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. RS: Rising stem.
- E. SWP: Steam working pressure.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.

2. Protect threads, flange faces, grooves, and weld ends.
  3. Set ball and plug valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valves in Insulated Piping: With **2-inch (50-mm)** stem extensions and the following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- E. Valve-End Connections:
1. Solder Joint: With sockets according to ASME B16.18.
  2. Threaded: With threads according to ASME B1.20.1.
- F. Valve Bypass and Drain Connections: MSS SP-45.

### 2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements :
    - a. Conbraco Industries, Inc.; Apollo Valves.
    - b. Milwaukee Valve Company.
    - c. NIBCO INC.
    - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  2. Description:
    - a. Standard: MSS SP-110.
    - b. SWP Rating: **150 psig (1035 kPa)**.
    - c. CWP Rating: **600 psig (4140 kPa)**.
    - d. Body Design: Two piece.
    - e. Body Material: Bronze.
    - f. Ends: Threaded.
    - g. Seats: PTFE or TFE.
    - h. Stem: Bronze.
    - i. Ball: Chrome-plated brass.
    - j. Port: Full.

## 2.3 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
  - 1. Manufacturers: Subject to compliance with requirements, :
    - a. Hammond Valve.
    - b. Milwaukee Valve Company.
    - c. NIBCO INC.
    - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 3.
    - b. CWP Rating: 200 psig (1380 kPa).
    - c. Body Design: Horizontal flow.
    - d. Body Material: ASTM B 62, bronze.
    - e. Ends: Threaded.
    - f. Disc: Bronze.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.

### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball valves.
  - 2. Throttling Service: Ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, **NPS 2 (DN 50)** and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

### 3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe **NPS 2 (DN 50)** and Smaller:
  - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Ball Valves: Two piece, full port, bronze with bronze trim.
  - 3. Bronze Swing Check Valves: Class 150, bronze disc.

END OF SECTION 220523

## SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
  - 1. Steel pipe hangers and supports.
- B. Trapeze pipe hangers.

#### 1.3 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

#### 2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Available Manufacturers:
  - 1. B-Line Systems, Inc.; a division of Cooper Industries.
  - 2. Carpenter & Paterson, Inc.
  - 3. ERICO/Michigan Hanger Co.
  - 4. Grinnell Corp.
- C. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

## 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

## 2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Available Manufacturers:
  - 1. B-Line Systems, Inc.; a division of Cooper Industries.
  - 2. Power-Strut Div.; Tyco International, Ltd.
  - 3. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
  - 2. Pipe Hangers (MSS Type 5): For suspension of pipes, **NPS 1/2 to NPS 4 (DN 15 to DN 100)**, to allow off-center closure for hanger installation before pipe erection.
- G. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, **NPS 3/4 to NPS 20 (DN 20 to DN 500)**.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, **NPS 3/4 to NPS 20 (DN 20 to DN 500)**, if longer ends are required for riser clamps.

- I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
- J. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- K. Fixtures to support supply and waste piping for plumbing fixtures.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- E. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- F. Insulated Piping: Comply with the following:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
  - 3. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
  - 4. Insert Material: Length at least as long as protective shield.
  - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to **1-1/2 inches**.

END OF SECTION 220529



## SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Valve tags.
  - 5. Warning tags.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

#### 1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **1/16 inch (1.6 mm)** thick, and having predrilled holes for attachment hardware.
  2. Letter Color: White.
  3. Background Color: Black.
  4. Maximum Temperature: Able to withstand temperatures up to **160 deg F (71 deg C)**.
  5. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)**.
  6. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  7. Fasteners: Stainless-steel self-tapping screws.
  8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

## 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **1/16 inch (1.6 mm)**.

## 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  2. Lettering Size: At least **1-1/2 inches (38 mm)** high.

## 2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with **1/4-inch (6.4-mm)** letters for piping system abbreviation and **1/2-inch (13-mm)** numbers.
1. Tag Material: Brass, **0.032-inch (0.8-mm)** minimum thickness, and having predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on **8-1/2-by-11-inch (A4)** bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of **50 feet (15 m)** along each run. Reduce intervals to **25 feet (7.6 m)** in areas of congested piping and equipment.
  - 7. Pipes shall not be labeled where they pass over public restaurant spaces.
- B. Pipe Label Color Schedule:
  - 1. Domestic Cold Water Piping:
    - a. Background Color: Green.
    - b. Letter Color: White.
  - 2. Domestic Hot Water, and Hot Water Return Piping:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.

### 3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Size and Shape:
    - a. Cold Water: **1-1/2 inches (38 mm)**, round.
    - b. Hot Water: **1-1/2 inches (38 mm)**, round.
  - 2. Valve-Tag Color:

- a. Cold Water: Natural.
- b. Hot Water: Natural.

END OF SECTION 220553

## SECTION 220700 - PLUMBING INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Insulation Materials:
    - a. Flexible elastomeric.
    - b. Mineral fiber.
  - 2. Insulating cements.
  - 3. Adhesives.
  - 4. Mastics.
  - 5. Lagging adhesives.
  - 6. Sealants.
  - 7. Factory-applied jackets.
  - 8. Field-applied fabric-reinforcing mesh.
  - 9. Field-applied cloths.
  - 10. Field-applied jackets.
  - 11. Tapes.
  - 12. Securements.
  - 13. Corner angles.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.
  - 8. Detail field application for each equipment type.
- C. Qualification Data: For qualified Installer.

- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- E. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Micro-Lok.
    - b. Knauf Insulation; 1000 Pipe Insulation.
    - c. Owens Corning; Fiberglas Pipe Insulation.
  - 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### 2.2 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  - 3. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
    - a. Products: Subject to compliance with requirements, provide the following :
      - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

## 2.3 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    - b. Compac Corp.; 104 and 105.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 11.5 mils (0.29 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. Venture Tape; 1506 CW NS.
  2. Width: 2 inches (50 mm).
  3. Thickness: 6 mils (0.15 mm).
  4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

## 2.4 CORNER ANGLES

- A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.



- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least **1-1/2 inches (38 mm)**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **2 inches (50 mm)** o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches (100 mm)** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches (50 mm)** below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches (50 mm)**.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 07 Section "Joint Sealants" and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Joint Sealants".

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches (50 mm)** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at **6 inches (150 mm)** o.c.
  4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Place PVC cover fitting over the elbow and secure with bands.
  2. Install sections of pipe insulation, to a thickness equal to adjoining pipe insulation.
- C. Provide Black PVC jacket on all exposed piping running below floor framing in the restaurant public spaces and install with **1-inch (25-mm)** overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of

inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

### 3.10 INDOOR PIPING INSULATION SCHEDULE

#### A. Domestic Cold Water:

1. **NPS ½ and NPS ¾** : Insulation shall be one of the following:
  - a. Flexible Elastomeric: **1/2 inch (13 mm)** thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch (13 mm)** thick.
2. **NPS 1 (DN 25) and NPS 1-1/4 (DN 32)**: Insulation shall be one of the following:
  - a. Flexible Elastomeric: **1/2 inch (13 mm)** thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch (13 mm)** thick.
3. **NPS 1-1/2 (DN 40) and Larger**: Insulation shall be one of the following:
  - a. Flexible Elastomeric: **1/2 inch (13 mm)** thick.
  - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.

#### B. Domestic Hot Water:

1. **NPS 1 (DN 25) and Smaller**: Insulation shall be one of the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.
2. **NPS 1-1/4 (DN 32)** : Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1-1/2 inch (38 mm)** thick.
3. **NPS 1-1/2 (DN 40) and NPS 2 (DN 50)** : Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1-1/2 inch (38 mm)** thick.

END OF SECTION 220700

## SECTION 221116 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Domestic water pipes, tubes, fittings, and specialties inside the building.
2. Escutcheons.
3. Sleeves and sleeve seals.
4. PEX tubing shall be utilized for all domestic hot and cold water piping within the building up to and including 1-1/2" size.
5. Copper tubing shall be utilized for domestic cold water piping 2" in size.
6. Copper tubing shall be utilized for hot and cold piping is exposed below sinks and equipment.
7. Copper tubing shall be utilized at connections to the water heater and thermostatic mixing valve and where PEX is not recommended by the manufacturer.

#### 1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

#### 1.4 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  1. Notify Owner no fewer than two days in advance of proposed interruption of water service.

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

#### 2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: **ASTM B 88, Type L (ASTM B 88M, Type B)** water tube, drawn temper.
  1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
  2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.



3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Elkhart Products Corporation; Industrial Division.
      - 2) NIBCO INC.
    - b. **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
    - c. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. General Requirements:
1. Same size as pipes to be joined.
  2. Pressure rating at least equal to pipes to be joined.
  3. End connections compatible with pipes to be joined.
- C. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

## 2.1 PEX TUBE AND FITTINGS

### A. Basis of Design: Uponor

1. Contact: 5925 148th Street West, Apple Valley, MN 55124; Toll free (800) 321-4739, (952) 891-2000; Fax: (952) 891-2008; website: [www.uponor-usa.com](http://www.uponor-usa.com)

## 2.03 Materials

### A. Tubing

1. Material: Crosslinked polyethylene (PEX) manufactured by PEX-a or Engel method
2. Type: Wirsbo color coded AQUAPEX in straight lengths of tube. Hot water piping shall be red, cold water shall be blue.
3. Coiled tubing is permitted only within stud partitions and shall be properly secured.
4. Material Standard: Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third party agency
5. Standard grade hydrostatic design and pressure ratings from PPI
6. Fire-rated assembly listings in accordance with ANSI/UL 263
  - a. UL Design No. L557 — 1-hour wood frame floor/ceiling assemblies
  - b. UL Design No. K913 — 2-hour concrete floor/ceiling assemblies
  - c. UL Design No. U372 — 1-hour wood stud/gypsum wallboard wall assemblies
  - d. UL Design No. V444 — 1-hour steel stud/gypsum wallboard wall assemblies
7. Minimum Bend Radius (cold bending): No less than six times the outside diameter. Use a bend support as supplied by the PEX tubing manufacturer for tubing with a bend radius less than stated.
8. Nominal Inside Diameter: Provide tubing with nominal inside diameter, in accordance with ASTM F876 as indicated.



- a.  $\frac{3}{8}$  inch
- b.  $\frac{1}{2}$  inch
- c.  $\frac{3}{4}$  inch
- d. 1 inch
- e.  $1\frac{1}{4}$  inch
- f.  $1\frac{1}{2}$  inch

#### B. Fittings

- 1. Material: Fitting assembly is manufactured from material listed in paragraph 5.1 of ASTM F1960.
- 2. Material Standard: Comply with ASTM F1960.
- 3. Type: PEX-a cold expansion fitting.
  - a. Assembly consists of the appropriate ProPEX insert with a corresponding ProPEX Ring.

#### C. Accessories

- 1. Angle stops and straight stops that are compatible with PEX tubing are supplied by the PEX tubing manufacturer.
- 2. Bend supports designed for maintaining tight radius bends are supplied by the PEX tubing manufacturer.
- 3. ProPEX expander tool to install the ASTM F1960 compatible fittings are supplied by the PEX tubing manufacturer.
- 4. The tubing manufacturer provides clips and/or PEX rails for supporting tubing runs.
- 5. All horizontal tubing hangers and riser clamps are epoxy-coated material.

### PART 3 - EXECUTION

#### 3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance.
- C. Install domestic water piping level and plumb.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping adjacent to equipment and specialties to allow service and maintenance.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.

### 3.2 PEX TUBING INSTALLATION INSTRUCTIONS

- A. Comply with manufacturer's product data, including product technical bulletins, installation instructions, design drawings and the Uponor Professional Plumbing Installation Guide.
- B. Installation
  - 1. Wirsbo AQUAPEX Tubing
    - a. Install Wirsbo AQUAPEX tubing in accordance with the tubing manufacturer's recommendations and as indicated in the installation handbook.
    - b. Do not install PEX tubing within 6 inches of gas appliance vents or within 12 inches of any recessed light fixtures.
    - c. Do not solder within 18 inches of PEX tubing in the same waterline. Make sweat connections prior to making PEX connections.
    - d. Do not expose PEX tubing to direct sunlight for more than 30 days.
    - e. Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer.
    - f. Use grommets or sleeves at the penetration for PEX tubing passing through metal studs.
    - g. Protect PEX tubing with sleeves where abrasion may occur.
    - h. Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
    - i. Use tubing manufacturer-supplied bend supports where bends are less than six times the outside tubing diameter.
    - j. Minimum horizontal supports are installed not less than 32 inches between hangers in accordance with model plumbing codes and the installation handbook.
    - k. PEX riser installations require epoxy-coated riser clamps installed at the base of the ceiling per floor.
    - l. A mid-story support is required for riser applications.
    - m. Pressurize Wirsbo AQUAPEX tubing with air in accordance with applicable codes or in the absence of applicable codes to a pressure of 25 psi (173 kPa) above normal working pressure of the system.

- n. Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Do not use water to pressurize the system if ambient air temperature has the possibility of dropping below 32°F (0°C).
- C. Through-penetration Firestop
    1. Ensure compliance of one- and two-hour rated through penetration assemblies in accordance with ASTM E814.
    2. A list of firestop manufacturers that list PEX tubing with their firestop systems is available from the PEX tubing manufacturer.
    3. Related Products Installation: Refer to other sections listed in Related Sections paragraph herein for related products installation.
  - D. Cleaning
    1. Remove temporary coverings and protection of adjacent work areas.
    2. Repair or replace damaged installed products.
    3. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
    4. Remove construction debris from project site and legally dispose of debris.
  - E. Protection
    1. Protect installed work from damage due to subsequent construction activity on the site.

### 3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

### 3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping **NPS 2 (DN 50)** and smaller.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
  1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
  2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to existing water piping within the building.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Plumbing Fixtures and equipment: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.

### 3.7 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
  - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
  - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
  - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
- C. Escutcheons for Existing Piping:
  - 1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
  - 2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.

### 3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

### 3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
  - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

- a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
- b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

### 3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
  - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Fill and isolate system according to either of the following:
    - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
    - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
  - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.12 PIPING SCHEDULE

- A. Domestic water piping, NPS 2 (DN 50), and smaller as indicated in the section summary of this section shall be the following:
  1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast-copper solder-joint fittings; and soldered joints.
  2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) ; copper push-on-joint fittings; and push-on joints.
- B. Domestic water piping, 1-1/2" and smaller as indicated in the section summary of this section shall be the following: PEX.

### 3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  1. Shutoff Duty: Use ball valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
  2. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
  3. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

## SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
  - 1. Vacuum breakers.
  - 2. Temperature mixing valves.
  - 3. Drain valves.
  - 4. Water hammer arresters.
- B. Related Sections include the following:
  - 1. Division 22 Section "Domestic Water Piping".

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: **125 psig (860 kPa)**, unless otherwise indicated.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. 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.
- B. NSF Compliance:
  - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
  - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

## PART 2 - PRODUCTS

### 2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ames Co.
    - b. FEBCO; SPX Valves & Controls.
    - c. Watts Industries, Inc.; Water Products Div.
    - d. Zurn Plumbing Products Group; Wilkins Div.
  - 2. Standard: ASSE 1001.
  - 3. Size: **NPS 1/4 to NPS 3 (DN 8 to DN 80)**, as required to match connected piping.
  - 4. Body: Bronze.
  - 5. Inlet and Outlet Connections: Threaded.
  - 6. Finish: Rough bronze.

### 2.1 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. FEBCO; SPX Valves & Controls.
    - b. Watts Industries, Inc.; Water Products Div.
    - c. Zurn Plumbing Products Group; Wilkins Div.
  - 2. Standard: ASSE 1012.
  - 3. Operation: Continuous-pressure applications.
  - 4. Size: **NPS 3/4 (DN 20)**.
  - 5. Body: Bronze.
  - 6. End Connections: Solder joint.
  - 7. Finish: Rough bronze.
- B. Reduced-Pressure-Principle Backflow Preventers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 2. Basis-of-Design Product: Watts. Subject to compliance with requirements, provide a comparable product by one of the following:
    - a. Ames Co.
    - b. FEBCO; SPX Valves & Controls.
    - c. Watts Industries, Inc.; Water Products Div.
    - d. Zurn Plumbing Products Group; Wilkins Div.
  - 3. Water Entrance: Model 909QT, 1-1/2" threaded with 1-1/2" quarter turn ball valves. The Reduced Pressure Zone Assembly: The assembly shall include two tightly closing shutoff valves before and after the assembly, test cocks and a protective strainer upstream of the No. 1 shutoff valve.
  - 4. Boiler Supply: Model 909M1QT, 1" threaded, with quarter turn ball valves.
  - 5. Standard: ASSE 1013.
  - 6. Operation: Continuous-pressure applications.
  - 7. Configuration: Designed for horizontal, straight through flow.



## 2.2 WATER PRESSURE-REDUCING VALVES

### A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Watts Industries, Inc.; Water Products Div.
  - b. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
4. Size: 1/2”.
5. Design Flow Rate: 5 gpm (L/s).
6. Design Inlet Pressure: 60 psig (kPa).
7. Design Outlet Pressure Setting: 20 psig (kPa).
8. Body: Bronze for NPS 2 (DN 50) and.
9. Valves for Kitchen Dishwasher Water Supplies: Include integral bypass.
10. End Connections: Threaded.

## 2.3 THERMOSTATIC MIXING VALVE

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Leonard Valve Company.
  - b. Powers.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Leonard model LV-981-LF-BDT, Lead Free Thermostatic Mixing Valve with ball valve outlet and thermometer.
3. Description: Factory-fabricated, exposed-mounting, thermostatically controlled, water-mixing-valve assembly.
4. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.
5. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
6. Component Pressure Ratings: 125 psig (860 kPa) minimum, unless otherwise indicated.
7. Selected Large Flow, Tempered Water Valve Size: 1-1/4 inlets with 1-1/2” outlet.
8. Tempered-Water Setting: 120 deg F (deg C).
9. Unit Tempered-Water Design Flow Rate: 24 gpm.
10. Unit Minimum Tempered-Water Design Flow Rate: 2.5gpm.
11. Unit Pressure Drop at Design Flow Rate: 15 psig.
12. Unit Tempered-Water Outlet Size: 3/4” NPS end connection.
13. Unit Hot- and Cold-Water Inlet Size: 3/4” NPS end connection.
14. Thermostatic Mixing Valve and Water Regulator Finish: Rough bronze.

## 2.4 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.

8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball.
2. Pressure Rating: 200-psig (1380-kPa) minimum CWP or Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 (DN 6) side outlet with cap.

## 2.5 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. PPP Inc.
  - b. Sioux Chief Manufacturing Company, Inc.
  - c. Watts Drainage Products Inc.
  - d. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Copper tube with piston.
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

## 2.1 HOSE BIBBS

A. Hose Bibbs in Restrooms:

1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following: Chicago Faucet model 293-E27CP.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Polished Chrome.
4. Seat: Slow Compression, replaceable.
5. Supply Connections: NPS 1/2 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig (860 kPa).
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Chrome plated.
10. Finish for Service Areas: Chrome plated.
11. Finish for Finished Rooms: Chrome plated.
12. Operation for Equipment Rooms: Operating key.
13. Operation for Service Areas: Operating key.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include wall flange with each chrome-plated hose bibb.

## 2.2 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Woodford Manufacturing Company.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASME A112.21.3M for concealed -outlet, self-draining wall hydrants.
4. Pressure Rating: 125 psig (860 kPa).
5. Operation: Loose key.
6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
7. Inlet: NPS 3/4.
8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
9. Box: Deep, flush mounting with cover.
10. Box and Cover Finish: Polished nickel bronze.
11. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
12. Nozzle and Wall-Plate Finish: Polished nickel bronze.
13. Operating Keys(s): One with each wall hydrant.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  1. Install thermometers and water regulators if specified.
  2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- C. Install water hammer arresters in water piping according to PDI-WH 201.
- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  1. Locate backflow preventers in same room as connected equipment or system.
  2. Backflow preventers shall be accessible from a standing position on the floor.

3. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
4. Do not install bypass piping around backflow preventers.

- B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- C. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Electrical.

### 3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  1. Primary, thermostatic, water mixing valves.
  2. Primary water tempering valves.
  3. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### 3.1 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

## SECTION 221316 - SANITARY WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following for soil, waste, grease waste, indirect waste, grease waste vent and sanitary vent piping inside the building including vents through the roof.
- B. This Section includes the following for soil gas vent piping within the building including the vent above the roof.
  - 1. Pipe, tube, and fittings.
  - 2. Special pipe fittings.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
- B. Soil, Waste, and Vent Piping: 10-foot head of water 30 kPa or 5 psi.

#### 1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

#### 1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

## 2.3 ABS PIPE AND FITTINGS

- A. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
- B. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
- C. Solvent Cement and Adhesive Primer:
  - 1. Use Black ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
  - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
  - 2. Solvent Cement and Adhesive Primer:
    - a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

### 3.2 PIPING APPLICATIONS

- A. Aboveground, grease waste and vent, soil, waste and vent piping **NPS 4 (DN 100)** and smaller shall be the following:
  - 1. Drainage piping and traps directly connected to the dishwashers: Copper DWV tube, copper drainage fittings, and soldered joints.
  - 2. Exposed drainage piping within the two restaurant levels including under kitchen sinks and vents through the roof: Cellular-core Black ABS pipe, ABS socket fittings, and solvent-cemented joints.
  - 3. Drainage and vent piping concealed above ceilings, within stud walls and in the basement level: Solid-wall, white Schedule 40 DWV PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 4. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- B. Underground, soil, waste, and vent piping **NPS 4 (DN 100)** and smaller shall be the following:
- C. Schedule 40 Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

### 3.3 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- D. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- F. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Horizontal Sanitary Drainage Piping: 1/4" per foot downward in direction of flow.
  - 2. Vent Piping: 1/8" per foot down toward vertical fixture vent or toward vent stack.
- G. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- H. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

### 3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than **10-foot head of water (30 kPa)**. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of **1-inch wg (250 Pa)**. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.

### 3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.



- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

**This Page Intentionally Left Blank**

## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
  - 1. Cleanouts
  - 2. Floor Drains

### PART 2 - PRODUCTS

#### 2.1 FLOOR DRAINS

- A. Floor Drains
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts or a comparable product by one of the following:
    - a. Watts Drainage Products Inc.
    - b. Zurn Industries
  - 2. FD-1: FD-100-7A, 2" no hub outlet, dura-coated cast iron body, 7" round polished nickel bronze grid strainer.
  - 3. Standard: ASME A112.6.3.
  - 4. Anchor Flange: Required.
  - 5. Outlet: Bottom.
  - 6. Trap Material: Same material as connected piping.
  - 7. Trap Pattern: Standard P-trap.

#### 2.2 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Air-Gap Fittings :
  - 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
  - 2. Body: Bronze or cast iron.
  - 3. Inlet: Opening in top of body.
  - 4. Outlet: Larger than inlet.
  - 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to **NPS 4 (DN 100)**. Use **NPS 4 (DN 100)** for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.
  - 3. Locate at minimum intervals of **100 feet** for all piping.
  - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

### 3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

## SECTION 221613 - FACILITY NATURAL-GAS PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipes, tubes, and fittings.
  - 2. Piping specialties.
  - 3. Piping and tubing joining materials.
  - 4. Valves.
  - 5. Solenoid Gas Valves.
  - 6. Mechanical sleeve seals.

#### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 40 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressure within Buildings: 7" water column.
- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Piping specialties.
  - 2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
  - 3. Dielectric fittings.

4. Mechanical sleeve seals.
  5. Escutcheons.
- B. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
  - C. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
  - D. Field quality-control reports.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

## 1.7 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

## 1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## PART 2 - PRODUCTS

### 2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
  3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.

- d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
- e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

## 2.2 PIPING SPECIALTIES

### A. Appliance Flexible Connectors:

- 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
- 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
- 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
- 4. Corrugated stainless-steel tubing with polymer coating.
- 5. Operating-Pressure Rating: **0.5 psig (3.45 kPa)**.
- 6. End Fittings: Zinc-coated steel.
- 7. Threaded Ends: Comply with ASME B1.20.1.
- 8. Maximum Length: **72 inches (1830 mm)**.

## 2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.

## 2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, **NPS 2 (DN 50)** and Smaller: Comply with ASME B16.33.
  - 1. CWP Rating: **125 psig (862 kPa)**.
  - 2. Threaded Ends: Comply with ASME B1.20.1.
  - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves **1 inch (25 mm)** and smaller.
  - 6. Service Mark: Valves **1-1/4 inches (32 mm)** to **NPS 2 (DN 50)** shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, **NPS 2-1/2 (DN 65)** and Larger: Comply with ASME B16.38.
  - 1. CWP Rating: **125 psig (862 kPa)**.
  - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
  - 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Watts
  - b. Nibco
  - c. Conbraco Industries, Inc.; Apollo Div.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig (4140 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

## 2.5 SOLENOID GAS VALVES

- A. Electrically Operated Valves: Comply with UL 429.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide ASCO or comparable product by one of the following:
      - 1) ASCO Power Technologies, LP; Division of Emerson.
      - 2) Magnatrol Valve Corporation
      - 3) Watts Regulator Co.; Division of Watts Water Technologies, Inc.
      - 4) ISIMET, LLC.
  2. Model: Series JB8214C-CSA.
  3. Size: 2" rated for 2,940,500 btu/hr.
  4. Pilot operated.
  5. Body: Aluminum.
  6. Seats and Disc: Nitrile rubber.
  7. Springs and Valve Trim: Stainless steel.
  8. 120-V ac, 60 Hz, (Kitchen Gas Valve).
  9. NEMA ICS 6, Type 4, coil enclosure.
  10. Normally closed.

## 2.6 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.



## 2.7 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
  - 3. Pressure Plates: Carbon steel.
  - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

## 2.8 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Escutcheons: With set screw.
  - 1. Finish: Polished chrome-plated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

### 3.3 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Locate valves for easy access.
- F. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install escutcheons at penetrations of interior walls, ceilings, and floors.
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - d. Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
    - f. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - g. Piping in Equipment Rooms: One-piece, cast-brass type.
    - h. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- J. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Through-Penetration Firestop Systems."
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

- O. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
    - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
    - 2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
      - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
    - 3. Prohibited Locations:
      - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
      - b. Do not install natural-gas piping in solid walls or partitions.
  - P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
  - Q. Connect branch piping from top or side of horizontal piping.
  - R. Install unions in pipes **NPS 2 (DN 50)** and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
  - S. Do not use natural-gas piping as grounding electrode.
  - T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
  - U. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."
- 3.4 VALVE INSTALLATION
- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
  - B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- 3.5 PIPING JOINT CONSTRUCTION
- A. Ream ends of pipes and tubes and remove burrs.
  - B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  - C. Threaded Joints:
    - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
    - 2. Cut threads full and clean using sharp dies.
    - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.

4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- B. Comply with requirements for pipe hangers and supports specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
  1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
  2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
  3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
  4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).

### 3.7 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### 3.8 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 22.

### 3.9 PAINTING

- A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  - 1. Alkyd System: MPI EXT 5.1D.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel (semigloss).
    - d. Color: Gray to match gas utility equipment.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

### 3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.11 OUTDOOR PIPING SCHEDULE

- A. Aboveground natural-gas piping shall be the following:
  - 1. Steel pipe with wrought-steel fittings and joints.

### 3.12 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (14" water column)

- A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.

### 3.13 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be the following:
  - 1. Bronze plug valve.
- B. Valves for pipe sizes NPS 2-1/2 (DN 65) and larger at service meter shall be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- C. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- D. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be one of the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- E. Valves in branch piping for single appliance shall be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231123

## SECTION 223500 - DOMESTIC WATER HEAT EXCHANGERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following heat exchangers:
  - 1. Circulating, storage heat exchangers.
  - 2. Heat-exchanger accessories.

#### 1.3 SUBMITTALS

- A. Product Data: For each type and size of heat exchanger indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Product Certificates: For each type of storage type heat exchanger, signed by product manufacturer.
- D.
- E. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of heat exchangers through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of heat exchangers and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- C. 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.
- D. ASME Compliance: Where ASME-code construction is indicated, fabricate and label heat-exchanger storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

- E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with water.

## 1.5 COORDINATION

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of heat exchangers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including heat exchanger, storage tank, and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Period(s): From date of Substantial Completion:
    - a. Circulating, Storage Heat Exchangers:
      - 1) Storage Tank: Five years.
      - 2) Tube Coil: Five years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
- B. Inter-Tank Circulating Storage Heat Exchangers:
  - 1. Manufacturers:
    - a. Amtrol.
    - b. Superstor
    - c. Triangle Tube
  - 2. Basis of Design: Amtrol Commercial Boiler Mate model WHS-60ZC-DW.
  - 3. Description: Factory assembled and packaged 60 gallon, vertical 316L stainless steel tank with insulated polyethylene jacket.
  - 4. Storage Tank Construction: **150-psig** working-pressure rating.
    - a. Configuration: Vertical.
    - b. Domestic water tapings: 1" NPTM domestic water inlet, 1" NPTF domestic water outlet, 1" sweat union boiler water inlet and outlet.
    - c. Insulation: CFC-Free Urethane Foam Complying with ASHRAE/IESNA 90.1, unless otherwise indicated, and suitable for operating temperature.
  - 5. Heat-Exchanger Coil: **NPS 1"** diameter, copper or copper-alloy.
    - a. Heat-Exchanger Pressure Rating: Equal to or greater than heating-fluid supply pressure.
    - b. Double wall coil for use with glycol boiler water.



6. Temperature Control: Heater shall be supplied with Electro-mechanical aquastat. The device shall be removed in the field for installation of digital control module in the tank port.
7. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity to relieve the total BTU input of the coil, and include pressure setting less than working-pressure rating of heat exchanger.
8. Capacity and Characteristics:
  - a. Capacity: 60 gal.
  - b. Tank Dimensions: 26" diameter by 54" tall.
  - c. Recovery: 200 gph at 90 deg F temperature rise.
  - d. Heating Hot-Water Supply:
    - 1) Inlet Temperature: 180 deg F (deg C).
    - 2) Outlet Temperature: 120 deg F (deg C).
    - 3) Boiler Pipe Size: 1".
  - e. Domestic Water Inlet and Outlet Pipe Size: 1".
  - f. Boiler output requirements: 150,000 btuh.

## 2.2 DOMESTIC HOT WATER EXPANSION TANK

- A. Description: Potable Domestic hot water, steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
- B. Basis of Design: Amtrol "THERM-X-TROL" model ST-25V , for potable water.
  1. Manufacturers:
    - a. AMTROL Inc.
    - b. Taco, Inc.
    - c. Watts Regulator Co.
  2. Construction:
    - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    - c. Air-Charging Valve: Factory installed.
  3. Capacity and Characteristics:
    - a. Working-Pressure Rating: 150 psi.
    - b. Capacity Acceptable: 10.3 gallon minimum (10.3 gallon total volume)
    - c. Air Precharge Pressure: 75 psi (coordinate with building pressure downstream of the service entrance backflow preventer).

## 2.3 HEAT-EXCHANGER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of heat exchanger. Select relief valves with sensing element that extends into heat-exchanger storage tank.
- B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

## 2.4 SOURCE QUALITY CONTROL

- A. Hydrostatically test heat-exchanger storage tanks before shipment to minimum of one and one-half times pressure rating.
- B. Prepare test reports.

## PART 3 - EXECUTION

### 3.1 HEAT-EXCHANGER INSTALLATION

- A. Install heat exchangers level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- B. Install temperature and pressure relief valves in top portion of storage tank shells of heat exchangers with domestic water storage. Use relief valves with sensing elements that extend into shells. Extend relief-valve outlet, with drain piping same as water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- C. Extend relief-valve outlet, with drain piping same as water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install heat-exchanger drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for heat exchangers that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
- E. Install thermometer on each heat-exchanger domestic-water inlet and outlet piping, and install thermometer on each heat-exchanger heating-fluid inlet and outlet piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- F. Install pressure gages on heat-exchanger heating-fluid piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- G. Fill heat exchangers with water.
- H. Charge compression tanks with air.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to heat exchangers to allow service and maintenance. Arrange piping for easy removal of heat exchangers.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace heat exchangers that do not pass tests and inspections and retest as specified above.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain heat exchangers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 223500

**This Page Intentionally Left Blank**

## SECTION 224000 - PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
  - 1. Faucets for lavatories.
  - 2. Water closets.
  - 3. Lavatories.
  - 4. Commercial Sinks.
- B. Related Sections include the following:
  - 1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

#### 1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- C. PVC: Polyvinyl chloride plastic.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for sink faucets:
  1. Faucets: ASME A112.18.1.
  2. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  3. NSF Potable-Water Materials: NSF 61.
  4. Pipe Threads: ASME B1.20.1.
  5. Supply Fittings: ASME A112.18.1.
  6. Brass Waste Fittings: ASME A112.18.2.
- G. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
  1. Atmospheric Vacuum Breakers: ASSE 1001.
  2. Brass and Copper Supplies: ASME A112.18.1.
  3. Brass Waste Fittings: ASME A112.18.2.

## 1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures of unit shell.
    - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  2. Warranty Period for Commercial Applications: Three year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 LAVATORY FAUCETS

- A. Lavatory Faucets: L-1.

- a. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler “Purist” model K-14402-4-BV. Description: ADA compliant, single-control lavatory faucet shall be made of brass construction. Product shall have a maximum flow rate of 1.5 gallons (5.7 L) per minute. Product shall feature a one-piece, self-contained ceramic disc valve, allowing volume and temperature control. Product shall feature temperature memory, allowing the faucet to be turned on and off at any temperature setting, and a high-temperature limit setting for added safety. Product shall be for single-hole mounting. Product shall feature a 5-1/2” (14 cm) spout reach, low spout design, a stationary spout.
- b. Install a polished chrome plated grid strainer with ADA offset in lieu of the pop-up drain and tailpiece.
- c. Body Material: Commercial, solid brass.
- d. Finish: Vibrant Brushed bronze.
- e. Maximum Flow Rate: 1.5 gallon per minute.
- f. Mounting: Single hole, faucet deck mounted.
- g. Inlet(s): NPS 1/2 (DN 15).
- h. Spout: Rigid type.
- i. Operation: Single handle manual operation.

## 2.2 WATER CLOSETS

### A. Water Closets, WC-1:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler, or a comparable product by one of the following:
  - a. American Standard Companies, Inc.
  - b. Kohler Co.
  - c. Toto
- 2. Description Model K-3754-0 with K-9385-BV handle, elongated high efficiency wall hung toilet, “Right Height”, two piece tank type with manual flush handle on the left side.
  - a. Supply: NPS 1/2” chrome-plated brass or copper with screwdriver stop.
  - b. Bowl Type: Elongated.
  - c. Trapway: 2-1/8” minimum glazed.
  - d. Design Consumption: 1.6 gal./flush.
  - e. Color: White.
  - f. Seat: White elongated, open front, less seat.
  - g. Flush Handle: Replace chrome plated handle with K-9385 Vibrant Brushed Bronze finish.
  - h. MaP Flush Performance Rating: 1,000 grams.

## 2.3 LAVATORIES

### A. Lavatory L-1:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Porcher lavatory:
- 2. Description: Model 20000-01, single center faucet hole, accessible, wall mounted, fine fire clay fixture.
  - a. Type: Wall hung.
  - b. Fixture Size: 21” front-to-back by 26” wide.
  - c. Basin Size: 15-3/4” front-to-back by 18-1/4” wide by 5-1/2” deep.
  - d. Color: White.

- e. Faucet: See specification section 2.1-A.
- f. Supplies: Insulated NPS 3/8 (DN 10) chrome-plated copper with stops and wall escutcheons.
- g. Drain: Chrome Plated Grid Strainer.
- h. Drain Piping: Chrome Plated NPS 1-1/4" ADA offset, chrome-plated, NPS 1-1/4" x 1-1/2" cast-brass P-trap; NPS 1-1/2 (DN 40) tubular brass waste to wall; and wall escutcheon.
- i. Insulation: Not required.

## 2.4 INSTANTANEOUS HOT WATER HEATER AND FAUCET

- A. Instantaneous heater and faucet:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide In-Sinkerator model C1300.
  - 2. Description: Foodservice grade heating element provides 100 cups of near-boiling water per hour.
    - a. Swiveling gooseneck spout travels 90° to provide clearance for large vessels.
    - b. Easy-action lever with automatic shut-off.
    - c. Brass faucet with polished chrome finish.
    - d. 2/3-gallon Stainless Steel Tank construction.
    - e. Adjustable temperature control on front panel.
    - f. Mounts in standard sink opening or 1-1/4" drilled hole
    - g. 1-year full warranty on parts and labor.
    - h. Capacity: 2/3-gallon tank dispenses 100 cups of 200°F water per hour.
    - i. Electrical 120 Volts A.C., 1300 Watts, 10.8 amp heating element with 36" cord and grounded plug
    - j. Thermostat Snap action, adjustable from 160°F to 210°F (factory pre-set at approximately 200°F)
    - k. Insulation Meets U.L. 94HF-1 flammability specification
    - l. Mounting: Mount the heater directly below the counter. Maximum distance\_ between tank and base of faucet should be 14-1/2" or less.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.



- B. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- C. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- D. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- E. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

### 3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust high temperature limit stops on faucets. Replace damaged and malfunctioning units.

### 3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  2. Remove sediment and debris from drains.

- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

### 3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities.

END OF SECTION 224000

## SECTION 230500 – COMMON WORK RESULTS FOR HVAC

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Provide labor, materials, accessories, and other related items as required to complete operations in connection with the complete installation of the HVAC and mechanical systems as indicated on the Drawings and as specified herein.

#### 1.2 RELATED REQUIREMENTS

- A. Conditions of the Contract apply to the work, including the work of this Division. Examine Contract Documents for requirements affecting the work.
- B. Provide cooperation with, and assistance to, the Commissioning Agent as specified under “Responsibilities” in Division 01 Section “General Commissioning Requirements.”
- C. Provide cooperation with, and assistance to, the Testing and Balancing (TAB) Agent specified in Division 23 Section “Testing, Adjusting, and Balancing for Mechanical Systems.”

#### 1.3 DRAWINGS

- A. The general location of the apparatus and the details of the work are indicated on the Drawings. Exact locations not indicated shall be determined at the site as the work progresses and shall be subject to the Architect's approval.
- B. It is not intended that the Drawings shall show every pipe, pipe rise, pipe drop, duct rise, duct drop, pipe fitting, duct fitting, or appliance, but it shall be a requirement to furnish, without additional expense, material and labor necessary to complete the systems in accordance with the design intent and with the highest possible quality available.

#### 1.4 ALTERATIONS

- A. Execute alterations, additions, removals, relocations, new work, and other related items as indicated or required to provide a complete installation in accordance with the intent of the Contract Documents, including changes required by building alterations.
- B. Existing work disturbed or damaged by the alterations or the new work shall be repaired or replaced to the Architect's satisfaction and at no additional cost to the Owner.
- C. Existing ductwork, piping, and other systems indicated to be removed, shall be removed from the site. Cap off existing services remaining. The Owner retains the right to ownership of heating and ventilating equipment scheduled to be removed; store such equipment where requested by the Owner. Material not retained by the Owner shall be removed from the site.

#### 1.5 CONTINUITY OF SERVICE

- A. Arrange to execute the work at such times and in such locations as may be required to provide uninterrupted service for the building or any of its locations. Any unavoidable conditions requiring reduced building capacity shall be arranged for by programming with the Owner's

duly authorized representative at the building subject to the Architect's approval. If necessary, temporary work shall be installed to provide for the condition. Authorization for interrupting service shall be obtained in writing from the Owner. Any interruption of normal service shall be performed during an overtime period to be scheduled with the Owner. Costs for overtime work shall be included in the Bid.

## 1.6 REQUIREMENTS

- A. Installation Instructions: Obtain manufacturer's printed installation instructions to aid in properly executing work on major pieces of equipment. Install equipment in accordance with manufacturer's recommendations.
- B. Objectionable Noise, Fumes and Vibration:
  - 1. Mechanical and electrical equipment shall operate without creating objectionable noise, fumes, or vibration, as determined by the Architect.
  - 2. If such objectionable noise, fumes, or vibration is produced and transmitted to occupied portions of building by apparatus, piping, ducts, or any other part of mechanical and electrical work, make necessary changes and additions, as approved, without extra cost to Owner.
- C. Equipment Design and Installation:
  - 1. Uniformity: Unless otherwise specified, equipment or material of same type or classification, used for same purposes, shall be product of same manufacturer.
  - 2. Design: Equipment and accessories not specifically described or identified by manufacturer's catalog number shall be designed in conformity with ASME, IEEE, or other applicable technical standards, suitable for maximum working pressure, and with neat and finished appearance.
  - 3. Installation: Erect equipment aligned, level and adjusted for satisfactory operation. Install so that connecting and disconnecting of piping and accessories can be made readily, and so that parts are easily accessible for inspection, operation, maintenance and repair. Minor deviations from indicated arrangements may be made, as approved.
- D. Protection of Equipment and Materials: Responsibility for care and protection of materials and mechanical work rests with the Contractor until the entire project has been completed, tested and the project is accepted by the Owner.
- E. Foundations:
  - 1. Where floor mounting is indicated, locate equipment on 4 inch (102 mm) high reinforced concrete pad of adequate size with anchors and base plates as required, on pressure-treated sleepers, or on structural steel frame as detailed. The corners of pads shall be chamfered 1 inch (25 mm). Pad and steel sizes and location shall be coordinated with the approved equipment.

## 1.7 ELECTRIC WORK

- A. Provide motors, pilot lights, controllers, limit switches, and other related items for equipment provided under Division 23.
- B. Except as noted, required line switches, fused switches, and other related items and necessary wiring to properly connect equipment to motors and switches shall be furnished and installed under Division 26, Electric.

- C. Provide complete wiring system for automatic temperature controls as specified under Section Division 23 Section “Instrumentation and Controls for Mechanical Systems.”
- D. Wiring shall conform to the requirements of the National Electrical Code.

#### 1.8 FIRESTOPPING

- A. Firestopping for penetrations of ductwork, piping and equipment through building assemblies, including but not limited to partitions, walls, floors, ceilings, and roofs, shall be furnished and installed under this Section.
- B. Selection of firestopping materials and installation of firestopping materials shall be in accordance with Division 07 Section “Through Penetration Firestop Systems.” Coordinate with other trades for a consistent installation.

#### 1.9 SUBMITTALS

- A. After award of Contract and before installation, submit for approval Shop Drawings, bulletins, Product Data, Samples, and other related items.
- B. Submit Shop Drawings and Product Data as required in each Section. Submittal shall include physical data and performance data required to verify compliance with the Contract Documents.
- C. Submit Samples as required in each Section, and as indicated on the Drawings. These will generally be retained by the Architect/Engineer, unless otherwise indicated. Contractor may request these items returned; provide return shipping for returns.
- D. Architect/Engineer’s review will not include the review, coordination, or verification of dimensions or quantities; these shall be the responsibility of the Contractor.

#### 1.10 SUBSTITUTIONS

- A. Comply with provisions of the General Requirements
- B. The first item listed under “Acceptable Manufacturers”, “Approved Manufacturers” or “Manufacturers” is the design basis.
  - 1. Other manufacturers listed may be used in the base Bid, but conformance with details of the Specifications, as well as dimensional and electrical data, shall be verified by the Contractor.
  - 2. Architect/Engineer has not verified that each listed manufacturer has the ability to provide an acceptable substitution for the basis-of-design product. Contractor may not assume that substitutions will be approved.
  - 3. Modifications required as a result of differences between the design basis item and the submitted and approved item must be approved by the Architect and made at the Contractor’s expense. As an example, if a rooftop HVAC unit is submitted and approved and if the unit’s dimensions and weight are different from those of the unit which was used as the design basis, the Contractor shall be responsible for building structural modifications required to accommodate the submitted and approved unit, at no additional cost to the Owner.
  - 4. For items which have no manufacturers listed, any item conforming with the Contract

Documents is acceptable.

- C. Substitutions from manufacturers or providers which are not listed may be proposed within the time allowed in the General Conditions of the Specifications.
  - 1. The exception to this is products for which the list of manufacturers or providers is limited by the wording “no substitutions” or similar wording.

#### 1.11 COORDINATION

- A. Coordinate scheduling, submittals, and Work of the various Sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various Divisions having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean-up of work of separate Sections in preparation for Substantial Completion.
- F. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

#### 1.12 CLEANING

- A. Remove debris from site daily.
- B. Material and pieces of equipment shall be turned over to the Owner free of dust and dirt, both inside and out.
- C. At the completion of the Project, equipment shall have a clean, neat appearance of factory finish by cleaning or repainting as required.
- D. At the completion of the Project, surfaces exposed to view shall have a clean, neat appearance of finish free from smudges and scratches by cleaning or repainting as required.

#### 1.13 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect/Engineer 7 days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive

rotation, belt tension, control sequence, or other conditions which may cause damage.

- D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of responsible manufacturer's representative in accordance with manufacturer's instructions.
- G. When specified in individual Specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

#### 1.14 FACTORY START-UP AND START-UP REPORTS

- A. Provide factory start-up of mechanical equipment listed below. Factory start-up shall be performed by a factory authorized representative of the equipment manufacturer. When factory start-up is successfully completed for each piece of mechanical equipment listed below, submit a formal start-up report to the Architect for approval. Start-up report shall be formatted in accordance with equipment manufacturer's recommendations. Start-up report shall be typed, not hand written, and shall be submitted in a clean and legible form.
- B. Equipment requiring factory start-up
  1. Air handling units
  2. Boilers
  3. Kitchen Hood Fire Suppression Systems.

#### 1.15 ADJUSTMENTS AND OWNER'S INSTRUCTIONS

- A. After completion of the installation work called for in the Contract Documents, furnish necessary mechanics or engineers for the adjustment and operation of the systems, to the end that the systems are perfectly adjusted and turned over to the Owner in perfect working order. Further instruct the Owner's authorized representative in the care and operation of the installation, providing framed instruction charts, directions, and other related items.
- B. Instructors providing Owner training shall be experienced and familiar with the jobsite.

#### 1.16 TESTING

- A. After the entire installation is completed and ready for operation, test the systems as outlined in Division 23 Section "Testing, Adjusting and Balancing for HVAC." These tests are supplementary to detailed tests specified herein or directed. The Owner will provide water and electric current for the test. Provide necessary labor, test pump, gauges, meters, other instruments, and materials. Perform tests in the presence of the Architect or his representative.

- B. Perform other tests specified in individual Sections of this Specification.

#### 1.17 COMPLETION OF SYSTEMS

- A. The following mechanical systems shall not be complete until the following conditions are satisfied:
  - 1. Ductwork Systems:
    - a. Ductwork and related components and accessories shall be completely installed and insulated as specified.
    - b. Ductwork leakage testing shall be completed and leakage testing reports shall be submitted and approved.
    - c. Ductwork shall be balanced and a balancing report shall be submitted and approved.
    - d. Commissioning shall be completed.
  - 2. Piping Systems:
    - a. Piping, valves and accessories shall be completely installed, insulated and labeled as specified.
    - b. Piping pressure testing be completed and pressure testing reports shall be submitted and approved.
    - c. Piping systems shall be balanced and a balancing report shall be submitted and approved.
    - d. Commissioning shall be completed.
  - 3. Equipment:
    - a. Equipment, including but not limited to boilers, heat exchangers, terminal heat transfer units, pumps, air handling units, condensing units, chillers, split system air conditioning equipment, and exhaust fans, shall be completely installed.
    - b. Equipment start-up reports shall be completed, submitted and approved.
    - c. Equipment balancing shall be completed and the balancing report shall be submitted and approved.
    - d. Commissioning shall be completed.
  - 4. Automatic Temperature Controls (ATC):
    - a. ATC system shall be completely installed.
    - b. Commissioning shall be completed.
    - c. ATC system shall operate in an automatic mode for a minimum of 4 months during Owner occupancy without substantial deficiencies.

#### 1.18 OPERATING AND MAINTENANCE MANUALS

- A. Furnish quantity required in Division 01 of the Specifications, of bound operating and maintenance manuals. Deliver to the Architect for review. Required quantity is for the Owner; the Architect will not retain a bound copy.
- B. For maintenance purposes, provide approved Submittals, parts lists, specifications, and manufacturer's maintenance bulletins for each piece of equipment. For materials used which have been submitted to the Architect for approval but do not require regular maintenance, such as piping, ductwork, and insulation, provide one copy of approved Submittals.
- C. Provide name, address and telephone number of the manufacturer's representative and service company, for each piece of equipment or material so that service or spare parts can be readily obtained.



1.19 WARRANTY

- A. Provide guarantees and warranties for work under this Contract as indicated in the general requirements of the Contract.
- B. Provide manufacturers' standard warranties and guarantees for work by the mechanical trades. However, such warranties and guarantees shall be in addition to and not in lieu of other liabilities which the manufacturer and the Mechanical Contractor may have by law or by other provisions of the Contract Documents.
- C. Guarantee that elements of the systems provided under this Contract are of sufficient capacity to meet the specified performance requirements as set forth in these Specifications or as indicated on the Drawings.
- D. Upon receipt of notice from the Owner of failure of any part of the mechanical systems or equipment during the warranty period, the Mechanical Subcontractor shall replace the affected part or parts.
- E. Furnish a written guarantee covering the above requirements before submitting the application for final payment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 230500

**This Page Intentionally Left Blank**

## SECTION 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Common requirements for electric motors furnished on equipment specified in other Sections, including single phase and three phase electric motors.
- B. Starters.
- C. Thermal Overload Protection.
- D. Belt Drives.
- E. Variable Speed Drives.

#### 1.2 REFERENCES

- A. Division 01 Section “References”: Requirements for references and standards.
- B. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- C. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- D. NEMA MG 1 - Motors and Generators.
- E. NFPA 70 - National Electrical Code.
- F. UL 508A - Industrial Control Panels.
- G. UL 674 - UL Standard for Safety Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.
- H. UL 1836 - UL Standard for Safety for Electric Motors for Use in Class I, Division 2 and Class II, Division 2 Hazardous (Classified) Locations.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.
- B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

#### 1.4 REGULATORY REQUIREMENTS

- A. Conform to UL Component Recognition for appropriate sizes.
- B. Conform to NFPA 70 and local energy code.

## 1.5 DELIVERY, STORAGE, AND PROTECTION

- A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.
- B. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

## PART 2 - PRODUCTS

### 2.1 MOTORS

- A. Acceptable Manufacturers:
  - 1. A.O. Smith.
  - 2. Baldor.
  - 3. Emerson Motor Technologies.
  - 4. General Electric.
  - 5. Greenheck Fan Corporation.
  - 6. Marathon Electric.
  - 7. Siemens.
  - 8. Teco-Westinghouse.
  - 9. Toshiba.
  - 10. U.S. Motors (division of Emerson Motor Technologies).
  - 11. WEG.
- B. General Construction and Requirements:
  - 1. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer’s standard and need not conform to these Specifications.
  - 2. Motors shall have integral thermal overload protection.
  - 3. Single Phase Motors for general applications: PSC (permanent split capacitor) where available.
  - 4. Single Phase Motors for fans:
    - a. EC (electronically commutated) where available.
    - b. PSC (permanent split capacitor) where available, if EC is not available. ]
  - 5. Open drip-proof type except where specifically noted otherwise.
  - 6. Design for continuous operation in 40 degrees C environment.
  - 7. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
  - 8. Explosion-Proof Motors: UL approved for hazard classification.
  - 9. Visible Nameplate: Indicating manufacturer’s name and model number, motor horsepower, RPM, frame size, voltage, phase, cycles, full load amps, insulation system class, service factor, maximum ambient temperature, temperature rise at rated horsepower, minimum efficiency.
- C. Inverter Duty: Motors for use with variable frequency drives shall be rated for “inverter duty”, with winding insulation rated for 1600 Volts and Class H (180 degrees C) temperature rating.
- D. Single-Phase Power for Fans - Electronically-Commutated (EC) Motors - Also Known As Brush-Free DC (BFDC) Motors:
  - 1. Drive: Direct-drive only, not for use with belt drive.

2. Power Supply: Internal motor circuitry shall convert AC power supplied to DC power to operate the motor.
  3. Turndown: Speed-controllable down to 20 percent of full speed (80 percent turndown).
  4. Speed Control: Integral potentiometer with screwdriver setting, remote potentiometer dial with 24 VDC transformer to generate a 0-10 VDC signal, or integral circuitry to accept a 0-10 VDC signal from the building control system, as indicated and specified.
  5. Efficiency: Minimum of 85 percent efficient at all speeds.
  6. Soft-start type, capable of reliable start at any speed setting.
  7. Enclosure: Open drip-proof.
  8. Bearings: Permanently lubricated heavy duty ball bearings.
  9. Overload Protection:
    - a. Automatic Speed Control: In the event of overheating or overloading, the motor electronics slow the motor to operate within its acceptable range.
    - b. Thermal Overload: Internally fused, one-shot type as a last resort to prevent fires.
    - c. Locked Rotor: If the motor sees a locked rotor condition, it will automatically shut itself down, then try to restart 3 times. After the 3rd try, the motor will not attempt to restart until the power is cycled. ]
- E. Single Phase Power - Permanent-split Capacitor Motors:
1. Starting Torque: Exceeding one fourth of full load torque.
  2. Starting Current: Up to six times full load current.
  3. Multiple Speed: Through tapped windings.
  4. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.
- F. Single Phase Power - Capacitor Start Motors:
1. Starting Torque: Three times full load torque.
  2. Starting Current: Less than five times full load current.
  3. Pull-up Torque: Up to 350 percent of full load torque.
  4. Breakdown Torque: Approximately 250 percent of full load torque.
  5. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
  6. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated bearings.
  7. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.
- G. Single Phase Power - Split Phase Motors:
1. Starting Torque: Less than 150 percent of full load torque.
  2. Starting Current: Up to seven times full load current.
  3. Breakdown Torque: Approximately 200 percent of full load torque.
  4. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
  5. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.
- H. Three Phase Power - Squirrel-cage Motors:
1. Starting Torque: Between 1 and 1-1/2 times full load torque.
  2. Starting Current: Six times full load current.

3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
4. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B energy-efficient motors.
5. Insulation System: NEMA Class B or better.
6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
7. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
8. Sound Power Levels: To NEMA MG 1.
9. Part Winding Start Above 254T Frame Size: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
10. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
11. Nominal Efficiency: To NEMA MG 1, energy efficient for motor sizes 10 and larger.

## 2.2 STARTERS AND OVERLOADS

- A. Acceptable Manufacturers:
  1. Cerus Industrial, Inc.
  2. Allen-Bradley (division of Rockwell Automation).
  3. Cutler Hammer (division of Eaton Corporation).
  4. General Electric.
  5. Siemens.
  6. Square D (division of Schneider Electric).
- B. Provide motor starters for motors provided under this Division of these Specifications.
- C. Cerus Industrial "BAS" building automation HVAC starters are the basis of design. Features of starters/contactors, disconnects, and temperature controls shall be combined in a single package using these starters. Coordination with Automatic Temperature Controls supplier and installer is required to reduce total project costs.
  1. 3-phase starter features include:
    - a. Multi-tap control power transformer (CPT) for universal control voltage.
    - b. Motor circuit protector disconnect (MCP) with high interrupt rating and lockable operator handle.
    - c. Contactors rated as high as 2.5 million electrical operations and 25 million mechanical operations.
    - d. Anti-cycling feature.
    - e. Solid-state electronic overloads with wide adjustment range and highly accurate digital motor protection, including protection for phase loss, phase unbalance, stall and locked rotor conditions. Class 1-30.
    - f. Digital keypad, featuring an H-O-A (Hand, Off, Auto) panel with large, clearly labeled push buttons including a front panel reset function and high-intensity LED indicators for settings.
    - g. Damper and valve actuator control, to open the actuator before starting the fan or pump motor.

- h. Permissive auto control to disable auto inputs. Commonly used with a high pressure limit switch.
  - i. Universal control inputs, including auto dry input, and wet input for voltages from 20 to 138 VAC or VDC.
  - j. Power failure reset.
  - k. Fireman's override.
  - l. NEMA 1 enclosure with prepunched knockouts. NEMA 3R, 4, 4X, and 12 as required.
  - m. BACnet embedded communications option available.
  - n. UL Listed assembly.
  - o. 5-year warranty.
  - p. Factory printed label or engraved nameplate, designating the equipment served.
2. Single-phase starter (Cerus BAS-1P series) features include:
- a. Manually operated quick-make toggle mechanism lockable in the "Off" position, which shall also function as the motor disconnect.
  - b. Hand/Auto switch, concealed behind sliding cover to discourage tampering.
  - c. Capability to operate in both manual and automatic control modes. In automatic mode, the starter shall have the capability to integrate with a building automation system by providing terminals for run input, run status output, and fault output.
  - d. Control terminals integrated in the starter.
  - e. Power, run status, and fault LED pilot lights.
  - f. Interposing run relay and current sensing status output relay.
  - g. Voltage and dry inputs for auto run command.
  - h. System override mode (fireman's, occupancy, or manual).
  - i. Solid-state electronic overload with wide adjustment range and highly accurate digital motor protection, including protection for stall and locked rotor conditions. Class 10. Concealed adjustment behind sliding cover.
  - j. Surface mount enclosure, UL Type 1, single gang box installation, with sliding covers for concealed items.
  - k. Power Input: 1-phase, 110-240 VAC, 1-16 Amps, 0.1-1 HP (75 to 745 W).
  - l. Universal Control Inputs: Voltage auto-run 10-130 VAC/DC to energize. Dry auto-run normally-open dry contact closure.
  - m. Control Outputs: Proof of run and fault, normally-open 0.3 Amps at 125 VAC, 1 Amp at 24 VAC.
  - n. Ambient operating temperature -5 to 140 degrees F (-20 to 60 degrees C).
  - o. UL 508A Listed.
  - p. 5-year warranty.
- D. At Contractor's option, Cerus Industrial "EMS" energy management HVAC starters may be provided. Features of starters/contactors, disconnects, and temperature controls, and power metering, shall be combined in a single package using these starters. Coordination with Automatic Temperature Controls supplier and installer is required to reduce total project costs. Starter features include:
- 1. True power measurement with integrated current transformers (CTs) to detect belt loss and alert the building automation system.
  - 2. Power metering, 1percent ANSI grade accuracy, with pulse/analog output of kW/kWh. Pulse output: normally-open contact, up to 45 V, up to 8 ohms resistance. Analog output of kW: 4-20 mA. LCD Display of kW and kWh.
  - 3. [BACnet embedded communications, RS-485 MS/TP half-duplex data transmission, with 30 points including metering value objects, binary value objects, multi-state objects, and analog value objects.

4. Multi-tap control power transformer (CPT) for universal control voltage.
5. Motor circuit protector disconnect (MCP) with high interrupt rating and lockable operator handle.
6. Contactors rated as high as 2.5 million electrical operations and 25 million mechanical operations.
7. Anti-cycling feature.
8. Solid-state electronic overloads with wide adjustment range and highly accurate digital motor protection, including protection for phase loss, phase unbalance, stall and locked rotor conditions. Class 1-60.
9. LCD 16-character 2-line display with backlight, plain English operation, with selectable readouts including power metering attributes and overload settings.
10. Digital keypad, featuring an H-O-A (Hand, Off, Auto) panel with large, clearly labeled push buttons including a front panel reset function and high-intensity LED indicators for settings.
11. Damper and valve actuator control, to open the actuator before starting the fan or pump motor.
12. Permissive auto control to disable auto inputs. Commonly used with a high pressure limit switch.
13. Fireman's override.
14. Power failure reset.
15. NEMA 1 enclosure with prepunched knockouts. NEMA 3R, 4, 4X, and 12 as required.
16. Power Input: 3-phase, 200-600 VAC, 0.5-95 Amps, 1-200 HP (0.75 to 149 kW).
17. Universal Control Inputs: Voltage auto-run, and fireman's override, 10-130 VAC/DC to energize. Dry auto-run, damper position switch, permissive auto, and shutdown, normally-open dry contact closure.
18. Control Outputs: Proof of run and fault, normally-open 0.3 Amps at 125 VAC, 1 Amp at 24 VAC. Damper and valve control, 1 Amp at 24 VAC (or 120 VAC).
19. Ambient operating temperature -5 to 140 degrees F (-20 to 60 degrees C).
20. UL Listed assembly.
21. 5-year warranty.
22. Factory printed label or engraved nameplate, designating the equipment served.]

E. Feature Descriptions:

1. Fireman's Override Input: Causes the starter to run the motor in any mode (Hand, Off or Auto) regardless of other inputs or lack of inputs either manual or auto. The purpose of the Fireman's Override input is to act as a smoke purge function. Fireman's Override has priority over the Emergency Shutdown input.
2. Emergency Shutdown Input: Disables the starter from operating in either Hand or Auto mode regardless of other inputs either manual or auto.
3. Phase Failure Protection: Initiates when phase loss is greater than 70 percent for 3 seconds or phase unbalance is greater than 50 percent for more than 5 seconds.
4. Cycling Fault Protection: Activates whenever the starter is cycled at a rate of more than 1000 cycles in a one hour period. This feature shall be selectable to be disabled. Cycling fault shall cause overload LED to blink rapidly.

- F. Contactors in starters shall be general purpose NEMA rated for connected H.P. (definite purpose starters not acceptable). Coordinate control voltage with Controls Contractor. Provide auxiliary contacts where required for interlocking of electrical equipment. Provide 2-speed motor starters where indicated or required.



- G. Single phase motors shall have one of the following factory wired methods of motor protection:
  - 1. Integral thermal overload protection in motor and cord with plug and receptacle in unit casing.
  - 2. Integral thermal overload protection in motor and disconnecting switch mounted in or on casing as specified with equipment.
  - 3. Switch with thermal overload protection for unprotected motors with switch serving as disconnect device.
  
- H. For starters associated with equipment that is required to be shut down upon a fire alarm condition, provide input contacts within the starter enclosure to interface with the building's fire alarm system. Upon receipt of a signal from the building's fire alarm system, power to load side of the starter shall be turned off. Circuitry shall be provided to ensure that power is off whether the starter is in the "AUTO", "HAND" or "BYPASS" mode. If this feature is not available from the starter manufacturer, provide a contactor on the line side of the starter to accomplish the same function. The contactor shall meet the requirements of Division 26.

### 2.3 V-BELT DRIVES

- A. Provide self-aligning roller-bearings mounted in sealed housings with grease fittings and grease overflow valves. Fan wheels and shafts shall be designed for critical speed at least 20 percent higher than the maximum fan speed. The assembled fan shall be statically and dynamically balanced at the factory. Bearings shall be certified to have an average life per AFBMA of not less than 200,000 hours.
  
- B. The drive base shall be constructed to allow adjustment of belt tension without having to loosen motor hold-down bolts.
  
- C. Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
  - 1. Provide adjustable-sheave belt drives for motors, except as otherwise specified in individual Sections of the Specifications.
  - 2. Sheaves on motors 25 hp (18.6 kW) and over shall be fixed type.

### 2.4 VARIABLE FREQUENCY DRIVES

- A. Acceptable Manufacturers:
  - 1. ABB (ACH550 Series) (basis of design).
  - 2. Cerus Industrial, Inc. (P-Series).
  - 3. Danfoss (VLT FC-100 Series).
  - 4. Rockwell Automation (Allen-Bradley).
  - 5. Toshiba (Q7 Series).
  - 6. Yaskawa (E7 Series).
  - 7. No substitutions.
  
- B. The variable frequency drives (VFDs) with options shall be UL listed as a complete assembly and shall be built in compliance with the latest standards of ANSI, IEEE, NEMA and the National Electric Code.
  
- C. The VFDs shall be designed to meet the requirements of the following standards: IEC801-2, IEC801-4, IEC255-4.

- D. Quality Assurance:
1. Manufacturer: Shall specialize in manufacture, assembly, and field performance of VFDs with minimum 5 years' experience.
  2. The VFD manufacturer shall have an existing representative, exclusively for HVAC applications, an independent service and start-up organization, and a parts stocking depot local to the installation.
- E. Warranty and Start-Up Service:
1. Start-Up Service: The VFD manufacturer shall provide a start-up service package. Service shall include inspection, final adjustment, operational checks, coordination with interface to building's ATC system (coordinate with Division 23 Section "Instrumentation and Controls for HVAC") and a final report for record purpose. Start-up service shall be performed by a factory approved and certified technician.
  2. Report: Submit a report of start-up and initial settings and readings.
  3. Owner Training: Provide a session of at least 4 hours, to train 2 or more of the Owner's representatives in the operation and maintenance of the drives. Schedule the training at the Owner's convenience within normal working hours, within 2 months after Substantial Completion.
  4. Warranty: For a period of 2 years after factory start-up, the VFD manufacturer shall include a full parts and labor on-site warranty at no additional cost.
- F. Construction:
1. Pulse Width Modulated design converting the fixed utility voltage and frequency to a variable voltage and frequency output. The VFD shall employ a full wave bridge rectifier, DC bus choke, DC bus filter capacitors, and Insulated Gate Bipolar Transistors (IGBTs) as the output switching device. SCRs, GTOs and Darlington transistors are not acceptable. The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.
  2. 6-pulse (minimum) converter section.
  3. NEMA 1 ABS plastic or metal enclosure.
  4. Standard operating conditions are:
    - a. Incoming AC power at building power system design's phase and voltage (see Contract Drawings)  $\pm 10$  percent, 60 Hz. Output voltage, phase and frequencies compatible with equipment served (see Contract Drawings).
    - b. Humidity 0 to 95 percent (noncondensing and noncorrosive).
    - c. Altitude 0 to 3,300 feet above sea level, without derating.
    - d. Ambient temperature 0 to 40 degrees C.
    - e. Verify actual operating conditions, and derate drive capacity as required.
  5. VFDs shall include the following features:
    - a. Customer interface, including digital display in plain English (code numbers are not acceptable), keypad and customer connections.
    - b. Carrier (Switching) Frequency: Optimized for a 3 kHz or 4 kHz carrier frequency to reduce motor noise. The carrier frequency shall be adjustable by the start-up technician, in a range at least as low as 1 kHz and as high as 8 kHz. Provide at least the following settings to allow fine tuning: 1 kHz, 4 kHz, and 8 kHz.
    - c. Built-in program to automatically vary the carrier (switching) frequency. Acceptable types of control include:
      - 1) ABB's switching frequency foldback control, reduces heat generated by the IGBTs by reducing the carrier frequency if the heatsink temperature rises above 176-194 degrees F (80-90 degrees C).

- 2) Danfoss automatic switching frequency modulation, reduces noise at low loads (below 60 percent) by adjusting the carrier frequency up to a selected maximum, and provides maximum power and efficiency at higher loads by adjusting the carrier frequency downward to a more efficient setting.
  - d. The option of either (1) displaying a fault, (2) running at a preset speed, or (3) running at the last known speed (average of last 10 seconds) if the input reference (4-20mA or 2-10V) is lost.
  - e. Automatic restart after an overcurrent, overvoltage, or undervoltage, or loss of input signal protective trip. The number of restart attempts and trial time shall be programmable.
  - f. The ability to start into a rotating load (forward or reverse) and accelerate or decelerate without safety tripping or component damage (flying start).
  - g. Automatic power loss ride through circuit that will utilize the inertia of the load to keep the drive powered. Minimum power loss ride through shall be 1 cycle based on full load and no inertia.
  - h. Isolated power for control circuits.
  - i. Input line fuses.
  - j. Acceptable start/stop commands shall include closure of a contact or switch, application and removal of input power and optional application and removal of 115 VAC on-off signal.
  - k. Load loss detection. Each VFD shall provide a dry contact closure at a field adjustable load threshold to indicate a loss of motor load (for example, broken fan belt or pump cavitation).
  - l. Pilot light cluster to provide visual indication of protective functions and circuit status, including the following LEDs:
    - 1) Power on (Red): Illuminates when main power is applied to the controller.
    - 2) AFC Run (Green): Illuminates to annunciate a drive run condition.
    - 3) AFC Fault (Yellow): Illuminates to annunciate a fault condition.
  - m. Five programmable critical frequency lockout ranges to prevent the VFD from continuously operating at an unstable speed.
  - n. PI setpoint controller integral to the drive, allowing a pressure or flow signal to be connected to the VFD, using the VFD for the closed loop control, eliminating the need for external controllers.
  - o. Three programmable digital relay outputs, rated for maximum switching current 8 amps at 24 VDC and 0.4 amps at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS.
  - p. Seven programmable preset speeds.
  - q. Six programmable digital inputs for interface with energy management system.
  - r. Two independently adjustable acceleration and deceleration ramps, adjustable from 1 to 1800 seconds.
  - s. Ramp or coast to a stop.
  - t. Two programmable analog outputs to provide 4-20 ma signals linear to output frequency, motor speed, output current, motor torque, motor power, DC bus voltage, and motor voltage.
6. VFD door mounted operator digital display shall include:
- a. Output Frequency
  - b. Motor Speed (RPM)
  - c. Motor Current
  - d. Calculated Motor Torque
  - e. Calculated Motor Power
  - f. DC Bus Voltage

- g. Output Voltage
  - h. Heat Sink Temperature
  - i. Analog Input Values
  - j. Keypad Reference Values
  - k. Elapsed Time Meter
7. VFD speed command input shall include:
- a. Keypad.
  - b. Two analog inputs, each capable of accepting a 0-20 mA, 4-20mA, 0-10V, and 2-10V signal inputs isolated from ground, and programmable via the keypad for different uses. Inputs shall have a programmable filter to remove any oscillation of the reference signal. The filter shall be adjustable from 0.01 to 10 seconds. The input shall be able to be inverted, so that minimum reference corresponds to maximum speed, and maximum reference corresponds to minimum speed.
  - c. Floating point input to accept a three wire input from a Dwyer Photohelic gauge or equivalent type instrument.
  - d. RS-485 communications.
8. The VFD shall include the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in plain words.
- a. Overcurrent trip, 200 percent of the VFD's variable torque current rating.
  - b. Overvoltage trip, 130 percent of the VFD's rated voltage.
  - c. Undervoltage trip, 60 percent of the VFD's rated voltage.
  - d. Over temperature, + 70 degrees C.
  - e. Ground fault.
  - f. Adaptable Electronic Motor Overload Protection: Shall protect the motor based on speed, load curve, and external fan parameter. Circuits that protect the motor only at full speed are unacceptable.
  - g. Power line surge protection by means of a metal oxide varistor (m.o.v.).
9. Accessories to be furnished and mounted by the drive manufacturer and contained in a single enclosure (the use of more than one enclosure is not acceptable):
- a. Protection From Harmonics and Voltage Spikes: Provide one of the following:
    - 1) Line Reactors: 3-percent AC input line reactors to reduce harmonic current distortion to the incoming power line, and to provide some protection to the drive from incoming voltage spikes. Provide reactors in each phase of incoming power to each VFD. Install between the input power and the drive's input bridge rectifier (so they protect the rectifier). The line reactor shall provide attenuation of line side voltage transients, thus preventing overvoltage trips or other unnecessary VFD shutdowns and providing a reduction in harmonic current distortion. Line reactors shall be manufactured by TCI of Milwaukee, WI and must meet the following requirements: provide a minimum of 2-1/2 percent line impedance, have a saturation rating of no less than 2.5 times the continuous current rating, and be UL recognized.
    - 2) ABB Design: Integral 5 percent swinging chokes in the AC input lines, configured between the input power and the drive's input bridge rectifier (so they protect the rectifier from spikes in input power).
      - a) The swinging choke is an inductor with an inductance value inversely proportional to its operating current. Over a substantial portion of the normal operating current range, the inductance decreases as the current in the choke increases. A conventional or linear choke has a fixed inductance value that changes very little as the operating current varies in the normal operating range.

- b) The harmonic limiting effectiveness of the swinging choke increases when the operating point is less than maximum power.
  - c) Compared to a standard linear choke, the swinging choke provides superior line harmonic current reduction when the drive's output power is less than or equal to rated output.
  - d) The effective inductance value of a swinging choke at full load is higher than the value of a linear choke of the same physical size.
  - e) The efficiency of a swinging choke is higher than the efficiency of a linear choke of the same inductance value.
  - f) Since the design point BHP is nearly always less than the nameplate horsepower of the selected motor, with swinging chokes the harmonic contribution of the drive will nearly always be less than that at maximum rated output power.
  - g) See U.S. Patent No. 6,774,758, "Low harmonic rectifier circuit" using non-linear inductor(s).
- 3) Danfoss Design: Harmonic suppression and surge suppression integral to the drive using separate components.
- a) Harmonic Suppression: DC link chokes (inductors) installed between the drive's input bridge rectifier and the inverter bus capacitor, consisting of a dual, 5 percent DC-link reactor on the positive and negative rails of the DC bus. This reactor reduces the level of harmonics reflected back into the building power system without causing a voltage loss at the drive's input, and improves input power factor. The reactor is non-saturating (linear) to provide full harmonic filtering throughout the entire load range. In performance, the harmonic suppression of the DC-link reactor is equivalent to a 5 percent AC line reactor.
  - b) Incoming Power-Line Surge Suppression: Fast-acting Metal Oxide Varistor (or (MOV) installed between the input power and the drive's input bridge rectifier, Zener diodes and oversized DC bus capacitors to provide protection against high potential spikes. When the voltage exceeds 2.3 times the expected incoming voltage for 1.3 milliseconds, the MOV shorts, protecting the internal parts of the drive including the 3-phase full-wave diode bridge. The reactor also acts to reduce input current caused by power line disturbances. Provide 4 MOVs, one on each of the 3 inputs and one attached to the DC Link. Comply with the German specification for surge suppression (VDE 0160).
- 4) Linear chokes or DC link chokes used alone without surge suppression on the incoming power are NOT acceptable as alternatives to line reactors. If they are standard and integral to the VFD, they may be provided in addition to line reactors.
- b. Bypass: Manual transfer to line power via contactors and including class 20 bimetal motor thermal overload relays and fuse or circuit breaker protection while in bypass operation, with automatic bypass capability.
- 1) Provide bypass on drives which serve single non-redundant motors, such as fan motors in air handling units and air conditioning units.
  - 2) Bypass is not required on drives which serve one of a pair of matching and fully-redundant motors with individual drive per motor (such as a pair of pumps where one is the lead pump and one is a 100 percent backup, and each pump has its own VFD).

- c. Service switch which provides the ability to service the controller (electrically isolated while in bypass operation) without having to remove power to motor.
  - d. Hand-off automatic switch (HOA), prewired. The HOA switch shall be operable in both the Normal and Bypass (if provided) modes of operation. The switch may be dial type, or momentary-contact pushbutton type with LED indicator lights. The switch may be integral to the standard VFD keypad, if it is a dedicated physical switch that is always available, but it is not allowed to serve any other functions, and it may not be a virtual switch such as on a touchscreen.
    - 1) When Auto mode is selected, the external start command and external reference speed signal shall control the motor.
    - 2) When Hand mode is selected, the motor shall run and the manual potentiometer shall control the motor speed. Other controls and inputs/outputs shall function as in Auto mode.
  - e. Manual potentiometer, dial type with calibrated nameplate. Provide an analog (dial-type) or digital meter to indicate selected speed.
    - 1) If the HOA switch is a dedicated button integral to the VFD keypad, and the potentiometer function is immediately available without any further steps when the HOA is in “Hand” position (such as up-down pushbuttons on the face of the keypad), the potentiometer may be integral to the standard VFD keypad. The speed meter may be a display on the general display screen.
  - f. Customer Interlock Terminal Strip - provide a separate terminal strip for connection of fire, smoke, freeze contacts and external start command. External interlocks and start/stop contacts shall function with drive in hand, auto or bypass.
  - g. Door interlocked disconnect or circuit breaker, padlockable in off position.
  - h. For drives that control fans or pumps which are specified to operate in an automatic lead/lag arrangement, provide automatic alternation device in VFD enclosure. (coordinate with Division 23 Section “Instrumentation and Controls for Mechanical Systems”).
10. Energy Management System Interface
- a. Drive shall have the capability to be controlled and monitored via analog and digital inputs and outputs.
  - b. In addition to analog and digital I/O the VFD shall be capable of communicating with the following controls companies’ communication buses with no extra hardware:
    - 1) Johnson Controls
    - 2) Siemens Controls
  - c. Drive shall have integral capability to be controlled and monitored through BACnet, LonWorks, Modbus, or other serial communication protocol compatible with the building automatic temperature control system. Provide adapter modules as required.
  - d. Coordinate with suppliers and installers of building automatic temperature control system to ensure compatibility and full functionality. See Division 23 Section “Instrumentation and Controls for Mechanical Systems.”
11. In the event of a power failure and upon restoration of power, the variable frequency drive shall remain responsive to its command signal from the building’s energy management/temperature control system. The drive shall not require manual resetting after a power outage in order to respond to the energy management/temperature control system’s command signal.
12. For drives that are associated with equipment that is required to be shut down upon a fire alarm condition, provide input contacts within the VFD enclosure to interface with the building’s fire alarm system. Upon receipt of a signal from the building’s fire alarm

system, power to load side of the VFD shall be turned off. Circuitry shall be provided to ensure that power is off whether the VFD is in the “AUTO”, “HAND” or “BYPASS” mode. If this feature is not available from the VFD manufacturer, provide a contactor on the line side of the VFD to accomplish the same function. The contactor shall meet the requirements of the Electrical Division of the Specifications.

13. Occasional input and output power circuit switching shall be able to be accomplished without interlocks or damage to the drive. If drive design cannot tolerate interruption of output, such as by a disconnect switch mounted between the drive and the motor, provide protective devices and coordinate with installers to protect the drive as specified in Part 3 – Execution in this Section.

G. Compliance with IEEE-519:

1. Input Line Reactors: Provide as specified in “Construction” paragraph of this Section.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Division 01 Section “Quality Requirements”: Manufacturer’s instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Coordinate with Division 26 “Electrical.”
- D. Check line voltage and phase and direction of rotation, and ensure agreement with nameplate.
- E. Install guards in accordance with Codes and OSHA requirements.
- F. Adjust motor overload devices based on motor amperage ratings and field measurements of running amps, to ensure protection of the motor and eliminate nuisance trips.
- G. Disconnect Switch Mounting Height: Install at height above finished floor in accordance with NFPA 70.
  1. In most instances, the center of the grip of the disconnect switch operating handle in its highest position shall be no more than 79 inches (2.0 m) above finished floor or working platform.
  2. Switches and circuit breakers installed adjacent to the equipment served (and within 79 inches (2.0 m) above finished floor or working platform.
- H. Variable Frequency Drives:
  1. Mounting Height:
    - a. Install with the disconnect switch height in accordance with NFPA 70, as described in the paragraph “Disconnect Switch Mounting Height” in this Section.
    - b. The VFD shall be considered to be a piece of equipment served by its disconnect switch, for purposes of NFPA 70, unless otherwise indicated, or otherwise directed by the Authority Having Jurisdiction or by the Owner.
      - 1) If the motor served by the VFD is within sight of the VFD, and within 50 feet (15.2 m) measured in a straight line, this disconnect switch may also serve the motor unless otherwise indicated.

- c. When possible, install VFDs with their operator-interface display at 79 inches (2.0 m) or less above finished floor, unless otherwise indicated or directed.
    - 1) To restrict unauthorized access, VFDs in locations accessible to the public (such as but not limited to classrooms, unrestricted storage rooms, and corridors) shall be mounted with the disconnect switch at 72 to 79 inches (1.8 to 2.0 m) above finished floor, with the VFD operator display and other accessories mounted above the disconnect switch, where ceiling height allows, unless otherwise indicated.
    - 2) In mechanical rooms and other restricted-access locations, mount VFDs at a height for greatest user convenience.
  - d. When possible, mount groups of adjacent VFDs with tops at uniform height above finished floor.
  - e. Because VFDs produce heat, do not install a VFD above another one, or above another heat-producing device. Do not install a VFD below or too near to any heat-sensitive device or room temperature sensor. Provide ventilation space and other means of cooling as required by the manufacturer.
  - f. Install with service and installation clearances as required by the manufacturer.
2. Electrical Connections:
- a. Provide separate metal conduits for drive input power, output power to the motor, and control wiring. Output motor cables from multiple drives shall be run separately.
  - b. Ground each drive separately.
  - c. Ensure that a fused disconnect switch is provided upstream between the transformer and the drive. Fuses are required because they are faster-acting than circuit breakers.
  - d. If drive design cannot tolerate interruption of output, such as by a disconnect switch mounted between the drive and the motor, provide protective devices and coordinate with installers to protect the drive, and coordinate with installers to ensure that no unnecessary switching is installed.
    - 1) When the VFD is out of sight from the equipment served, or is more than 50 feet (15.2 m) from the equipment served, a disconnect switch mounted on or adjacent to the equipment is generally required in Division 26 “Electrical” or by the Authority Having Jurisdiction. If such a disconnect or other switching device is indicated or required, provide protective devices as required by the VFD manufacturer. Such devices typically include an “early-break” auxiliary set of contacts or a “Stop” button on the disconnect switch, field-wired to the VFD’s external fault input or stop input, so that if the switch is opened while the VFD is running, the input will shut off the output of the VFD. The VFD stop method must be set to “Coast.” Provide field wiring in conduit.
    - 2) Provide engraved nameplates at disconnect switches and other devices, instructing users on the proper operation of these devices to prevent damage to the VFD.
3. Carrier Frequency: Adjust to minimize noise, but also to minimize the potential for motor bearing damage due to VFD-induced shaft voltage.
- a. VFDs convert line AC voltage to a pulse width modulated (PWM) AC voltage of variable frequency. The switching frequency of these pulses is referred to as the “carrier frequency.” The switching induces a voltage on the rotor shaft, which, if it builds up to a sufficient level, can discharge as “bearing current” to ground through the bearings. This has an electric discharge machining (EDM) effect, causing



- pitting of the bearing's rolling elements and raceways. This effect can be minimized by proper setup.
- b. The higher the carrier frequency, the higher the rate of the current discharge pulses, and the more likely EDM will occur. At higher carrier frequencies the VFD will generally run quieter; however, it becomes more destructive on the motor insulation and bearings.
  - c. Adjust the carrier frequency as low as possible without creating unacceptable audible noise levels, and to avoid frequencies above 6 kHz altogether if possible.
4. Coordinate with building controls systems as specified in Part 2 of this Section.
  5. Perform startup service, and submit report.
  6. Provide warranty service.
  7. Provide Owner training.

END OF SECTION 230513

**This Page Intentionally Left Blank**

## SECTION 230519 – METERS AND GAUGES FOR HVAC PIPING

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Pressure gauges and Pressure gauge taps.
- B. Test Plugs.
- C. Thermometers and thermometer wells.
- D. Thermowell heat transfer paste.

#### 1.2 RELATED SECTIONS

- A. Division 23 Section “Hydronic Piping.”
- B. Division 23 Section “Instrumentation and Controls for Mechanical Systems.”

#### 1.3 REFERENCES

- A. Division 01 Section “References”: Requirements for references and standards.
- B. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
- C. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.
- D. ASTM D217 - Standard Test Methods for Cone Penetration of Lubricating Grease.
- E. ASTM D566 - Standard Test Method for Dropping Point of Lubricating Grease.
- F. ASTM E1 - Standard Specification for ASTM Thermometers.
- G. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
- H. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
- I. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
- J. AWWA C702 - Cold-Water Meters - Compound Type.
- K. AWWA C703 - Cold-Water Meters - Fire-Service Type.
- L. AWWA C706 - Direct-Reading Remote-Registration Systems for Cold-Water Meters.
- M. AWWA C710 - Cold-Water Meters - Displacement Type, Plastic Main Case.
- N. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
- O. HCF\_SPEC-13 - HART Communication Protocol Specification.

P. MIL-HDBK-217F – Military Handbook – Reliability Prediction of Electronic Equipment.

Q. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.

R. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

#### 1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years' experience.

#### 1.5 SUBMITTALS

A. Division 01 Section “Submittal Procedures”: Procedures for submittals.

B. Product Data: Provide manufacturers data and list which indicates use, operating range, total range, accuracy, and location for manufactured components.

#### 1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 01 Section “Closeout Procedures.”

B. Project Record Documents: Record actual locations of components and instrumentation.

#### 1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

B. Include instructions for calibrating instruments.

#### 1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 01 Section “Product Requirements”: Environmental conditions affecting products on site.

B. Do not install instruments when areas are under construction, except for required rough-in, taps, supports and test plugs.

C. Supply 2 bottles of red gauge oil for static pressure gauges.

### PART 2 - PRODUCTS

#### 2.1 PRESSURE GAUGES

- A. Manufacturers:
1. Weiss Series 4CTS.
  2. Trerice 600 Series.
  3. Marshalltown.
  4. Amtek.
  5. Dwyer.

- B. Gauge: Non-filled type, with bourdon tube, rotary brass movement, brass socket, soft-soldered connections, front recalibration adjustment, black scale on white-finished metal background.
  - 1. Case: Cast aluminum or stainless steel.
  - 2. Lens: Push-in Lexan polycarbonate, or clear glass or acrylic with stainless steel ring, per manufacturer's standard.
  - 3. Bourdon Tube: Phosphor bronze.
  - 4. Dial Size: 4 to 4-1/2 inch (101 to 114 mm).
  - 5. Connection: Lower, 1/4 inch NPT.
  - 6. Accuracy: 1 percent of full scale range, per ANSI-ASME B40.1 Grade 1A.
  - 7. Scale: Psi .
  - 8. Range: 0-60 psig typical, select for application.
- C. Verify suitability of range for each application. Best selection is for typical reading to be close to mid-scale.

## 2.2 PRESSURE GAUGE TAPPINGS

- A. Ball Valve: Provide under Division 23 Section "Hydronic Piping."
- B. Pulsation Damper:
  - 1. Manufacturers:
    - a. Weiss.
    - b. Trerice.
    - c. Marshalltown.
    - d. Amtek.
    - e. Dwyer.
  - 2. Pressure snubber, brass with 1/4 inch (6 mm) NPT connections.

## 2.3 TEST PLUGS

- A. Test Plug:
  - 1. Manufacturers:
    - a. Peterson Equipment Co., Inc., "Pete's Plugs".
    - b. Weiss.
    - c. Flow Design, Inc.
    - d. Trerice.
  - 2. 1/2 inch (13 mm) NPT brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with self-closing valves as follows:
    - a. Nordel (EPDM) core for water and hydronic heating and cooling service, temperatures range 30 to 275 degrees F (-1 to 176 degrees C).
    - b. Neoprene core for natural gas or LP gas service, temperature range -40 to 150 degrees F (-40 to 65 degrees C).
    - c. Verify core suitability for other fluids and temperatures.
  - 3. Working Pressure: 500 psig
  - 4. Cap Retaining Strap: Color coded to indicate core material.
  - 5. Construction with either dual self-closing valves (Pete's Plug standard design) or single valve are allowed.
  - 6. For chilled water applications, provide "XL" plugs which include a 1-1/2 inch (38 mm) extension for insulated piping.

- B. Pressure and Temperature Test Kit: Furnish 1 to the Owner.
1. Carrying case with inside foam padding.
  2. Pressure gauge, liquid filled with 1/4 inch (6 mm) NPT connection, range 0 to 100 psig (0 to 700 kPa), with gauge adapter attached.
  3. Additional gauge adapter with 1/8 inch (3 mm) diameter probe and protecting shield.
  4. Bimetal thermometer, range 25 to 125 degrees F (-5 to 50 degrees C), 5 inch (127 mm) stem, 1-3/4 inch (44 mm) dial, external calibration.
  5. Bimetal thermometer, range 0 to 220 degrees F (-17 to 104 degrees C), 5 inch (127 mm) stem, 1-3/4 inch (44 mm) dial, external calibration.
  6. If extended "XL" plugs are used, provide the XL test kit which is suitable for any length of plug.

## 2.4 THERMOMETERS - DIAL

- A. Manufacturers:
1. Weiss.
  2. Terrice.
  3. Amtek.
  4. Ernst.
- B. Thermometer: Weiss Model 45VA, ASTM E1, stainless steel or cast aluminum case, adjustable angle with front recalibration, vapor actuated, black scale on white-finished metal background, black pointer, sealed lens, brass stem.
1. Size: 4 to 4-1/2 inch (101 to 114 mm) dial.
  2. Lens: Snap-in Lexan polycarbonate with o-ring, or clear glass with rubber ring.
  3. Bulb: Copper. Provide extended bulb for socket extension in insulated pipe.
  4. Extended Bulb: Where required, provide extended capillary tube with braided copper protection.
  5. Connection: Separable socket.
  6. Accuracy: 1 scale division throughout range.
  7. Calibration: Degrees F.
  8. Scale Range: 30 to 240 degrees F (0 to 115 degrees C) .
  9. Graduations: 2 degrees F.
  10. Air Duct Flange: Provide for duct applications.

## 2.5 THERMOMETER SUPPORTS

- A. Socket (Thermometer Well) for Piping: Brass separable sockets for thermometer stems, with extensions for insulated piping. Provide with Honeywell viscous heat transfer paste.
- B. Flange for Duct: 3 inch (76 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

## 2.6 THERMOWELL HEAT TRANSFER PASTE

- A. Manufacturers:
1. MG Chemicals.
  2. Honeywell.
  3. Terrice.

- B. Description:
1. Formulation: Silicone or synthetic base, containing metal oxides.
  2. Thermal Conductivity: At least 4.5 Btu-in./(hr-ft<sup>2</sup>-°F) (0.65 W/(m-K)).
  3. Temperature Range: To 392 degrees F (200 degrees C).
  4. Flash Point: 500 degrees F (260 degrees C).
  5. Dropping Point: ASTM D566, greater than 500 degrees F (260 degrees C).
  6. Specific Gravity: 2.3 minimum at 77 degrees F (25 degrees C).
  7. Consistency: ASTM D217, 310 to 320.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Use ball valves for water service; use needle valves for steam service.
- B. Division 01 - Quality Requirements: Manufacturer's instructions.
- C. Install 1 pressure gauge per pump, with taps on suction and discharge of pump; pipe to gauge.
- D. Install gauge taps in piping; refer to Division 23 Section "Hydronic Piping" and "Steam and Condensate Heating Piping."
- E. Install pressure gauges with pulsation dampers. Provide valve to isolate each gauge; see "Pressure Gauge Tappings" in this Section.
- F. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches (64 mm) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- G. Install thermometers in air duct systems on flanges.
- H. Fill thermometer sockets with heat transfer paste.
- I. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.
- J. Locate duct mounted thermometers minimum 10 feet (3 m) downstream of mixing dampers, coils, or other devices causing air turbulence.
- K. Coil and conceal excess capillary on remote element instruments.
- L. Install static pressure gauges to measure across filters and filter banks (inlet to outlet). On multiple banks, provide manifold and single gauge.
- M. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- N. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

- O. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- P. Locate test plugs where indicated.
- Q. Provide pressure gauge at high point of system for setting of cold water make-up pressure reducing valve.
- R. Provide pressure gauge at connection to bladder type expansion tank for setting of air side pre-charge pressure.

END OF SECTION 230519



## SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Pipe and equipment hangers and supports.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment and pipe stacks.

#### 1.2 RELATED SECTIONS

- A. Division 03 Section “Cast-In-Place Concrete”: Equipment bases.
- B. Division 23 Section “Vibration and Seismic Controls for HVAC Piping and Equipment.”
- C. Division 23 Section “HVAC Piping Insulation.”
- D. Division 23 Section “HVAC Equipment Insulation.”
- E. Division 23 Section “Hydronic Piping.”

#### 1.3 REFERENCES

- A. ASME B31.1 - Power Piping.
- B. ASME B31.2 - Fuel Gas Piping.
- C. ASME B31.5 - Refrigeration Piping.
- D. ASME B31.9 - Building Services Piping.
- E. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- F. ASTM A653 G90 SS Gr. 33 - Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot Dipped Process.
- G. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- H. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, Monolithic Surfaces, and Polymer Concretes.
- I. ASTM C642 - Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete.
- J. ASTM C672 - Test Methods for Scaling Resistance of Concrete Surfaces Exposed to Deicing

Chemicals.

- K. ASTM D395 - Standard Test Methods for Rubber Property - Compression Set.
- L. ASTM D412 - Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
- M. ASTM D573 - Test Method for Rubber - Deterioration in an Air Oven.
- N. ASTM D746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- O. ASTM D2240 - Test Method for Rubber Property - Durometer Hardness.
- P. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- Q. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- R. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- S. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- T. NFPA 70 - National Electrical Code

#### 1.4 SUBMITTALS

- A. Submit under provisions of Division 01 Section "Submittal Procedures".
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data: Provide manufacturers catalog data including load capacity.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

#### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years' experience.

#### 1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable Codes for support of piping.
- B. Supports for Electrical: In conformance with NFPA 70 and Division 26 of the Specifications.

## PART 2 - PRODUCTS

### 2.1 HANGERS, SUPPORTS, & PIPE CLAMPS

- A. Approved Manufacturers (first manufacturer is basis of design):
1. Strut Hangers:
    - a. Unistrut (division of Tyco).
    - b. Anvil International.
    - c. Cooper B-Line.
    - d. Hydra-Zorb Company.
    - e. Thomas & Betts - Superstrut line.
    - f. Tolco (division of Cooper B-Line).
  2. Adjustable Swivel Band Hangers:
    - a. Carpenter & Paterson.
    - b. Anvil International.
    - c. Cooper B-Line.
    - d. Tolco (division of Cooper B-Line).
  3. Clevis Hangers:
    - a. Cooper B-Line.
    - b. Anvil International.
    - c. Carpenter & Paterson.
    - d. Tolco (division of Cooper B-Line).
  4. J-Hangers:
    - a. Cooper B-Line.
    - b. Carpenter & Paterson.
    - c. Thomas & Betts - Superstrut line.
    - d. Tolco (division of Cooper B-Line).
    - e. Unistrut (division of Tyco).
  5. Cushion Clamps:
    - a. Hydra-Zorb Company.
    - b. Cooper B-Line.
    - c. Thomas & Betts - Superstrut line.
    - d. Tolco (division of Cooper B-Line).
    - e. Unistrut (division of Tyco).
  6. Insulated Pipe Couplings:
    - a. Cooper B-Line - Armafix line.
    - b. Klo-Shure Corporation.
  7. No substitutions.
- B. Horizontal Piping Supports: Provide struts for trapeze hangers for single or multiple pipes. Where individual piping runs are hung with individual hangers, adjustable swivel band hangers, clevis hangers, or j-hangers may be used.
- C. Strut hangers shall be standard 1-5/8 inches x 1-5/8 inches (41x41 mm) size.
- D. Hangers, clamps, and supports located outdoors or otherwise exposed to weather, or in wet or washdown areas, shall be hot-dipped galvanized steel or 300-series stainless steel. Struts may be extruded aluminum. Threaded rods, nuts, and washers may have standard galvanizing if hot-dipped galvanized is not available.
1. Hot-dipped galvanized steel shall have a nominal zinc coating of 2.6 mil (0.066 mm)

- thickness and 1.5 oz./sq.ft (458 g/m<sup>2</sup>) coating weight.
2. In lieu of galvanizing, strut systems and their accessories may have Unistrut Perma-Green III electrodeposited thermoset acrylic coating, or be epoxy-coated equal to B-Line's Dura-Green or Dura-Copper coatings.
  3. Lesser coatings for struts and clamps, such as pre-galvanizing (0.75 mil (0.019 mm) thickness), electroplated zinc (0.2 to 0.5 mil (0.005 to 0.013 mm) thickness), and yellow zinc dichromate coating, are not acceptable in these locations.
- E. Pipe hanger rods and nuts shall be plated to match the hangers. Nuts shall be self-locking type, or provide double nuts tightened to lock together. Rods shall be threaded one end, or continuous threaded. Provide washers at each nut.
- F. Cushion Clamps for Un-insulated Lines: Plastic cushion shall be Dupont Hytel plastic, 5555HS plastic elastomer, warranted from -40 to 275 degrees F (-40 to 135 degrees C).
- G. Copper-plated hangers are plated for identification only. Traditional thin copper plating on steel substrate does not provide adequate protection from galvanic corrosion due to contact between dissimilar metals.
1. Where copper-plated supports are specified for use with copper piping, either copper plating or a copper-colored finish such as Cooper B-Line's Dura-Copper epoxy coating is acceptable. This is for identification, and does not protect dissimilar metals.
  2. Where copper piping is used with steel hangers and supports, provide protection from galvanic corrosion such as thick plastic or vinyl factory coating, or plastic-lined cushion clamps.
- H. For Insulated Lines Clamped to Strut: Insulated pipe coupling insert with the same thickness as the insulation. Protects insulation from crushing, and provides continuous insulation and vapor barrier thru the hanger or clamp. Klo-Shure product provides plastic pipe support and rigid outer band, for field insulation into the coupling. Armafix product provides insulation with rigid outer band, for field insulation glued to the ends of the insert.

## 2.2 PIPE SUPPORTS

- A. Hydronic Piping:
1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
  2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
  3. Hangers for Cold Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, clevis.
  4. Hangers for Hot Pipe Sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.
  5. Hangers for Hot Pipe Sizes 5 inches (125 mm) and Over: Adjustable steel yoke, cast iron roll, double hanger.
  6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches (150 mm) and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
  8. Wall Support for Pipe Sizes to 3 inches (76 mm): Cast iron hook.
  9. Wall Support for Cold Pipe Sizes 4 inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
  10. Wall Support for Hot Pipe Sizes 4 inches (100 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes to 4 inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 5 inches (125 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

B. Refrigerant Piping:

1. Conform to ASME B31.5, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 inches (75 mm): Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

## 2.3 INSERTS

A. Manufacturers:

1. Cooper B-Line.
2. Grinnell.

B. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

## 2.4 FLASHING

A. Metal Flashing: 26 ga (0.5 mm) thick galvanized steel.

B. Metal Counterflashing: 22 ga (0.8 mm) thick galvanized steel.

C. Lead Flashing:

1. Waterproofing: 5 lb/sq ft (24.5 kg/sq m) sheet lead
2. Soundproofing: 1 lb/sq ft (5 kg/sq m) sheet lead.

D. Flexible Flashing: 47 mil (1.2 mm) thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 ga (0.8 mm) minimum; 16 ga (1.5 mm) at fire resistant elements.

## 2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 ga (1.2 mm) thick galvanized steel.

- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 ga (1.2 mm) thick galvanized steel.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Sleeves for Round Ductwork: Galvanized steel.
- E. Sleeves for Rectangular Ductwork: Galvanized steel.
- F. Stuffing or Firestopping Insulation: Glass fiber type, non-combustible.
- G. Sealant: Acrylic.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

#### 3.2 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
- C. Place hangers within 12 inches (300 mm) of each horizontal elbow.
- D. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet (1.5 m) maximum spacing between hangers.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Refer to Division 09 Section "Painting". Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Do not support pipes from other pipes or equipment.

- M. Size pipe hangers to accommodate continuous piping insulation.

### 3.3 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches (100 mm) thick and extending 6 inches (150 mm) beyond supported equipment, with 1 inch (25 mm) chamfered edges. Provide dowels to fasten pad to structural floor. Refer to Division 03. Unless otherwise shown or specified, floor-mounted major equipment shall be set on housekeeping pads and anchored to housekeeping pads. This shall include but not be limited to, air handling units, utility set fans, compressors, base mounted pumps, boilers, converters, heat exchangers, storage tanks and expansion tanks.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.
- E. Do not support equipment from pipes or from other equipment.

### 3.4 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weatherproofed or waterproofed walls, floors, and roofs.
- B. Flash pipes projecting 3 inches (75 mm) minimum above finished roof surface with lead, 8 inches (200 mm) minimum clear on sides with 24 x 24 inches (600 x 600 mm) sheet size. For pipes through outside walls, turn flanges back into wall and caulk, counterflash with metal, and seal.
- C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- D. Provide curbs for mechanical roof installations 14 inches (350 mm) minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

### 3.5 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors 1 inch (25 mm) above finished floor level. Caulk sleeves.
- D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or

duct and adjacent work with fire stopping insulation and caulk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

- E. Install chrome plated steel escutcheons at finished surfaces.

### 3.6 SUPPORTING OTHER TRADES

- A. Supports furnished under Division 23 of the Specifications may also be used to support piping furnished under Division 22 "Plumbing" and conduits furnished under Division 26 "Electrical" if this Subcontractor is willing to allow this. Supports shared with other trades shall be designed to accommodate the weight, expansion/contraction, vibration, and other requirements of the other trades' items without detriment to the function, accessibility, and serviceability of the HVAC items or those of the other trades. Provide flexible sections of piping and conduit as required to allow each trade's items to expand and contract along with the other trades, and to absorb vibration caused by the other trades.
- B. Electrical lighting fixtures and equipment, and architectural items such as ceilings, may not be supported from supports furnished under this Section.
- C. Prevent contact between components of other trades, such as architectural suspended ceiling support wires, and HVAC supports which may transmit vibration to the occupied space.

### 3.7 SCHEDULES

PIPE SIZE		HANGER ROD MAX. HANGER SPACING		DIAMETER	
Inches	(mm)	Feet	(m)	Inches	(mm)
Steel and Copper Piping					
1/2 to 1-1/4	12 to 32	6.5	2	3/8	9
1-1/2 to 2	38 to 50	10	3	3/8	9
2-1/2 to 3	62 to 75	10	3	1/2	13
4 to 6	100 to 150	10	3	5/8	15

END OF SECTION 230529



## SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Labels.
- D. Pipe Markers.

#### 1.2 RELATED SECTIONS

- A. Division 09 Section “Painting”: Identification painting.

#### 1.3 REFERENCES

- A. Division 01 Section “References”: Requirements for references and standards.
- B. ASME A13.1 - Scheme for the Identification of Piping Systems (2007 edition or newer).
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
- D. NFPA 99 - Standard for Health Care Facilities.

#### 1.4 SUBMITTALS

- A. Division 01 Section “Submittal Procedures.”
- B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Samples: Submit 2 tags, 1-1/2 inches (38 mm) in size.
- F. Samples: Submit 2 labels, 1.9 x 0.75 inches (48 x 19 mm) in size.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Submit under Division 01 Section “Closeout Procedures.”
- B. Record actual locations of tagged valves; include valve tag numbers.

## 1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 01 Section "Operation and Maintenance Data."
- B. Include valve tag chart.

## 1.7 REGULATORY REQUIREMENTS

- A. Conform to NFPA 99 requirements for labeling and identification of medical gas piping systems and accessories.

## PART 2 - PRODUCTS

### 2.1 NAMEPLATES

- A. Manufacturers:
  - 1. Seton Identification Products.
  - 2. E.R. Perry Signs & Engraving.
  - 3. Brimar Industries, Inc., PipeMarker division.
  - 4. No substitutions.
- B. Plastic Nameplates: Laminated 3-layer plastic with beveled edges and engraved letters on contrasting background color, 1/16 inch (1.58 mm) thick. Letters shall be black on light backgrounds, or white on dark backgrounds, as applicable. Service temperature range -40 to 175 degrees F (-40 to 79 degrees C); minimum application temperature for adhesive 50 degrees F (10 degrees C). Suitable for average outdoor lifespan of at least 2-3 years.
- C. Aluminum Nameplates: For higher temperature applications, and for outdoor applications when manufacturer does not recommend their plastic nameplates for use outdoors, provide aluminum nameplates, with integral anodized or painted surface color coating and natural aluminum engraved letters, 1/32-inch (0.78 mm) thick. Service temperature range -40 to 350 degrees F (-40 to 177 degrees C); minimum application temperature for adhesive 50 degrees F (10 degrees C). Suitable for average outdoor lifespan of at least 2-3 years.
- D. Colors: Select background color as appropriate for the application. Color for general applications shall be white (except that aluminum nameplate standard color shall be black). Color for general warnings shall be red or yellow. Colors for fluid services shall comply with ASME A13.1-2007. Comply with ASME/ANSI standards and other regulations as applicable.
- E. Provide with factory adhesive, and with side holes for fastener attachment as applicable. Mechanical fasteners are required for applications which are outdoors or otherwise exposed to weather or sunlight, or in moist areas such as kitchens and locker rooms, or on cooled surfaces subject to condensation, or on surfaces with operating temperatures above 150 degrees F (65 degrees C). Where nameplate is on an irregular surface and cannot make complete contact, provide mechanical fasteners or ties in addition to adhesive.

## 2.2 TAGS

- A. Plastic Tags:
  - 1. Manufacturers:
    - a. Seton Identification Products.
    - b. E.R. Perry Signs & Engraving.
    - c. Brimar Industries, Inc., PipeMarker division.
    - d. No substitutions.
  - 2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches (38 mm) diameter.
- B. Metal Tags:
  - 1. Manufacturers:
    - a. Seton Identification Products.
    - b. Brady Worldwide, Inc.
    - c. Brimar Industries, Inc., PipeMarker division.
    - d. No substitutions.
  - 2. Brass with stamped letters; tag size minimum 1-1/2 inches (38 mm) diameter with smooth edges.
- C. Information Tags:
  - 1. Manufacturer: Seton Identification Products.
  - 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches (83 x 143 mm) with grommet and self-locking nylon ties.
- D. Tag Chains and Hooks: Brass or stainless steel compatible with tag material for general applications. Brass where in contact with copper piping or other copper-alloy materials.
- E. Tag Chart: Typewritten letter size list in anodized aluminum frame with plexiglass cover.

## 2.3 LABELS

- A. Manufacturer: Seton Identification Products.
- B. Description: Polyester, size 1.9 x 0.75 inches (48 x 19 mm), adhesive backed with printed identification.

## 2.4 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
  - 1. Manufacturers:
    - a. Seton Identification Products.
    - b. Brady Worldwide, Inc.
    - c. Brimar Industries, Inc., PipeMarker division.
    - d. No substitutions.
  - 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

- C. Plastic Underground Pipe Markers:
  - 1. Manufacturers:
    - a. Seton Identification Products.
    - b. Brady Worldwide, Inc.
    - c. Brimar Industries, Inc., PipeMarker division.
    - d. No substitutions.
  - 2. Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Division 09 Section "Painting" for stencil painting.

### 3.2 INSTALLATION

- A. Division 01 Section "Quality Requirements": Manufacturer's instructions.
- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic or aluminum engraved nameplates with corrosion-resistant mechanical fasteners, or adhesive, as specified. In outdoor locations, where lifetime of nameplates is limited, fasteners shall be removable screws or bolts for ease of nameplate replacement.
- D. Install labels with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain. Number tags consecutively by location.
- F. Identify items of mechanical equipment such as chillers, fans, terminal units, air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify valves in main and branch piping with metal tags.
- I. Tag automatic controls, instruments, and relays. Key to control schematic.
- J. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, at each branch and riser take-off, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- K. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

- L. Identify duct access doors at fire dampers, smoke dampers, and smoke detectors with 1/2 inch (12.7 mm) lettering to indicate the fire protection device(s) within, in accordance with NFPA 90A.
- M. Provide [ceiling dots with label-maker labels] [ceiling tacks] to locate valves, dampers and equipment above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
- N. Secure valve tag chart on an easily accessible wall in the mechanical room or in a location as otherwise directed by the Architect.

END OF SECTION 230553

**This Page Intentionally Left Blank**

## SECTION 230593 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Testing, Adjustment, and Balancing of Air Systems.
- B. Testing, Adjustment, and Balancing of Hydronic Systems.
- C. Measurement of Final Operating Condition of HVAC Systems.

#### 1.2 RELATED SECTIONS

- A. Division 01 Section “Quality Requirements”: Testing laboratory services: Employment of testing agency and payment for services.
- B. Division 01 Section “General Commissioning Requirements.”

#### 1.3 REFERENCES

- A. AABC - National Standards for Total System Balance.
- B. ADC - Test Code for Grilles, Registers, and Diffusers.
- C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

#### 1.4 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers.
- C. NEBB: National Environmental Balancing Bureau.
- D. SMACNA: Sheet Metal and Air Conditioning Contractors’ National Association.
- E. TAB: Testing, Adjusting, and Balancing.

#### 1.5 SUBMITTALS

- A. Submit under provisions of Division 01 Section “Submittal Procedures.”
- B. Submit name of TAB Agency for approval within 30 days after award of Contract.

- C. Design Review Reports:
  1. Submit prior to commencement of construction under provisions of Division 01 Section "Quality Requirements."
  2. Review the Contract Documents, and indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- D. Preliminary Report Submittals:
  1. Prior to commencing work of this Section, and no more than 30 days after approval of TAB Agency submittals, submit report forms or outlines indicating adjusting, balancing, and equipment data required, with columns of design data filled in. By means of plan views, equipment profiles, and similar graphical descriptions, indicate where measurements will be taken.
  2. Submit the procedures to be used.
- E. Field Reports: Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.
- F. Provide reports in letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- G. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
- H. Test Reports: Indicate data on AABC National Standards for Total System Balance forms, or forms prepared following ASHRAE 111, or NEBB forms, or forms containing information indicated in Schedules.

## 1.6 QUALITY ASSURANCE

- A. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance; or ASHRAE 111; or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

## 1.7 QUALIFICATIONS

Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum 3 years' experience and certified by AABC or NEBB, or equivalent experience which would qualify for membership in these testing organizations. Agency shall be one of those listed under article 3.1 AGENCIES in this Section

- A. Perform Work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, or registered Professional Engineer experienced in performance of this Work and licensed at the place where the Project is located

## 1.8 SEQUENCING

- A. Sequence work under the provisions of Division 01 Section "Summary."



- B. Sequence work to commence after completion of systems or portions of work, and schedule completion of work before Substantial Completion of Project.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 AGENCIES

- A. Tekon Technical Consultants, Rochester, NH. Contact: Charles Corlin, (603) 335-3080.
- B. Maine Air Balance, Brewer, ME. Tel. (207) 989-0533.
- C. Whitetail Air Balance LLC, Lisbon, ME. Contact: Jim Davis, (207) 577-9292.
- D. Air Solutions, Auburn, NH, Contact: Jeremy Reid, (603) 262-9292
- E. TAB-TECH International, Albion, ME. Contact: Daniel Althenn, 207-437-4400.
- F. No Substitutions.

### 3.2 EXAMINATION

- A. Verify that systems are complete and operating correctly in accordance with sequence of operations before commencing work. Ensure the following conditions:
  - 1. Systems are started and operating in a safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 5. Duct systems are clean of debris.
  - 6. Fans are rotating correctly.
  - 7. Fire and volume dampers are in place and open.
  - 8. Air coil fins are cleaned and combed.
  - 9. Access doors are closed and duct end caps are in place.
  - 10. Air outlets are installed and connected.
  - 11. Duct system leakage is minimized.
  - 12. Hydronic systems are flushed, filled, and vented.
  - 13. Pumps are rotating correctly.
  - 14. Proper strainer baskets are clean and in place.
  - 15. Service and balance valves are open.
- B. Submit field reports. Report to the responsible Subcontractors, defects and deficiencies noted during performance of services which prevent system balance. Submit list of locations where the Contractor needs to provide additional balancing devices.
- C. Beginning of work means acceptance of existing conditions.

### 3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

### 3.4 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

### 3.5 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

### 3.6 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.
- G. Provide system schematic (in floor-plan or line-diagram view) with outlets and inlets numbered with the reference numbers used in the TAB Agent's tabular data, and with required and actual air quantities recorded at each outlet or inlet.
  - 1. Indicate locations of duct traverses.

2. Indicate locations of duct pressure sensors, airflow monitoring stations, and other devices which require measurements for control settings.
- H. Measure static air pressure conditions on air supply units, air return units, exhaust units, and heat recovery units, including pressure drops across filters, coils, dampers, mixing boxes, and heat recovery devices, and total pressure across the fan. Make allowances for 50 percent loading of filters, and indicate actual filter drop as well as the allowances. Provide equipment diagram indicating internal components and measurement points.
  - I. Provide duct traverse diagrams with measurement points indicated, with readings recorded at each point, and with calculated velocity and airflow.
  - J. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions. Adjust at minimum position and maximum position, and use manual dampers and actuator limit stops to minimize differences.
  - K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
  - L. Where available fan capacity is less than total flow requirements of individual system parts (due to system diversity), full flow in one part may be simulated by temporary restriction of flow to other parts.
  - M. Coordinate with Division 23 Section "Instrumentation and Controls for Mechanical Systems" for calibration of air handling units' airflow monitoring stations. Calibrate airflow monitoring stations to ensure that airflow readings from airflow monitoring stations correspond with actual airflows.
  - N. Coordinate with Division 23 Section "Instrumentation and Controls for Mechanical Systems" for calibration of air handling units' static pressure sensors and determination of pressure setpoints.
  - O. Set pattern-control vanes and other devices in air inlets and outlets to provide the spread and throw patterns indicated, without objectionable noise or air motion to the occupants. Split the flow of linear slot diffusers in directions as required for good coverage. At completion, patterns shall be uniform and pleasing to the eye.
- 3.7 WATER SYSTEM PROCEDURE
- A. Adjust water systems to provide required or design quantities.
  - B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
  - C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
  - D. Effect system balance with automatic control valves fully open to heat transfer elements.

- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing.
- F. Where available pump capacity is less than total flow requirements of individual system parts (due to system diversity), full flow in one part may be simulated by temporary restriction of flow to other parts.
- G. Coordinate with Division 23 Section “Instrumentation and Controls for Mechanical Systems” for calibration of pump static pressure sensors and determination of pressure setpoints.
- H. When the available pump head is more than 15 percent above the required head to meet the design flow, trim the pump impeller to bring the head within 100 to 110 percent of the required head to meet the design flow. At least one balancing valve in the system, and one balancing valve per each multi-circuit sub-main branch served by a branch balancing valve, shall be fully open when balancing is complete.

### 3.8 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing:
  - 1. HVAC Pumps
  - 2. Air Coils
  - 3. Terminal Heat Transfer Units
  - 4. Air Handling Units
  - 5. Makeup Air Units
  - 6. Fans
  - 7. Air Inlets and Outlets
  - 8. Kitchen Hood
- B. Report Forms:
  - 1. Title Page:
    - a. Name of Testing, Adjusting, and Balancing Agency
    - b. Address of Testing, Adjusting, and Balancing Agency
    - c. Telephone number of Testing, Adjusting, and Balancing Agency
    - d. Project name
    - e. Project location
    - f. Project Architect
    - g. Project Engineer
    - h. Project Contractor
    - i. Project altitude
    - j. Report date
  - 2. Summary Comments:
    - a. Design versus final performance
    - b. Notable characteristics of system
    - c. Description of systems operation sequence
    - d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
    - e. Nomenclature used throughout report
    - f. Test conditions
  - 3. Instrument List:
    - a. Instrument
    - b. Manufacturer

- c. Model number
- d. Serial number
- e. Range
- f. Calibration date
- 4. Electric Motors:
  - a. Manufacturer
  - b. Model/Frame
  - c. HP/BHP
  - d. Phase, voltage, amperage; nameplate, actual, no load
  - e. RPM
  - f. Service factor
  - g. Starter size, rating, heater elements
  - h. Sheave Make/Size/Bore
- 5. V-Belt Drive:
  - a. Identification/location
  - b. Required driven RPM
  - c. Driven sheave, diameter and RPM
  - d. Belt, size and quantity
  - e. Motor sheave diameter and RPM
  - f. Center to center distance, maximum, minimum, and actual
- 6. Variable Frequency Drive (VFD):
  - a. Motor(s) served
  - b. Manufacturer
  - c. Model/Frame
  - d. HP/BHP ratings
  - e. Phase, voltage, amperage; nameplate, actual, no load
  - f. Input and output frequency (Hz)
  - g. Reference speed command from control system
  - h. Carrier frequency setting
  - i. Speeds programmed out for vibration
  - j. Speed adjustment for motor balancing (if allowed)
- 7. Pump Data:
  - a. Identification/number
  - b. Manufacturer
  - c. Size/model
  - d. Impeller
  - e. Service
  - f. Design flow rate, pressure drop, BHP
  - g. Actual flow rate, pressure drop, BHP
  - h. Discharge pressure
  - i. Suction pressure
  - j. Total operating head pressure
  - k. Shut off, discharge and suction pressures
  - l. Shut off, total head pressure
- 8. Combustion Test:
  - a. Boiler manufacturer
  - b. Model number
  - c. Serial number
  - d. Fuel type
  - e. Firing rate
  - f. Fuel tank fill level

- g. Oil pump inlet pressure/vacuum
  - h. Overfire draft
  - i. Gas meter timing dial size
  - j. Gas meter time per revolution
  - k. Gas pressure at meter outlet
  - l. Gas flow rate
  - m. Heat input
  - n. Burner manifold gas pressure
  - o. Percent carbon monoxide (CO<sub>2</sub>)
  - p. Percent carbon dioxide (CO<sub>2</sub>)
  - q. Percent oxygen (O<sub>2</sub>)
  - r. Percent excess air
  - s. Flue gas temperature at outlet
  - t. Ambient temperature
  - u. Net stack temperature
  - v. Percent stack loss
  - w. Percent combustion efficiency
  - x. Heat output
9. Air Cooled Condensing Unit:
- a. Identification/number
  - b. Location
  - c. Manufacturer and Model number
  - d. Serial number
  - e. Entering DB air temperature, design and actual
  - f. Leaving DB air temperature, design and actual
  - g. Number of compressors
  - h. Refrigerant and oil types and quantities
10. Heating Coil Data:
- a. Identification/number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. Rows, and fins per inch
  - f. Air flow, design and actual
  - g. Water flow, design and actual
  - h. Water pressure drop, design and actual
  - i. Entering water temperature, design and actual
  - j. Leaving water temperature, design and actual
  - k. Entering air temperature, design and actual
  - l. Leaving air temperature, design and actual
  - m. Air pressure drop, design and actual
11. Air Moving Equipment:
- a. Location
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Arrangement/Class/Discharge
  - f. Air flow, specified and actual
  - g. Return air flow, specified and actual
  - h. Outside air flow, specified and actual
  - i. Total static pressure (total external), specified and actual

- j. Inlet pressure
  - k. Discharge pressure
  - l. Component pressure drops
  - m. Sheave Make/Size/Bore
  - n. Number of Belts/Make/Size
  - o. Fan RPM
12. Exhaust Fan Data:
- a. Location
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Air flow, specified and actual
  - f. Total static pressure (total external), specified and actual
  - g. Inlet pressure
  - h. Discharge pressure
  - i. Sheave Make/Size/Bore
  - j. Number of Belts/Make/Size
  - k. Fan RPM
13. Duct Traverse:
- a. System zone/branch
  - b. Duct size
  - c. Area
  - d. Design velocity
  - e. Design air flow
  - f. Test velocity
  - g. Test air flow
  - h. Duct static pressure
  - i. Air temperature
  - j. Air correction factor
14. Air Distribution Test Sheet:
- a. Air terminal number
  - b. Room number/location
  - c. Terminal type
  - d. Terminal size
  - e. Area factor
  - f. Design velocity
  - g. Design air flow
  - h. Test (final) velocity
  - i. Test (final) air flow
  - j. Percent of design air flow

END OF SECTION 230593

**This Page Intentionally Left Blank**



## SECTION 230713 – DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Ductwork Insulation.
- B. Fire Resistive Duct Wrap for Kitchen Grease Exhaust.

#### 1.2 RELATED SECTIONS

- A. Division 09 Section “Painting”: Painting insulation jackets.
- B. Division 23 Section “Identification for HVAC Piping and Equipment.”
- C. Division 23 Section “Metal Ducts”: Factory-insulated flexible ductwork.
- D. Division 23 Section “Metal Ducts”: Ductwork.

#### 1.3 REFERENCES

- A. Division 01 Section “References”: Requirements for references and standards.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
- D. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board.
- E. ASTM C356 - Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat.
- F. ASTM C411 - Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation.
- G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- H. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- I. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- J. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation.
- K. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).

- L. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
- M. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- N. ASTM C1482 - Standard Specification for Polyimide Flexible Cellular Thermal and Sound Absorbing Insulation.
- O. ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- P. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- R. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- S. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- T. ASTM E119 (UL 263) - Standard Test Methods for Fire Tests of Building Construction and Materials.
- U. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.
- V. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- W. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- X. ASTM E2336 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.
- Y. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- Z. ISO 6944 - 1985 - Fire Resistance Tests - Ventilation Ducts.
- AA. NAIMA - National Insulation Standards.
- BB. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- CC. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- DD. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- EE. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
- FF. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

#### 1.4 SUBMITTALS

- A. Division 01 Section “Submittal Procedures”.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.
- B. Applicator Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

#### 1.6 REGULATORY REQUIREMENTS

- A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723. For elastomeric foam insulation, rating shall apply for thicknesses up to 2 inches (50 mm).
- B. Insulation materials shall be asbestos free. No fibers with dimensions similar to asbestos fibers shall be released from any material.

#### 1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

#### 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 Section “Product Requirements”: Environmental conditions affecting products on site.
- B. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- C. Maintain temperature during and after installation for minimum period of 24 hours.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Glass and Mineral Fiber Products:
  - 1. Knauf Insulation.

2. Certainteed Corporation.
3. Johns Manville.
4. Owens Corning.
5. No substitutions.

B. Fire-resistive Duct Blankets for Kitchen Grease Exhaust:

1. 3M Company – Fire Barrier Duct Wrap 615+.
2. Thermal Ceramics Inc. – FireMaster FastWrap XL.
3. Unifrax Corporation – FyreWrap Elite 1.5.
4. No substitutions.

C. Glass Fiber Insulation Sealing Tapes:

1. Venture Tape Corporation.
2. 3M Company.
3. Ideal Tape Co., division of American Biltrite Inc.
4. Nashua Tape Products, division of Berry Plastics Corp.
5. No substitutions.

D. Accessories:

1. Ceel-Co division of Johns Manville (product: plastic jacket systems).
2. Foster Products, division of Specialty Construction Brands, Inc., a subsidiary of H.B. Fuller (mastics, sealants, reinforcing membranes, and accessories).
3. Johns Manville (products: Super-Seal acrylic polymer coatings, Zeston plastic jacket systems).
4. Pabco/Childers Metals, division of ITW Insulation Systems (products: metal jacket systems, and accessories).
5. Vac Systems International (product: Tough Coat acrylic polymer mechanical insulation repair coating).
6. Venture Tape Corporation (product: Jacket for outdoor insulation).

## 2.2 GLASS FIBER, FLEXIBLE

A. Insulation: ASTM C553; flexible, noncombustible blanket.

1. 'K' ('Ksi') value: ASTM C518, 0.27 at 75 degrees F (0.039 at 24 degrees C).
2. Maximum service temperature: 250 degrees F (121 degrees C) faced and 350 degrees F (176 degrees C) unfaced.
3. Maximum moisture absorption: 0.20 percent by volume.
4. Minimum density: 1.0 lb/cu. ft. (16 kg/m<sup>3</sup>).

B. Vapor Barrier Jacket:

1. ASTM C1136, Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier film. Facing as required for the application. Integral staple flap on one edge.
  - a. Aluminum Faced: FSK (aluminum foil-scrim-kraft) construction.
  - b. White Faced: PSK (polypropylene-scrim-kraft) construction.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150 degrees F (66 degrees C).
4. Overlap longitudinal laps and butt strips.
5. Secure with outward clinch expanding staples and vapor barrier mastic and pressure sensitive tape.

- C. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.
- D. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- E. Tie Wire: Annealed steel, 16 ga (1.5 mm).

### 2.3 GLASS FIBER, RIGID

- A. Insulation: ASTM C612; rigid, noncombustible blanket. Supplied in board form.
  - 1. 'K' ('Ksi') value: ASTM C518, 0.24 at 75 degrees F (0.036 at 24 degrees C).
  - 2. Maximum service temperature: 450 degrees F (232 degrees C).
  - 3. Maximum moisture absorption: 1.0 percent by volume.
  - 4. Density: 3.0 lb/cu. ft. (48 kg/cu m).
- B. Vapor Barrier Jacket:
  - 1. ASTM C1136, kraft paper reinforced with glass fiber yarn and bonded to aluminized film. Facing as required for the application.
    - a. Aluminum Faced: FSK (foil-scrim-kraft) construction
    - b. White Faced: ASJ (all-service jacket) construction.
  - 2. Moisture vapor transmission: ASTM E96; 0.02 perm.
  - 3. Suitable for insulation surface temperatures up to 150 degrees F (66 degrees C).
  - 4. Overlap longitudinal laps and butt strips.
  - 5. Secure insulation with mechanical fasteners to substrate, and seal jacket with pressure sensitive tape.
- C. Vapor Barrier Tape: See article “Glass Fiber Insulation Sealing Tape” in this Section.
- D. Indoor Vapor Barrier Finish:
  - 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight, glass fabric.
  - 2. Vinyl emulsion type acrylic, compatible with insulation, [black] [white] color.

### 2.4 GLASS FIBER INSULATION SEALING TAPE

- A. Self-adhesive tape with integral vapor barrier, pressure sensitive acrylic-based or rubber-based adhesive, and release liner strip. Width 3 inch (76 mm) nominal.
- B. Manufactured by VentureTape, by the insulation manufacturer, or by one of the other tape manufacturers listed in the article “Manufacturers” in this Section.
- C. Types:
  - 1. For rigid and semi-rigid insulations, tape shall be reinforced type. For flexible “duct wrap” insulation, tape shall be either reinforced or non-reinforced.
  - 2. White or aluminum outer surface to match the insulation.
  - 3. Reinforced: Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier layer.
    - a. Aluminum Finish with FSK: VentureTape 1525CW.
    - b. White Finish with ASJ: VentureTape 1540CW
    - c. White Finish with PSK: VentureTape 1531CW.
  - 4. Non-Reinforced: Foil insulation tape. Dead-soft temper 2 mil (0.05 mm) thick

aluminum foil, without reinforcement. Hand-tearable.

- a. Venture Tape 3520CW.
5. Performance:
  - a. Peel Adhesion: PSTC-101 with 20 minute dwell, 45 oz/in. (12.5 N / 25 mm).
  - b. Shear Adhesion: PSTC-107, 2.2 psi (15.2 kPa) after 24 hours.
  - c. Tensile Strength: PSTC-131:
    - 1) Reinforced Types: 40 lb/in. (180.8 N / 25 mm).
    - 2) Non-reinforced Types: 21 lb/in. (94.9 N / 25 mm).
  - d. Elongation: PSTC 131, 6 percent maximum.
  - e. Service Temperature: -40 to 240 degrees F (-40 to 116 degrees C).
  - f. UL 723 listed or classified (flame/smoke rating).

## 2.5 FIRE RESISTIVE DUCT WRAP

- A. General:
  1. Work includes labor, material, and equipment to provide 2 hour fire resistive rated grease or air duct enclosure as a shaft alternative and a method for providing zero-inch clearances around commercial kitchen grease duct exhaust systems to combustible materials.
  2. These Specifications are based on 3M Fire Barrier Duct Wrap 615+ materials. Where installation requirements of substituted products differ from these Specifications, the more stringent requirements shall apply.
- B. Listing Agency: Provide products that are listed by at least one the following:
  1. Underwriters Laboratories Inc. (UL), in "Fire Resistance Directory" category XHEZ or XHBN as appropriate.
  2. Omega Point Laboratories (OPL), in "Directory of Listed Products, Through Penetration Fire Resistance Directory."
  3. Any other qualified independent testing and inspection agency that conducts periodic follow-up inspections and is acceptable to authorities having jurisdiction.
- C. Furnish products identical to those tested for classification by listing agency.
- D. Mark product packing with classification marking of listing agency.
- E. Duct Wrap Exposed to View: Provide products with flame spread index of less than 25 and smoke developed index of less than 450, when tested in accordance with ASTM E84.
- F. Duct Wrap Exposed to View, Traffic, Moisture, or Physical Damage: Provide products that after curing do not deteriorate when exposed to those conditions during and after construction.
- G. Materials: Use only products specifically listed for use in Listed systems.
- H. Submittals: Submit test reports substantiating performance requirements and Code compliance along with manufacturer's installation instructions.

- I. Duct Wrap: 3M Fire Barrier Duct Wrap 615+: Lightweight, non-asbestos, high temperature, bio-soluble, calcium-magnesium-silicate (CMS) non-woven blanket, encapsulated in a scrim-reinforced foil, blanket thickness of 1.5 inches (38 mm) for ventilation and grease duct applications.
1. Color: White blanket, aluminum foil encapsulated.
  2. Weight: 0.9 psf (4.38 kg/m<sup>2</sup>).
  3. Density: 6 pcf (96.1 kg/m<sup>3</sup>) nominal.
  4. Thermal Conductivity (k-value) at 500 degrees F (260 degrees C) (ASTM C411, ASTM C518): 0.48 Btu/(ft<sup>2</sup> x h x F) (0.07 W/(m x K)).
  5. R-Value per ASTM C518 at ambient 77 degrees F (25 degrees C): At least 6.3 F-ft<sup>2</sup>-hr/Btu (1.1 K-m<sup>2</sup>/W)..
  6. Service range up to 2000 degrees F (1093 degrees C)
  7. Fire Resistance: For use in 1 hour and 2 hour fire resistant systems.
  8. Product complies with ASTM E2336 test standard.
  9. Product complies with ISO 6944 test standard.
  10. Through-penetration per ASTM E814 (UL 1479).
  11. Non-combustible per ASTM E136.
- J. Accessory Materials:
1. Tapes:
    - a. High Performance Filament Tape: 3M tape No. 898, 1inch (25 mm) wide.
    - b. FSK Facing Tape: 3M tape No. 3320, with aluminum foil, fiberglass scrim, and kraft paper backing. Nominal 3 inches (76 mm) wide or 4 inches (102 mm) wide. For sealing cut blanket edges and seams.
  2. Banding Material: Stainless or carbon steel banding, 1/2 inch (13 mm) wide x 0.015 inch (0.4 mm) thick, as stated in duct wrap Design Listing.
  3. Insulation Pins and Clips:
    - a. Copper-coated steel pins, 12 gauge with a minimum length of 4 inches (102 mm), with 2.5 inch (64 mm) square galvanized steel speed clips.
    - b. 12 ga insulated cup head steel pins.
  4. Through-Penetration Fire Stop Materials:
    - a. Packing Material: Scrap pieces of fire resistive duct wrap, 1.5inches (13 mm) thick, or 4 pcf (56 kg/m<sup>3</sup>) mineral wool.
    - b. Sealant: 3M 2000+ premium non-slump silicone sealant, or other sealant as stated in the duct wrap's Design Listing.
  5. Access Doors: 3M Fire Barrier Grease Duct Access Doors.
    - a. Steel angle opening frame, with threaded holes for fasteners.
    - b. Access cover, minimum 16 ga, with loop handle, labeling, and fastener holes.
    - c. Thumb screws for initial fastening of access cover to frame.
    - d. 3M Fire Barrier Grease Duct Access Door Hardware Extension Kit, including threaded rods, wing nuts, nuts, and washers.
    - e. Outer plate, minimum 16 ga steel, field furnished.
    - f. Layers of fire-resistant duct wrap, sized per manufacturer's instructions, with edges sealed with aluminum foil tape.
    - g. Insulation pins and speed clips to fasten the layers of duct wrap to the inside face of outer steel plate.
    - h. Label for outer plate.
- K. Execution: See Part 3 of this Section.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Division 01 Section "Project Management and Coordination": Verification of existing conditions before starting work.
- B. Verify that ductwork has been tested before applying insulation materials.
- C. Verify that surfaces are clean, foreign material removed, and dry.
- D. Verify that insulation materials are clean and dry. Discard any materials that exhibit signs of moisture damage, contamination, mold, mildew, or other biological growth. Discard any materials used in the air handling airstream if they have been exposed to water.

### 3.2 INSTALLATION

- A. Division 01 Section "Quality Requirements": Manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Provide insulation for surfaces of ductwork, as indicated and specified. Insulation values shall meet or exceed the requirements of ASHRAE 90.1-2010, State Energy Codes, and Table I, whichever is greater. In addition, comply with the other requirements of this Section.
- D. Insulated Ductwork Conveying Air below Ambient Temperature:
  - 1. Provide insulation with vapor barrier jackets.
  - 2. Finish with tape and vapor barrier jacket.
  - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- E. Insulated Ductwork Conveying Air above Ambient Temperature:
  - 1. Provide with or without standard vapor barrier jacket.
  - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- F. Ductwork Exposed below 10 feet (3 meters) above finished floor in Mechanical Equipment Rooms: Provide glass fiber rigid insulation with vapor barrier jacket.
- G. Do not insulate exposed heating or cooling supply ductwork in the conditioned spaces which it serves, unless otherwise specified or indicated on the Drawings.
- H. Wherever exposed ductwork for air conditioned systems passes through non air conditioned spaces, insulate ductwork with glass fiber rigid insulation with vapor barrier, to prevent condensation.
- I. Where rigid glass fiber insulation is scheduled, semi-rigid glass fiber insulation may be used on round and flat oval ducts and irregular shapes, and preformed pipe insulation may be used on small diameter round ducts.



- J. Ensure that surface is clean and dry prior to installation. Ensure that insulation is dry before and during application. Finish with system at operating conditions.
- K. Ensure that insulation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation material, properly sealed.
- L. Finish insulation neatly at hangers, supports and other protrusions.
- M. Locate insulation or cover seams in least visible locations.
- N. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.
- O. Standing seams, supporting angles and flanges on insulated ductwork shall be insulated with thickness equal to the duct and edges shall be finished and vapor sealed.
- P. For supply or return ductwork which is required to be insulated, insulation shall be continuous and shall include the insulating of register, grille and diffuser connection plenums/boots.
- Q. Mechanical fasteners shall not be riveted or screwed to the duct and shall not penetrate the metalwork.

### 3.3 FIRE RESISTIVE DUCT WRAP FOR KITCHEN GREASE EXHAUST

- A. Install duct wrap system in accordance with manufacturer's instructions and referenced standards.
- B. Install duct wrap in direct contact with the duct it encloses. Install in accordance with details of the product's Listing. Protect every portion of duct with no less than 2 layers. Overlap both perimeter and longitudinal joints minimum of 3 in. (76 mm) per layer of material. If required, tape seams using minimum 3 in. (76 mm) wide aluminum foil self-adhesive tape.
- C. Air Duct Enclosure Wrap: Follow same traditional wrap method with exception of utilizing a 3 in. (76 mm) perimeter overlap in conjunction with longitudinal butt joint wrap plus duct wrap collar over exterior layer joints.
- D. Filament tape may be used as a temporary securing measure on both layers until banding hardware is in place. Band exterior layer spaced no more than 10.5 in. (267 mm) on center, and within 1.5 in. (39 mm) of overlapped seams.
- E. For duct widths greater than 24 inches (610 mm), weld insulation pins to bottom of horizontal and outer vertical duct runs. Space on a grid in accordance with duct wrap manufacturer's instructions. Impale duct wrap over pins and secure with galvanized steel speed clips before banding is applied.
- F. Locate grease duct access doors at horizontal cleanouts as required by local Codes. Protect with 3 layers of duct wrap, each layer overlapping previous by 1 inch (25 mm) on all sides and in accordance with manufacturer's instructions.
- G. Install duct access doors and their insulation in accordance with manufacturer's instructions. Provide labeling in accordance with NFPA 96 and Code requirements.

- H. Where fire rated duct wrap is used as a shaft enclosure, firestop at fire separations in accordance with the duct wrap manufacturer's recommendations.
- I. Protect fire wrap from damage when installed in locations accessible to building occupants.
- J. Repair Procedure:
  1. Repair damaged duct wrap in accordance with manufacturer's instructions.
  2. Remove damaged section. Apply a new section of same dimension. Place and fit ensuring same overlap that existed previously. Place banding around new duct wrap material and tension to sufficiently hold in place.
  3. If damage has penetrated to interior layer, remove affected sections and reinstall as specified in Installation.

3.4 FIELD INSPECTION

- A. Visually inspect to ensure that materials used conform to Specifications. Inspect installations progressively for compliance with requirements.

TABLE I  
DUCTWORK INSULATION MATERIAL AND WALL THICKNESS

DUCTWORK TYPE	INSULATION MATERIAL	VAPOR BARRIER REQUIRED	INSULATION WALL THICKNESS
Outside air intake ductwork	Glass Fiber, Rigid	Yes	2 layers of 1 inch (25.4 mm) with staggered joints
Supply ductwork for heating only systems with supply air temperatures less than 100 degrees F (37.7 degrees C)	Glass Fiber, Flexible	No	1 ½ inches (38.1 mm)
	Glass Fiber, Rigid	No	1 inch (25.4 mm)
Supply ductwork for heating and cooling systems with heating supply air temperatures less than 100 degrees F (37.7 degrees C)	Glass Fiber, Flexible	Yes	1 ½ inches (38.1 mm)
	Glass Fiber, Rigid	Yes	1 inch (25.4 mm)
Exposed supply ductwork for cooling systems that pass through non air-conditioned spaces	Glass Fiber, Rigid	Yes	1 inch (25.4 mm)
Exposed supply ductwork in mechanical or equipment rooms	Glass Fiber, Rigid	No for heating only systems, Yes for cooling systems	1 inch (25.4 mm)
Kitchen Hood Grease Exhaust Ductwork	Fire Resistive Duct Wrap	---	2 layers of 1-1/2 inches (38.1 mm) with staggered joints per Manufacturer's Recommendations to achieve zero clearance to combustibles

END OF SECTION 230713

## SECTION 230716 – HVAC EQUIPMENT INSULATION

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Equipment insulation.
- B. Covering.
- C. Breeching insulation.
- D. Shields, Inserts, and Saddles.

#### 1.2 RELATED SECTIONS

- A. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment”: Placement of hangers and hanger inserts.
- B. Division 23 Section “Identification for HVAC Piping and Equipment.”
- C. Division 23 Section “Hydronic Piping”: Placement of hangers and hanger inserts.

#### 1.3 REFERENCES

- A. Division 01 Section “References”: Requirements for references and standards.
- B. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulation Cement.
- F. ASTM C240 - Standard Test Methods of Testing Cellular Glass Insulation Block.
- G. ASTM C335 / C335M - Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.
- H. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- I. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- J. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- K. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal

Insulation in Sheet and Tubular Form.

- L. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
  - M. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - N. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
  - O. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - P. ASTM C1104 – Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
  - Q. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
  - R. ASTM C1511 - Standard Test Method for Determining the Water Retention (Repellency) Characteristics of Glass Fiber Insulation (Aircraft Type).
  - S. ASTM C1639 - Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation
  - T. ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
  - U. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  - V. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - W. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
  - X. NAIMA National Insulation Standards.
  - Y. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
  - Z. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.
- 1.4 SUBMITTALS
- A. Division 01 Section “Submittal Procedures.”
  - B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
- 1.5 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.

- B. Applicator Qualifications: Company specializing in performing the work of this Section with minimum 3 years' experience.

#### 1.6 REGULATORY REQUIREMENTS

- A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723. For elastomeric foam insulation, rating shall apply for thicknesses up to 2 inches (50 mm).
- B. Insulation materials and accessories shall be asbestos-free. No fibers with dimensions similar to asbestos fibers shall be released from any material.

#### 1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Division 01 Section "Product Requirements": Transport, handle, store, and protect products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

#### 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 Section "Product Requirements": Environmental conditions affecting products on site.
- B. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- C. Maintain temperature during and after installation for minimum period of 24 hours.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Glass and Mineral Fiber Products:
  - 1. Knauf Insulation.
  - 2. Certainteed Corporation.
  - 3. Johns Manville.
  - 4. Owens Corning.
  - 5. No substitutions.
- B. Removable, Reusable Insulation Covers:
  - 1. Advance Thermal Corp.
  - 2. Pacor, Inc.
  - 3. Thermal Science Technologies.
  - 4. Thermaxx LLC.
  - 5. No substitutions.

- C. Glass Fiber Insulation Sealing Tapes:
  1. Venture Tape Corporation.
  2. 3M Company.
  3. Ideal Tape Co., division of American Biltrite Inc.
  4. Nashua Tape Products, division of Berry Plastics Corp.
  5. No substitutions.
  
- D. Accessories:
  1. Ceel-Co division of Johns Manville (product: plastic jacket systems).
  2. Foster Products, division of Specialty Construction Brands, Inc., a subsidiary of H.B. Fuller (mastics, sealants, reinforcing membranes, and accessories).
  3. Johns Manville (products: Super-Seal acrylic polymer coatings).
  4. Pabco/Childers Metals, division of ITW Insulation Systems (products: metal jacket systems, and accessories).
  5. Vac Systems International (product: Tough Coat acrylic polymer mechanical insulation repair coating).

## 2.2 GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible.
  1. 'K' (KSI) Value: ASTM C177 or ASTM C518, 0.24 at 75 degrees F (0.035 at 24 degrees C).
  2. Maximum Service Temperature: 450 degrees F (232 degrees C).
  3. Maximum Moisture Absorption: 0.2 percent by volume.
  4. Density: 1.5 lb/cu. ft. (24 kg/cu m).
  
- B. Vapor Barrier Jacket:
  1. ASTM C1136, Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier film. Facing as required for the application. Integral staple flap on one edge.
    - a. Aluminum Faced: FSK (aluminum foil-scrim-kraft) construction.
    - b. White Faced: PSK (polypropylene-scrim-kraft) construction.
  2. Moisture vapor transmission: ASTM E96; 0.02 perm.
  3. Suitable for insulation surface temperatures up to 150 degrees F (66 degrees C).
  4. Overlap longitudinal laps and butt strips.
  5. Secure with outward clinch expanding staples and vapor barrier mastic and pressure sensitive tape.
  
- C. Vapor Barrier Lap Adhesive: Compatible with insulation.
  
- D. Vapor Barrier Tape: See article "Glass Fiber Insulation Sealing Tape" in this Section.
  
- E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
  
- F. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

## 2.3 GLASS FIBER, RIGID

- A. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
  1. 'K' (KSI) Value: ASTM C177 or ASTM C518, 0.24 at 75 degrees F (0.035 at 24 degrees C).

2. Maximum Service Temperature: 850 degrees F (454 degrees C).
3. Maximum Moisture Absorption: 0.1 percent by volume.
4. Density: 3.0 lb/cu. ft. (48 kg/cu m).

B. Vapor Barrier Jacket:

1. ASTM C1136, kraft paper reinforced with glass fiber yarn and bonded to aluminized film. Facing as required for the application.
  - a. Aluminum Faced: FSK (foil-scrim-kraft) construction
  - b. White Faced: ASJ (all-service jacket) construction.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150 degrees F (66 degrees C).
4. Overlap longitudinal laps and butt strips.
5. Secure insulation with mechanical fasteners to substrate, and seal jacket with pressure sensitive tape.

C. Facing: 1 inch (25 mm) galvanized steel hexagonal wire mesh stitched on one face of insulation.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Vapor Barrier Tape: See article "Glass Fiber Insulation Sealing Tape" in this Section.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

## 2.4 GLASS FIBER, SEMI-RIGID

A. Insulation: ASTM C612; semi-rigid, noncombustible blanket, with fibers oriented perpendicular to insulation surface to provide compressive strength while maintaining flexibility. Supplied in roll form, suitable for application on rounded shapes such as pipes, tanks, ducts, vessels, and other similar round and irregular shapes.

1. 'K' ('Ksi') value: ASTM C518, 0.24 at 75 degrees F (0.036 at 24 degrees C).
2. Maximum service temperature: 450 degrees F (232 degrees C).
3. Maximum moisture absorption: 1.0 percent by volume.
4. Density: 2.5 lb/cu. ft. (40 kg/cu m).

B. Vapor Barrier Jacket:

1. ASTM C1136, kraft paper with glass fiber yarn and bonded to aluminized film. Facing as required for the application.
  - a. Aluminum Faced: FSK (foil-scrim-kraft) construction
  - b. White Faced: ASJ (all-service jacket) construction.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Suitable for insulation surface temperatures up to 150 degrees F (66 degrees C).
4. Overlap longitudinal laps and butt strips.
5. Secure with outward clinch expanding staples and vapor barrier mastic and pressure sensitive tape.

C. Vapor Barrier Tape: See article "Glass Fiber Insulation Sealing Tape" in this Section.

D. Indoor Vapor Barrier Finish:

1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, [black] [white] color.

## 2.5 GLASS FIBER INSULATION SEALING TAPE

- A. Self-adhesive tape with integral vapor barrier, pressure sensitive acrylic-based or rubber-based adhesive, and release liner strip. Width 3 inch (76 mm) nominal.
- B. Manufactured by VentureTape, by the insulation manufacturer, or by one of the other tape manufacturers listed in the article “Manufacturers” in this Section.
- C. Types:
  - 1. For rigid and semi-rigid insulations, tape shall be reinforced type. For flexible “duct wrap” insulation, tape shall be either reinforced or non-reinforced.
  - 2. White or aluminum outer surface to match the insulation.
  - 3. Reinforced: Kraft paper reinforced with glass fiber yarn and bonded to vapor barrier layer.
    - a. Aluminum Finish with FSK: VentureTape 1525CW.
    - b. White Finish with ASJ: VentureTape 1540CW
    - c. White Finish with PSK: VentureTape 1531CW.
  - 4. Non-Reinforced: Foil insulation tape. Dead-soft temper 2 mil (0.05 mm) thick aluminum foil, without reinforcement. Hand-tearable.
    - a. Venture Tape 3520CW.
  - 5. Performance:
    - a. Peel Adhesion: PSTC-101 with 20 minute dwell, 45 oz/in. (12.5 N / 25 mm).
    - b. Shear Adhesion: PSTC-107, 2.2 psi (15.2 kPa) after 24 hours.
    - c. Tensile Strength: PSTC-131:
      - 1) Reinforced Types: 40 lb/in. (180.8 N / 25 mm).
      - 2) Non-reinforced Types: 21 lb/in. (94.9 N / 25 mm).
    - d. Elongation: PSTC 131, 6 percent maximum.
    - e. Service Temperature: -40 to 240 degrees F (-40 to 116 degrees C).
    - f. UL 723 listed or classified (flame/smoke rating).

## 2.6 SHIELDS, INSERTS, AND SADDLES:

- A. Shields: Galvanized steel formed in at least a 90 degree arc. Minimum 18 gauge (1.2 mm) thickness. Minimum 12 inches (300 mm) long.
- B. Inserts:
  - 1. Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  - 2. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- C. Saddles:
  - 1. Factory fabricated of curved carbon steel plate, of same overall thickness and contour as adjoining insulation. Sides designed for welding to pipe. Center support plate for pipe sizes 12 inches (300 mm) and larger.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

### 3.2 INSTALLATION

- A. Division 01 Section "Quality Requirements": Manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards where applicable.
- C. Insulation values shall meet or exceed the requirements of ASHRAE 90.1-2010, applicable State Energy Codes, and Table I, whichever is greater. In addition, comply with the other requirements of this Section.
- D. Factory Insulated Equipment: Do not insulate.
- E. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- F. Where rigid glass fiber insulation is scheduled, semi-rigid glass fiber insulation may be used on round and flat oval and irregular shapes, and preformed pipe insulation may be used on small diameter round items.
- G. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- H. For hot equipment containing fluids over 140 degrees F (60 degrees C), insulate flanges and unions with removable sections and jackets.
- I. Fiber glass insulated equipment containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
- J. Fiber glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- K. Shields, Inserts, and Saddles:
  - 1. Application: Provide shields at hangers. Provide inserts for equipment 1-1/2 inches (40 mm) diameter or larger. Provide saddles for equipment 6 inches (150 mm) and larger.
  - 2. Shield location: Between insulation jacket and hanger.
  - 3. Insert location: Between support shield and equipment and under the finish jacket.
  - 4. Saddle location: Between support shield and equipment.
  - 5. Tack-weld saddles to the equipment. Fill air spaces within the saddle with insulation material.
  - 6. Glue shields to outside of insulation after system is filled and run at operating temperature.
  - 7. Align mid-length of shields, inserts, and saddles with the hanger centerline.

- L. Finish insulation at supports, protrusions, and interruptions.
- M. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- N. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- O. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- P. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.
- Q. Insulate equipment after system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust and scale, and dried. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction with valve handles, safety reliefs, and other components requiring movement. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer's recommended coverage per gallon. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:
  - 1. Nameplate labels.
  - 2. Valve hand wheels.
  - 3. ASME stamps.
- R. Equipment Insulation:
  - 1. General Procedures: Apply equipment insulation suitable for temperature and service in rigid block or semi-rigid board or flexible form to fit as closely as possible to equipment. Groove or score insulation where necessary to fit the contours of equipment. Stagger end joints where possible. Bevel the edges of the insulation for cylindrical surfaces to provide tight joints. Bevel insulation around name plates, ASME Stamp, and access plates. For insulation on equipment that must be opened periodically for inspection, cleaning, or repair, construct insulation to be removable and replaceable without damage. Protect exposed insulation corners with corner angles under wires and bands.
  - 2. Fill mineral fiber joints with insulating cement conforming to ASTM C195.
  - 3. Join sections of cellular glass insulation with bedding compound. After the cellular glass insulation is in place on areas to be insulated, except where metal-encased, fill joints, seams, chipped edges, or depressions with bedding compound to form a smooth surface.
- S. Insulate equipment and accessories as specified in Table I. In outside locations, provide insulation one inch thicker than that specified in Table I. In addition, comply with the other requirements of this Section.

### 3.3 FIELD INSPECTION

- A. Visually inspect to ensure that materials used conform to Specifications. Inspect installations progressively for compliance with requirements.

TABLE I  
EQUIPMENT INSULATION MATERIAL AND WALL THICKNESS

EQUIPMENT	INSULATION MATERIAL	VAPOR BARRIER REQUIRED	INSULATION WALL THICKNESS
Air Separators with fluids above room temperature	Glass Fiber, Rigid	No	2 inch (51 mm)

END OF SECTION 230716

**This Page Intentionally Left Blank**

## SECTION 230719 – HVAC PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.
- C. Shields, Inserts, and Saddles.

#### 1.2 RELATED SECTIONS

- A. Division 23 Section “Identification for HVAC Piping and Equipment.”
- B. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment”: Placement of hangers and hanger inserts.
- C. Division 23 Section “HVAC Equipment Insulation”: Removable, reusable insulation covers.
- D. Division 23 Section “Hydronic Piping”: Placement of hangers and hanger inserts.

#### 1.3 REFERENCES

- A. Division 01 Section “References”: Requirements for references and standards.
- B. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
- D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
- E. ASTM C240 - Standard Test Methods of Testing Cellular Glass Insulation Block.
- F. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- G. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- H. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- I. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- J. ASTM C547 - Standard Specification for Mineral Fiber Preformed Pipe Insulation.
- K. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.

- L. ASTM C578 - Standard Specification for Preformed, Cellular Polystyrene Thermal Insulation.
  - M. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyurethane Thermal Insulation.
  - N. ASTM C610 - Standard Specification for Expanded Perlite Block and Pipe Thermal Insulation.
  - O. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - P. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
  - Q. ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
  - R. ASTM D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
  - S. ASTM D1667 - Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
  - T. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  - U. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
  - V. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - W. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
  - X. NAIMA National Insulation Standards.
  - Y. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
  - Z. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.
- 1.4 SUBMITTALS
- A. Submit under provisions of Division 01 Section “Submittal Procedures”.
  - B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- 1.5 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years’ experience.
  - B. Applicator Qualifications: Company specializing in performing the work of this Section with minimum 3 years’ experience.

## 1.6 REGULATORY REQUIREMENTS

- A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723. For elastomeric foam insulation, rating shall apply for thicknesses up to 2 inches (50 mm).
- B. Insulation materials and accessories shall be asbestos-free. No fibers with dimensions similar to asbestos fibers shall be released from any material.

## 1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Division 01 Section "Product Requirements": Transport, handle, store, and protect products.
- B. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

## 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 Section "Product Requirements": Environmental conditions affecting products on site.
- B. Maintain ambient conditions required by manufacturers of each product.
- C. Maintain temperature before, during, and after installation for minimum of 24 hours.

## 1.9 EXISTING PIPING

- A. Insulate existing piping as indicated on the Drawings. Contractor shall be responsible to field-verify quantities and sizes. Provide access to existing piping as required for complete insulation. Remove existing finishes and existing insulation as required.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Elastomeric Foam Products:
  - 1. Armacell LLC.
  - 2. K-Flex USA.
  - 3. No substitutions.
- B. Glass and Mineral Fiber Products:
  - 1. Knauf Insulation.
  - 2. Certainteed Corporation.
  - 3. Johns Manville.
  - 4. Owens Corning.
  - 5. No substitutions.
- C. Accessories:
  - 1. Ceel-Co division of Johns Manville (product: plastic jacket systems).
  - 2. Foster Products, division of Specialty Construction Brands, Inc., a subsidiary of H.B. Fuller (mastics, sealants, reinforcing membranes, and accessories).

3. Johns Manville (products: Super-Seal acrylic polymer coatings, Zeston plastic jacket systems).
4. Pabco/Childers Metals, division of ITW Insulation Systems (products: metal jacket systems, and accessories).
5. Pittsburgh Corning (product: cellular glass insulation for high-density inserts).
6. Proto Corporation (product: plastic jacket systems).
7. Vac Systems International (product: Tough Coat acrylic polymer mechanical insulation repair coating).

## 2.2 ELASTOMERIC FOAM

- A. Products:
  1. Armacell: AP Armaflex and AP Armaflex FS pipe and sheet insulation.
  2. K-Flex USA: Insul-Tube and K-Flex LS pipe insulation, and Insul-Sheet S2S and K-Flex LS sheet insulation.
  3. No substitutions.
- B. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
  1. 'K' ('Ksi') value: ASTM C177; 0.277 Btu-in/(hr-sq.ft- degrees F) at 75 degrees F (0.04 W/m-K at 24 degrees C).
  2. Minimum service temperature: -70 degrees F (-57 degrees C) (flexible to -20 degrees F (-29 degrees C)).
  3. Maximum service temperature: 220 degrees F (104 degrees C).
  4. Maximum moisture absorption: ASTM C209, 0.2 percent by volume; or ASTM D1056, 5 percent by weight.
  5. Moisture vapor transmission: ASTM E96; 0.08 perm-inches (0.116 ng/(s-m-Pa)).
  6. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
- D. Insulated Hanger Inserts: At Contractor's option, Armacell Armafix IPH insulated pipe hanger inserts may be used at hanger locations.
  1. Engineered from Armaflex insulation, with inserts of CFC-free PPUR/PIR polyurethane foam insulation bearing segments.
  2. Outer shell of 30 mils (0.76 mm) -thick painted aluminum.
  3. Self-adhesive closure strip.
  4. Provide Armaflex insulation tape, wrapped around the IPH prior to placing in the hanger.

## 2.3 GLASS FIBER

- A. Insulation: ASTM C547; rigid molded, noncombustible.
  1. 'K' ('Ksi') value: ASTM C177, 0.24 Btu-in/(hr-sq.ft- degrees F) at 75 degrees F (0.035 W/m-K at 24 degrees C).
  2. Maximum service temperature: 850 degrees F (454 degrees C).
  3. Maximum moisture absorption: 0.2 percent by volume.
- B. Vapor Barrier Jacket:
  1. ASTM C1136, White kraft paper with glass fiber yarn, bonded to aluminized film.
  2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.
- C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300



mm) centers.

- D. Vapor Barrier Lap Adhesive: Compatible with insulation.
- E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- F. Indoor Vapor Barrier Finish:
  - 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
  - 2. Vinyl emulsion type acrylic, compatible with insulation, white color.
- G. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- H. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- I. Insulating Cement: ASTM C449/C449M.

## 2.4 JACKETS

- A. PVC Plastic.
  - 1. Jacket: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color.
    - a. Minimum service temperature: 0 degrees F (-18 degrees C).
    - b. Maximum service temperature: 150 degrees F (66 degrees C).
    - c. Moisture vapor transmission: ASTM E96; 0.002 perm-inches.
    - d. Thickness: 15 mil (0.38 mm)
    - e. Connections: Brush on welding adhesive, tacks (for heating systems only) or pressure sensitive color matching vinyl tape.
  - 2. Covering Adhesive Mastic: Compatible with insulation.
- B. ABS Plastic:
  - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
    - a. Minimum service temperature: -40 degrees F (-40 degrees C).
    - b. Maximum service temperature of 180 degrees F (82 degrees C).
    - c. Moisture vapor transmission: ASTM E96; 0.012 perm-inches.
    - d. Thickness: 30 mil (0.76 mm).
    - e. Connections: Brush on welding adhesive.

## 2.5 SHIELDS, INSERTS, AND SADDLES

- A. Shields:
  - 1. Carpenter and Paterson Figure 265GS, or equal.
  - 2. Galvanized or electro-galvanized steel, minimum 12 inch length, minimum 120-degree arc, minimum 18 ga.
  - 3. Provide contact adhesive to glue shields to the insulation.
- B. Snap-On Shields:
  - 1. Cooper B-Line "Snap-N Shield".
  - 2. Snap-N Shield is an acceptable substitute for metal shields when installed with strut trapeze hangers on horizontal piping.

3. Paintable polypropylene plastic 12 inch long preformed shields, snap-on design for attachment to strut.
4. Gluing is not required with Snap-N Shield.
5. Provide black or white color to match the insulation in areas exposed to public view.

C. Inserts:

1. Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
2. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

D. Saddles:

1. Factory fabricated of curved carbon steel plate, of same overall thickness and contour as adjoining insulation. Sides designed for welding to pipe. Center support plate for pipe sizes 12 inches (300 mm) and larger.

## 2.6 MANUFACTURER'S STAMP OR LABEL

- A. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use shall have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation packages and containers shall be asbestos-free.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

### 3.2 INSTALLATION

- A. Division 01 Section "Quality Requirements": Manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards where applicable.
- C. Provide insulation for surfaces of new piping and for surfaces of existing piping that is uninsulated.
- D. Insulation values shall meet or exceed the requirements of ASHRAE 90.1-2010, applicable State Energy Codes, and Table I, whichever is greater. In addition, comply with the other requirements of this Section.
1. International Energy Conservation Code (IECC): Chapter 5 of the Code allows the use of ASHRAE 90.1 insulation thicknesses instead of the Minimum Pipe Insulation table which is in Chapter 5 of the IECC. This Specification does not reference the table in IECC.
- E. Piping systems requiring insulation, types of insulation required, and insulation thickness shall be as listed in Table I herein. For piping not listed in Table 1, insulate to meet Code

requirements, using suitable specified materials, subject to Architect's approval. Except for flexible unicellular insulation, insulation thicknesses as specified in Table I shall be one inch (25 mm) greater for insulated piping systems located outside the building and in unconditioned spaces. Unless otherwise specified, insulate fittings, flanges, and valves, except valve stems, hand wheels, and operators. Use factory pre-molded, precut, or field-fabricated insulation of the same thickness and conductivity as used on adjacent piping. Insulation exterior shall be factory cleanable, grease resistant, non-flaking, and non-peeling.

- F. Exposed Piping: Locate insulation and cover seams in least visible locations.
- G. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
- H. Glass Fiber Insulated Pipes Conveying Fluids above Ambient Temperature:
  - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
  - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- I. Large Valve Bodies and Other Fittings: Large valves and other fittings requiring service access may be insulated with removable, reusable equipment covers with "Velcro" closures. Refer to Division 23 Section "HVAC Equipment Insulation."
- J. Branches to Expansion Tanks: For chilled water systems, insulate completely. For hot water systems, insulate from the connection at the main to at least 10 feet (3 m) toward the tank.
- K. Branches to Gauges, Sensors, Drains, and Vents: Insulate branches to gauges, sensors, drains, and vents as for active sections of piping. For piping with operating temperatures above ambient, insulate to at least 6 inches (150 mm) from the active main. For temperature devices, insulate to include the sensing bulb or other element. For pressure devices in hot piping with syphon loops, insulate from the active main to the syphon loop, but it is not necessary to insulate the syphon loop or the portion of the branch on the device side of the syphon loop.
- L. Shields, Inserts, and Saddles:
  - 1. Application: Provide shields at hangers. Provide inserts for piping 2 in. (50 mm) nominal size or larger. Provide saddles for piping 6 in. (150 mm) nominal size and larger and for generator exhaust piping and muffler.
  - 2. Shield location: Between insulation jacket and hanger.
  - 3. Insert location: Between support shield and piping and under the finish jacket.
  - 4. Saddle location: Between support shield and piping.
  - 5. Tack-weld saddles to the pipe or muffler. Fill air spaces within the saddle with insulation material.
  - 6. Glue shields to outside of insulation after system is filled and run at operating temperature.
  - 7. Align mid-length of shields, inserts, and saddles with the hanger centerline.
- M. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Division 07.
- N. Pipe Exposed in Mechanical Equipment Rooms 10 feet (3 meters) or Less Above Finished

Floor: Finish with PVC or ABS jacket and fitting covers.

### 3.3 UNIFORM INSTALLATION

- A. Systems shall use a single insulation type throughout the installation.

### 3.4 PREPARATION

- A. Insulate piping after system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and dried. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction of valve handles, safety reliefs, and other components requiring movement. Allow adequate space for pipe expansion. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Insulation shall be continuous through sleeves, wall and ceiling openings. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer's recommended coverage per gallon. Individually insulate piping. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:
  1. Piping in radiation enclosures, or within cabinets of unit heaters.
  2. Valve hand wheels.
  3. Fire protection pipes.
  4. Vibration isolating connections.
  5. Adjacent insulation.
  6. ASME stamps.

### 3.5 PIPING INSULATION

- A. Pipe Insulation (Except Elastomeric and Hydrous Calcium Silicate Insulation): Place sections of insulation around the pipe and joints tightly butted into place. The jacket laps shall be drawn tight and smooth. Secure jacket with fire resistant adhesive, factory applied self sealing lap. Cover circumferential joints with butt strips, not less than 3-inches (76 mm) wide, of material identical to the jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inches (38 mm). Adhesive used to secure the butt strip shall be the same as used to secure the jacket laps. When a vapor barrier jacket is required, as indicated in Table I, or on the ends of sections of insulation that butt against flanges, unions, valves, fittings, and joints, use a vapor-barrier coating conforming to manufacturer's weatherproof coating for outside service. Apply this vapor barrier coating at longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, and coating as specified for butt strips. Extend the patch not less than 1-1/2 inches (38 mm) past the break in both directions. At penetrations by pressure gauges and thermometers, fill the voids with the vapor barrier coating for outside service. Seal with a brush coat of the same coating. Where penetrating roofs, insulate piping to a point flush with the top of the flashing and seal with the vapor barrier coating. Butt tightly the exterior insulation to the top of the flashing and interior insulation. Extend the exterior metal jacket 2 inches (51 mm) down beyond the end of the insulation. Seal the flashing and counterflashing underneath with the vapor barrier coating.
- B. Elastomeric Foam Insulation: Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral-fiber insulation inserts and sheetmetal sleeves. Insulate flanges,

unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two coats of vinyl lacquer finish to elastomeric foam insulation before applying PVC jacket in outside locations.

3.6 FIELD INSPECTION

- A. Visually inspect to ensure that materials used conform to specifications. Inspect installations progressively for compliance with requirements.

TABLE I  
PIPING INSULATION MATERIAL AND WALL THICKNESS

SERVICE	INSULATION MATERIAL	VAPOR BARRIER REQUIRED	INSULATION WALL THICKNESS AT THE FOLLOWING PIPE DIAMETERS					
			<1 inch	1 inch to <1.5 inches	1.5 inches to <4 inches	4 inches to <8 inches	8 inches or Greater	
Heating Systems (Steam, Steam Condensate, Hot Water Supply and Return)								
Fluid Design Operating Temperature Range								
141 degrees F to 200 deg. F	Glass Fiber	No	1.5 inches	1.5 inches	2 inches	2 inches	2 inches	
Refrigerant Suction and Liquid Piping								
Operating Temperature								
40 degrees F to 60 deg. F	Elastomeric Foam	N/A	0.75 inch	1 inch	1 inch	1.5 inches	2 inches	

END OF SECTION 230719

**This Page Intentionally Left Blank**

## SECTION 230900 – INSTRUMENTATION AND CONTROL FOR MECHANICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Direct Digital Control (DDC) equipment.
- B. Software.
- C. Installation.

#### 1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Piping:
  - 1. Control Valves – piping connections.
  - 2. Temperature Sensor Wells and Sockets.
  - 3. Pressure Sensors and Switches.
- B. Ductwork:
  - 1. Dampers - ductwork connections.

#### 1.3 PRODUCTS FURNISHED UNDER OTHER SECTIONS

- A. Controllers furnished with some Plumbing equipment (Division 22).
- B. Controllers furnished with some HVAC equipment (Division 23).
- C. Monitoring devices furnished with some Electrical equipment (Division 26).

#### 1.4 RELATED SECTIONS

- A. Division 01 Section “General Commissioning Requirements.”
- B. Division 01 Section “Testing, Adjusting, and Balancing for HVAC.”
- C. Division 08 Section “Access Doors and Frames.”
- D. Division 23 Section “Common Work Results for HVAC.”
- E. Division 23 Section “Common Motor Requirements for HVAC Equipment.”

#### 1.5 REFERENCES

- A. U.S. Department of Justice – 2010 ADA Standards for Accessible Design.
- B. ASME MC85.1 - Terminology for Automatic Control.
- C. NEMA EMC1 - Energy Management Systems Definitions.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

- E. NFPA 70 - National Electrical Code.
- F. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

#### 1.6 SYSTEM DESCRIPTION

- A. A fully integrated Automatic Temperature Control (ATC) Building Management and Control System incorporating Direct Digital Control (DDC), energy management, equipment monitoring, and control consisting of the following:
  - 1. Microcomputer-based equipment controllers interfacing directly with sensors, actuators and environmental delivery systems.
  - 2. Electric controls and mechanical devices for items indicated on Drawings and described hereinafter including dampers, valves, and motor drives.
  - 3. Microcomputer-based terminal controllers interfacing with sensors, actuators, and terminal equipment control devices.
- B. Submittals, data entry, electrical installation, programming, start up, test and validation, instruction of Owner's representative on maintenance and operation, as built documentation, and system warranty.
- C. System Summary:
  - 1. The intent of this project is to provide a new ATC system with electric actuators.
  - 2. Air handling units, coils, and terminal heating units which are designated to be controlled by a temperature sensor shall be interfaced with the DDC system.
- D. Note: The terms "BMS", "ATC", and "DDC" are used somewhat interchangeably throughout this Section.

#### 1.7 DEFINITIONS

- A. Note: The terms ATC, BAS, and DDC may be used interchangeably in this Section and on the Drawings, to indicate the overall control system.
- B. Definitions:
  - 1. ATC: Automatic temperature control.
  - 2. BACnet: A control network technology platform for designing and implementing interoperable control devices and networks.
  - 3. BAS: Building Automation System.
  - 4. DDC: Direct digital control.
  - 5. I/O: Input/output.
  - 6. MS/TP: Master slave/token passing.
  - 7. PC: Personal computer.
  - 8. PID: Proportional plus integral plus derivative.
  - 9. RTD: Resistance temperature detector.

#### 1.8 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
  - 1. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
  - 2. Object Scan: Transmit change of state and change of analog values to control units or



- workstation within six seconds.
- 3. Alarm Response Time: Annunciate alarm at workstation within 45 seconds.
- 4. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
- 5. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
- 6. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
  - a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
  - b. Water Flow: Plus or minus 5 percent of full scale.
  - c. Water Pressure: Plus or minus 2 percent of full scale.
  - d. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
  - e. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
  - f. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
  - g. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
  - h. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
  - i. Relative Humidity: Plus or minus 5 percent.
  - j. Electrical: Plus or minus 5 percent of reading.

## 1.9 SUBMITTALS

- A. Submit in accordance with Division 01 Section "Submittal Procedures."
- B. Qualification Data: For Installer and manufacturer.
- C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
  - 1. Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
  - 2. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
  - 2. Schematic flow diagrams showing fans, coils, dampers, valves, and control devices.
  - 3. Wiring Diagrams: Power, signal, and control wiring.
  - 4. Details of control panel faces, including controls, instruments, and labeling.
  - 5. Written description of sequence of operation.
  - 6. Schedule of dampers including size, leakage, and flow characteristics.
  - 7. Schedule of valves including size and flow characteristics.
  - 8. DDC System Hardware:
    - a. Wiring diagrams for control units with termination numbers.
    - b. Schematic diagrams and floor plans for field sensors and control hardware.
    - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control units.
  - 9. Control System Software: List of color graphics indicating monitored systems, data

- (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:
    - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    - c. Written description of sequence of operation including schematic diagram.
- E. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
  2. Program Software Backup: On a magnetic media or CD, complete with data files.
  3. Device address list.
  4. Printout of software application and graphic screens.

F. Field quality-control test reports.

G. Operation and Maintenance Data.

#### 1.10 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 01 Section "Operation and Maintenance Data."

B. For mechanical instrumentation and control system to include in emergency, operation, and maintenance manuals.

C. In addition to items specified in Division 01, include the following:

1. Maintenance instructions and lists of spare parts for each type of control device.
2. Exploded assembly views.
3. Interconnection wiring diagrams with identified and numbered system components and devices.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

D. Manuals: Provide the following:

1. An Operator's Manual with graphic explanations of keyboard use for operator functions specified under Operator Training.
2. Computerized printouts of equipment controller's data file construction including point processing assignments, physical terminal relationships, scales and offsets, command and alarm limits, and others as applicable.
3. A manual including revised as-built documents of materials required under the paragraph "SUBMITTALS" in this Specification Section.
4. Provide the quantity of manuals specified in Division 01, and at least 2 Operator's Manuals and 2 As-Built Manuals to the Owner. Refer to other Sections of the Specifications for project requirements for quantities of documentation.

#### 1.11 CODES AND APPROVALS

A. The complete temperature control installation shall be in strict accordance to the national and local electrical codes and the electrical Division of these Specifications. Devices designed for or used in line voltage applications shall be UL listed. Microprocessor based remote and

central devices shall be UL916 Listed.

- B. Electronic equipment shall conform to the requirements of FCC regulation Part 15, Section 15 governing radio frequency electromagnetic interference and be so labeled.

#### 1.12 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. 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.
- C. Comply with ASHRAE Standard 135 (BACnet) for DDC system components.

#### 1.13 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01 Section "Project Requirements."
- B. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, provide shipping of control devices to equipment manufacturer, in a timely manner coordinated with the equipment manufacturer.
- C. Components to be Installed under Other Sections: For components to be installed under other Sections of the Specifications, provide delivery of components to appropriate Subcontractors, provide installation instructions, and supervise their installation.

#### 1.14 COORDINATION

- A. Coordinate location of thermostats and other exposed control sensors with Contract Drawings before installation.
- B. Coordinate equipment with Division 26 and existing fire alarm system to achieve compatibility with equipment that interfaces with that system.
- C. Coordinate line-voltage power supplies with Division 26.

#### 1.15 WARRANTY

- A. Components, system software, parts, and assemblies furnished under this Section shall be guaranteed against defects in materials and workmanship for 1 year from acceptance date.
- B. Labor to troubleshoot, repair, reprogram, or replace system components shall be provided at no charge to the Owner during the warranty period.
- C. Corrective software modifications made during warranty service periods shall be updated on user documentation and on user and manufacturer archived software disks.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE SUPPLIERS

- A. Acceptable Manufacturers and Installers:
  - 1. Siemens, Staefa Control Systems, Talon Series, installed by Siemens Building Technologies, Inc., 66 Mussey Road, Scarborough, ME 04074.
  - 2. TAC, I/A Series, installed by Maine Controls, 400 Presumpscot Street, Portland, ME 04103.
  - 3. Johnson Controls, installed by Trident Controls Inc., 187 Gray Road, Unit A, Cumberland, ME 04021.
  - 4. Honeywell Controls, installed by Honeywell Inc., 501 County Road, Westbrook, ME 04092.
  - 5. No Substitutions.
- B. The Temperature Control Contractor (or Subcontractor) shall hereinafter be referred to as the ATC Contractor.

### 2.2 SYSTEM REQUIREMENT

- A. Provide complete direct digital and electronic control system consisting of temperature sensors, thermostats, control valves, dampers, operators, indicating devices, and other apparatus required to operate mechanical system and to perform functions specified. Provide controls for the following:
  - 1. Air conditioning systems.
  - 2. Air doors / air curtains.
  - 3. Air moving and handling systems.
  - 4. Boilers, furnaces, and fuel-fired equipment.
  - 5. Control dampers and valves.
  - 6. Cooling and heating coils.
  - 7. Cooling and heating terminal units.
  - 8. Exhaust, return, and supply fans.
  - 9. Kitchen ventilation systems.
  - 10. Temperature monitoring.
  - 11. Hot water heating systems.
  - 12. Plumbing heating and pumping systems.
  - 13. Fire alarm system interfaces.
  - 14. Lighting control system interfaces.
  - 15. Variable frequency drives for pumps

### 2.3 DATA INPUTS AND OUTPUTS

- A. Input/output sensors and devices shall be closely matched to the requirements of the remote panel for accurate, responsive, noise-free signal input/output. Control input response shall be high-sensitivity and matched to the loop gain requirements for precise and responsive control.
- B. Duct temperature sensors shall be rigid stem or averaging type as required. Provide water sensors with a separable copper, monel or stainless-steel well.
- C. Control relays and analog output transducers shall be compatible with equipment controllers output signals. Relays shall be suitable for the loads encountered. Analog output transducers

shall be designed for precision closed loop control with pneumatic repeatability error no greater than 1/2 percent.

- D. Data inputs and outputs shall be compatible with variable frequency drives; see Division 23 Section "Common Motor Requirements for HVAC Equipment."

#### 2.4 TEMPERATURE CONTROL CENTRAL HARDWARE

- A. Equipment controllers shall be 16 bit microprocessor based with EPROM operating system (O.S.). ATC programs and data files shall be non-volatile EEPROM or flash memory to allow simple additions and changes. Each equipment controller shall have an on-board real-time clock with battery backup of a minimum of 30 days.
  - 1. Equipment controllers shall be provided where indicated or specified with capacity to accommodate input/output (I/O) points required for the application plus spare points specified. These panels shall be configured with analog and digital inputs and outputs, and pulse counting totalizers and such that the primary input, the output and control logic shall be resident in a single microprocessor to provide network independent stand-alone closed loop ATC.
  - 2. Panel electronics shall be installed in suitable enclosures. Equipment room panels shall have hinged doors and shall also contain the load relays, transducers, and associated equipment.
- B. Terminal Equipment Controllers shall be EEPROM based and modularity expandable to accommodate additional points if required for future functional changes or enhancements, and with I/O selected for the application plus specified spares. Terminal controllers shall be capable of processing sensor signals of the applications specified, and shall have capability to drive digital (on-off), pulse width modulation, and true analog (0-10V) outputs. Terminal Controller enclosures shall be compact, finished steel to fit within or on terminal equipment. Each terminal controller shall have complete standalone capability.

#### 2.5 CONTROLLER SOFTWARE

- A. Energy Management application programs and associated data files shall be in non-volatile memory.
  - 1. Optimum Start shall delay equipment start-up based on global outdoor temperature, space temperature, and system response to assure that comfort conditions are reached at scheduled occupancy. The optimum start program shall operate fully stand-alone in the local equipment controllers.
  - 2. A load reset program shall be provided to assure that only the minimum amount of heating, cooling, and electrical energy is supplied to satisfy zone temperature requirements.
- B. Control Software:
  - 1. Each equipment controllers shall contain up to 20 unique user modifiable time programs.
  - 2. Control Application Software shall be customized strictly to meet the detailed requirements of the "Sequence of Operation" specified hereinafter. Equipment controllers and terminal controllers shall be fully programmable. Initial software shall be fully modifiable, and not restricted by vendor's specific configuration guidelines. Equipment controllers control software shall be designed via a graphic programming facility, the detailed graphic design of which shall be provided as system documentation. Control strategies shall be advanced as noted with stabilizing setpoint ramps and

procedures to assure slow loading of variable load equipment and economizer modes to prevent unsafe overshoot of controlled pressure and unsafe undershoot of mixed air temperatures during start-up and transition periods.

C. Management Software:

1. Each equipment controllers shall be provided with a trend archive of at least the last 200 events (digital transitions or analog value changes) of any user selected group of up to 20 points. A stored event shall include date and time, and value or status. Point events shall be displayable at local panels as trend logs for evaluation of control system performance.
2. Each equipment controllers shall monitor analog input points and specified digital points for off-normal conditions. Each alarm shall have an "alarm delay" attribute which shall determine how long (in seconds) a point must be in an off-normal state prior to being considered in an alarm state.

D. Communications Software: Each equipment controllers shall have a full master peer-to-peer communications module to support global data sharing, hierarchical control, and global control strategies specified.

## 2.6 DATA COMMUNICATIONS

- A. Equipment controllers shall be interconnected via a primary communications network. Terminal controllers shall also be connected together via secondary networks to provide data concentration and parallel processing. Networks shall support sensor sharing, global application programs, and bus-to-bus communications without the presence of a host PC.
- B. The equipment controller's communications network shall support true peer protocol such that loss of any single device will not cause total bus failure.

## 2.7 GENERAL

- A. ATC setpoints, reset schedules, time programs, historical trends shall be displayable at local ATC panels.
- B. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
  1. Binary Inputs: Allow monitoring of on-off signals without external power.
  2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
  3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
  4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with 3-position (on-off-auto) override switches and status lights.
  5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
  6. Tri-State Outputs: Provide two coordinated binary outputs for control of 3-point, floating-type electronic actuators.
  7. Universal I/Os: Provide software selectable binary or analog outputs.

- C. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
  - 1. Output ripple of 5.0 mV maximum peak to peak.
  - 2. Combined 1 percent line and load regulation with 100-microsecond response time for 50 percent load changes.
  - 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
  
- D. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
  - 1. Minimum dielectric strength of 1000 V.
  - 2. Maximum response time of 10 nanoseconds.
  - 3. Minimum transverse-mode noise attenuation of 65 dB.
  - 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

## 2.8 SPARE POINTS

- A. Provide a minimum of 10 percent spare points or 16 spare points, whichever is greater, in each ATC control panel for future use. Spare points shall be equally distributed among analog input, analog output, digital input and digital output. It is not intended that spare points be provided in unitary control panels which serve VAV boxes, unit ventilators, fan coil units and heat pumps. It is intended that spare points be provided in master control panels and in panels which serve boiler/mechanical rooms and major equipment such as air handling units.

## 2.9 CONTROL CABLE

- A. Electronic and fiber-optic cables for control wiring shall be the responsibility of the controls contractor.

## 2.10 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or 2-position action.
  - 1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
  - 1. Manufacturers:
    - a. Belimo.
    - b. Approved equal
  - 2. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
    - a. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of at least 150 lbf-in. (16.9 N-m) and breakaway torque of at least 300 lbf-in. (33.9 N-m).

- b. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of at least 150 lbf-in. (16.9 N-m).
- 3. Dampers: Size for running torque as recommended by the damper manufacturer for tight sealing under design operating static pressures and velocities. Submit damper manufacturer's torque chart in same submittal as actuator selection table.
  - a. For dampers which do not list torque values, provide torque calculated as follows:
    - 1) Damper with Edge Seals: 7 inch lb/sq. ft. (8.6 N-m/sq. m) of damper.
    - 2) Damper without Edge Seals: 5 inch lb/sq. ft. (6.22 N-m/sq. m) of damper.
  - b. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft (2.3 sq. m): Size for running torque of at least 150 lbf in. (16.9 N-m) and breakaway torque of at least 300 lbf-in. (33.9 N-m).
  - c. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft (2.3 sq. m): Size for running and breakaway torque of at least 150 lbf-in. (16.9 N-m).
  - d. Dampers with 2- to 3 inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by a factor of 1.5.
  - e. Dampers with 3- to 4 inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by a factor of 2.0.
- 4. Coupling: V-bolt and V-shaped, toothed cradle.
- 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
- 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
- 7. Power Requirements (2-Position Spring Return): 24-V ac.
- 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
- 9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
- 10. Temperature Rating: 40 to 104 degrees F (5 to 40 degrees C).
  - a. In addition, valve actuators shall be suitable for the anticipated ambient temperature and fluid temperature. For example, actuators located within heating equipment terminal enclosures will experience higher temperatures.
- 11. Temperature Rating (Smoke Dampers): -22 to 250 degrees F (-30 to 121 degrees C).
- 12. Run Time: 30 seconds.
- 13. Actuator Housing: Molded or die-cast zinc or aluminum. Terminal unit actuators may be high-impact plastic with ambient temperature rating of 50 to 140 degrees F (10 to 60 degrees C) unless located in return-air plenums.
- 14. Damper actuators shall be provided with end switches.

## 2.11 CONTROL VALVES

- A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
  - 1. Globe-type valves are required except for those applications where terminal-unit control valves or butterfly valves are specified or detailed.
  - 2. Ball-type valves may be substituted for other types, and shall be manufactured by Belimo, with Belimo actuators (no substitutions).
  - 3. Valves shall be suitable for water with up to 50 percent inhibited ethylene or propylene glycol.
  - 4. 3-way valves shall be mixing pattern, except where diverting pattern is specified, or where manufacturer requires use of diverting pattern.
  - 5. Rubber-paddle or ball-plug type control valves such as, but not limited to, Honeywell Fan-Coil Valves or the TAC Erie product line (division of Schneider Electric) are not



- allowed.
6. Valves with thermal-wax motors are not allowed.
  7. Valves requiring cartridge replacement for service are not allowed.
  8. Valves requiring special water treatment such as 50-micron filtration are not allowed.
- B. Sizing: Maximum pressure drop determined with valve full-open at design flow rate and the following:
1. 2-Position: Line size.
  2. 2-Way Modulating: Between one-half and one times the variable-flow load pressure drop, but not to exceed 3 psig (21 kPa).
  3. 3-Way Modulating: Between one-half and one times the variable-flow load pressure drop, but not to exceed 1.5 psig (10.5 kPa).
  4. Note: For modulating valves, the load pressure drop is that across the modulated portion of the system. For example, for a 3-way valve providing reset-water control at a boiler, the modulated flow is across the boiler and accessories, whereas the building loop to terminal equipment is considered constant-flow for the purposes of this valve's sizing. For a 3-way valve modulating the flow thru a coil, the coil and its pipe fittings comprise the variable-flow load. For a 3-way valve in a primary-secondary loop to a coil, where the flow thru the coil is a constant pumped flow, the variable load is in the primary-secondary bridge.
- C. Hydronic system globe valves shall have the following characteristics:
1. NPS 2 (DN 50) and Smaller: Class 125 bronze (or red brass) body, bronze or brass seat, bronze trim, rising stainless steel stem, renewable brass or composition disc or plug, screwed ends, with backseating capacity, repackable under pressure. Valve may have integral union ends. Valves with ends other than threaded or factory-integral unions are not allowed.
  2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
  3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
    - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
    - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
  4. Flow Characteristics: 2-way valves shall have equal percentage characteristics; 3-way valves shall have linear characteristics through 1 of the ports, equal percentage through the other.
  5. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for 2-way valves, and 100 percent of pressure differential across valve or 100 percent of total system (pump) head for 3-way valves.
  6. Temperature Rating: 250°F (121°C).
- D. Butterfly Valves: 200-psig (1380-kPa), 150-psig (1034-kPa) maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Wafer or lug.
  2. Disc Type: Nickel-plated ductile iron or aluminum bronze.
  3. Seat: EPDM resilient seat replaceable. Disc may be coated, but primary sealing surface shall be the resilient seat mounted in the body.
  4. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.

5. Temperature Rating: 250°F (121°C).
- E. Terminal Unit Control Valves: Bronze body, bronze trim, 2 or 3 ports as indicated, replaceable plugs and seats, and union and threaded ends. Valves with ends other than threaded or factory-integral unions are not allowed.
1. Applications: Duct-mounted reheat coils, VAV-box reheat coils, unit heaters, cabinet unit heaters, radiant ceiling heating panels, and fintube radiation. For other applications, see globe valve specifications above. [\[\\*\\*Edit this list as required\\*\\*\]](#)
  2. Honeywell "small linear control valves" with "linear valve actuators" (or equal) may be used only for VAV box coils and hot water duct coils; they may not be used for other coil or equipment types.
  3. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
  4. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating sufficient to close against pump shutoff head.
  5. Flow Characteristics: 2-way valves shall have equal percentage characteristics; 3-way valves shall have linear characteristics.

## 2.12 DAMPERS

- A. Manufacturers:
1. Non-Insulated Dampers:
    - a. Ruskin - Model CD60.
    - b. American Warming & Ventilating.
    - c. Arrow.
    - d. Greenheck.
    - e. Tamco (T.A. Morrison & Co., Inc.).
  2. Insulated-Blade Dampers:
    - a. T.A. Morrison & Co., Inc.; Tamco Series 9000 SC "Severe Cold Option" dampers.
    - b. Ventex, Inc. - Series 3965 SC.
- B. Non-Insulated Dampers:
1. AMCA-rated, parallel (2-position) or opposed-blade (modulating) design.
  2. Frames shall be 16 gauge (1.6 mm) thick galvanized steel, reinforced to equivalent strength of 11 gauge (3 mm) galvanized steel; or 0.125 inch (3.2 mm) minimum thickness extruded-aluminum.
  3. Blades shall be airfoil type of not less than 14 gauge (2 mm) equivalent thickness galvanized steel or heavy gauge extruded aluminum, with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).
  4. Secure blades to 1/2 inch (13 mm) diameter, hex-profile, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze or nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
  5. Operating Temperature Range: From -40 to 200 degrees F (-40 to 9 degrees C).
  6. Edge Seals, Low-Leakage Applications: Replaceable, inflatable blade edging of Ruskiprene, neoprene, vinyl, or rubber, and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm/sq. ft (50 l/s per sq. m) of damper area, at differential pressure of 4-inch wg (1 kPa) when damper is held by torque of 50 in.-l bf (5.6 N-m); when tested according to AMCA 500D-98.

## 2.13 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
  - 1. Accuracy: Plus or minus 0.5°F (0.3°C) at calibration point.
  - 2. Wire: Twisted, shielded-pair cable.
  - 3. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
  - 4. Averaging Elements in Ducts: 36 inches (915 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
  - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64-mm).
  - 6. Room Sensor Cover Construction: See below.
  - 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
  - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. Pressure Transmitters/Transducers:
  - 1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
    - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    - b. Output: 4 to 20 mA.
    - c. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240-Pa).
  - 2. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.
  - 3. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
- D. Room Sensor Cover Construction: Manufacturer's standard locking covers.
  - 1. Set-Point Adjustment: Visible.
  - 2. Set-Point Indication: Visible.
  - 3. Thermometer: Visible.
  - 4. Communications Port: Standard phone-type jack for connection of portable laptop computer and other devices. Provide at each room sensor, no exceptions.
- E. Room sensor accessories include the following:
  - 1. Insulating Bases: For sensors located on exterior walls.
  - 2. Adjusting Key: As required for calibration and cover screws.
  - 3. Wall Mounting Box: Recessed, steel, securely fastened to wall framing. Equal to Steel City metallic switch boxes by Thomas & Betts Corp. Box may only be omitted where sensor attaches directly to masonry construction.

## 2.14 THERMOSTATS AND TEMPERATURE SENSORS

- A. Thermostats and Sensors in locations in regular view by the occupants shall have covers which are simple, aesthetically pleasing, neutral in color, with manufacturer's logo, if any, in black or neutral color, and shall fit flush to the surrounding wall surface.

- B. Freezestats:
  1. Freezestat safety low limits shall be duct-mounted manual-reset and automatic-reset (see control sequences) 20-foot limited fill capillary-tube type, responsive to the coolest section of its length.
  2. Air handling systems which handle outside air (or a mix of outside air and return air) or are located outdoors shall have freezestats at duct mounted hot water coils and air handler mounted hot water coils. Where freezestats are required, provide manual-reset type set near freezing temperature for shutdown.
  
- C. Temperature Sensors:
  1. Temperature sensors shall provide a 2-wire connection to the controller that is polarity and wire type insensitive. Sensors shall have communications jacks for connection to the communication trunk to which the controller is connected. The temperature sensor, the connected controller, and other devices on the communications bus shall be accessible by the Graphical Programming tool.
  2. Provide with manual adjustment rotary or sliding dials, with a scale labeled as either temperature in degrees F, or “warmer/cooler”. The input from this dial shall be programmable through the operator workstation to allow a maximum and minimum range for user adjustment. The min/max range shall initially be set at 4 degrees F above/below the programmed setpoint. When the dial is adjusted, it shall shift both heating and cooling setpoints by the programmed amount, in proportion to the distance moved. This dial shall only affect the occupied setpoints; the unoccupied setpoints shall remain as programmed.
  3. Provide with override buttons which, when depressed during unoccupied time periods, will override the zone’s temperature controls and setpoints to occupied conditions for a user adjustable period of time (initially set for 2 hours).
  
- D. Tamper-Resistant Covers and Guards:
  1. Provide tamper-resistant blank covers (without manual adjustments, temperature indicators, or override buttons) for thermostats and temperature sensors located in the following areas:
    - a. Toilet Rooms.

## 2.15 STATUS SENSORS

- A. Where differential pressure “sensor” is indicated or specified, they shall be analog-output type as specified herein. Where differential pressure “switch” is indicated, it may be digital-output type.
- B. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- C. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- D. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- E. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

- F. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

## 2.16 DIFFERENTIAL WATER PRESSURE SENSORS

- A. Manufacturers:
  - 1. Setra - Model 230 Wet-to-Wet Pressure Transducer.
  - 2. Ashcroft.
  - 3. Honeywell.
  - 4. Johnson Controls.
- B. At Contractor's option, Setra Model 231RS wet-to-wet multi-range differential pressure transducer with remote-wired sensors may be used.
- C. Differential-pressure monitoring shall be analog-output type unless otherwise specified.
- D. High output, low differential pressure transducer designed for wet to wet differential pressure measurements of liquids or gases. A fast-response capacitance sensor and signal conditioned electronic circuitry provide a highly accurate, linear analog output proportional to pressure. Both unidirectional and bidirectional pressure ranges are available for applications with line pressure up to 250 psig.
- E. An isolation system transmits the motion of the differential pressure sensing diaphragm from the high line pressure environment (e.g. corrosive liquids) to the dry (air) enclosure where it moves one of a pair of capacitance plates proportionally to the diaphragm movement. Response to pressure changes is approximately 20 times faster than conventional fluid-filled transducers. The electronic circuit linearizes output vs. pressure and compensates for thermal effects of the sensor.
- F. NEMA 4/IP65 rated enclosure. Pipe-thread fittings.
- G. Accuracy RSS (of non-linearity, non-repeatability and hysteresis) (at constant temperature) +/- 0.25 percent of full scale (pressure range).
- H. Pressure Range: Selected by the Contractor for the anticipated or field-measured (actual) pressure differential. Lower ranges have greater accuracy.
- I. Ambient Operating Temperature for Electronics: 0 to 175 degrees F (-18 to 79 degrees C).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that power supply and data outlet is available to control units and operator workstation.

### 3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Wiring and conduits shall be properly supported and run in a neat and workmanlike manner. Wiring and conduits exposed and in equipment rooms shall run parallel to or at right angles to the building structure. Wiring and conduits within enclosures shall be neatly bundled and

anchored to prevent obstruction to devices and terminals. Wiring, conduits, wall boxes, and accessories shall conform to Division 26 – Electrical of the Contract Documents.

- B. The ATC Contractor shall be responsible for electrical installation, including any low voltage and line voltage wiring which is required for a fully functional control system and not indicated on the Electrical Drawings or required by the Electrical Specifications (Divisions 26).
- C. Wiring shall be in accordance with local and national Codes and regulations.
- D. Provide electrical materials and installation under this Section. Requirements and standards shall be as specified in other Sections and Divisions of the Specifications, as indicated in paragraphs below.
  - 1. Install raceways, boxes, and cabinets in conformance to Division 26.
  - 2. Install building wire and cable in conformance to Division 26.
  - 3. Provide interface wiring (line and low voltage) as required to complete ATC system installation.
  - 4. Install signal and communication cable:
    - a. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
    - b. Install exposed cable in raceway.
    - c. Install concealed cable in raceway.
    - d. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
    - e. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
    - f. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
    - g. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- E. Control wiring shall be installed in conduit which shall comply with the requirements of the Electrical Specifications.
- F. Electronic low-voltage wiring shall be #18 AWG minimum THHN and shielded if required.
- G. Power for any temperature control panels required in addition to those indicated on the Drawings shall be the responsibility of this Section.

### 3.3 INSTALLATION

- A. Wall mounted thermostats and temperature sensors shall be attached to an electrical wall box attached to a wall stud, masonry wall, or to blocking. Attaching to gypsum wallboard only shall not be allowed.
- B. Mounting heights of room sensors, thermostats, and other devices, which have features which occupants may adjust or set by touching, shall be installed in locations and heights conforming to U.S. Department of Justice – 2010 ADA Standards for Accessible Design.
  - 1. Unobstructed Forward or Side Reach: Reaches, measured by distance above the finished floor or ground surface upon which the occupant shall be sitting or standing, shall be a high of 48 inches (1220 mm) maximum measured to the top of the device, and a low of 15 inches (380 mm) minimum measured to the bottom of the device.

2. Obstructed High Reach: Where a high forward reach is over an obstruction, the clear floor space shall extend beneath the element for a distance not less than the required reach depth over the obstruction. The high forward reach shall be 48 inches (1220 mm) maximum where the reach depth is 20 inches (510 mm) maximum. Where the reach depth exceeds 20 inches (510 mm), the high forward reach shall be 44 inches (1120 mm) maximum and the reach depth shall be 25 inches (635 mm) maximum.
  3. Coordinate with Division 26 – Electrical to match heights for an aesthetically pleasing appearance.
- C. Verify location of room temperature sensors and other exposed control sensors with Drawings and room details before installation.
1. Thermostats and temperature sensors are indicated on the Drawings for general location. Terminal heat transfer units and fans which control space temperature shall be provided with thermostatic control, whether or not a thermostat or temperature sensor has been indicated on the Drawings.
  2. Locate in the general location indicated, and coordinate to group together with room light switches and other devices of similar height, to minimize disruption of open wall space.
  3. Locate to not be above electrical dimmers.
  4. Locate to avoid heat-generating equipment such as computers, copiers, cooking equipment, coffee makers, vending machines, and refrigerators. Where electrical outlets are indicated near sensors, verify whether equipment is intended.
  5. Locate to avoid heating piping which may be concealed in partitions.
  6. Locate away from windows and exterior doors.
  7. Locate to avoid other false sources of heat such as strong sunlight.
- D. Provide guards on room sensors and thermostats in the following locations:
1. Public areas other than classrooms and offices, including but not limited to: Corridors, hallways, entrances, lobbies, vestibules, stairwells, toilet rooms, locker rooms, storage rooms, cafeterias, and gymnasiums.
  2. Locations vulnerable to traffic.
  3. Where indicated.
- E. At each wall-mounted temperature sensor, provide wiring for setpoint dial and override pushbutton, and for communications jacks, whether or not the specified sensor has these functions. This will allow the Owner to change sensors to add these functions in the future. Provide access to the associated controller and related control panels through each communication jack.
- F. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- G. Install freezestats serpentine across and clipped to the downstream face of coils. Entire length of capillary tube shall be within the unit airstream.
- H. Perform adjustment/relocation of freezestats as required to eliminate nuisance freezestat alarms.
- I. Aquastats installed on unit heaters and at any location above 60 inches (1525 mm) above finished floor shall be installed with adjustment knobs facing downward to facilitate adjustment.
- J. Outdoor air temperature sensor(s) shall be installed on the North side of the building.

- K. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- L. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.
- M. Connect fire alarm shutdown of motors on the load side of controls and hand-off-auto switches, to prevent motor from running in any switch position during fire alarm.
- N. For components to be installed under other Sections of the Specifications, provide delivery of components to appropriate Subcontractors, provide installation instructions, and supervise their installation.
- O. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
  - 1. Sensors shall be immersion type in wells unless otherwise specified or indicated.
  - 2. Enlarge piping at wells to prevent excess interference with flow.
  - 3. Locate wells to ensure insertion in active flowing section of piping or tank.
  - 4. Fill sensor wells with Honeywell thermal heat transfer paste to ensure good conduction.
- P. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping and Specialties."
- Q. Install automatic dampers in conformance to Division 23 Section "Air Duct Accessories."
- R. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures. Provide stand-off brackets of depth to meet or exceed specified thickness of duct insulation.
- S. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- T. Provide labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- U. Unless otherwise indicated, actuators shall be spring loaded and shall, upon a loss of power, actuate their device to an appropriate "fail safe" position.
  - 1. Hot water valves - fail safe to fully open.
  - 2. Outside and exhaust air dampers - fail safe to fully closed.
  - 3. Return air dampers - fail safe to fully open.
- V. For actuators that are required to "fail safe", provide spring return actuators. "Floating point" actuators shall not be allowed for these applications. "Floating point" actuators shall be allowed for actuators that are not required to "fail safe".
- W. Enter computer programs and data files into the related computers including control programs, initial approved parameters and settings, and English descriptors.
- X. Connect and configure equipment and software to achieve sequence of operation specified.



### 3.4 FIELD QUALITY CONTROL

- A. Coordinate with the requirements of Division 01 Section “General Commissioning Requirements”.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
  - 2. Test and adjust controls and safeties.
- D. DDC Verification:
  - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
  - 2. Check instruments for proper location and accessibility.
  - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
  - 4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
  - 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
  - 6. Check temperature instruments and material and length of sensing elements.
  - 7. Check control valves. Verify that they are in correct direction.
  - 8. Check DDC system as follows:
    - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    - c. Verify that spare I/O capacity has been provided.
    - d. Verify that DDC controllers are protected from power supply surges.
- E. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

### 3.5 ADJUSTING

- A. Calibrating and Adjusting:
  - 1. Calibrate instruments.
  - 2. Make 3-point calibration test for both linearity and accuracy for each analog instrument.
  - 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
  - 4. Control System Inputs and Outputs:
    - a. Check analog inputs at 0, 50, and 100 percent of span.
    - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    - c. Check digital inputs using jumper wire.
    - d. Check digital outputs using ohmmeter to test for contact making or breaking.
    - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:
  - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
  - b. Manually operate flow switches to verify that they make or break contact.
6. Pressure:
  - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
  - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
7. Temperature:
  - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
  - b. Calibrate temperature switches to make or break contacts.
8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to 3 visits to Project during other than normal occupancy hours for this purpose.

### 3.6 VALIDATION

A. The ATC Contractor shall completely check out, calibrate, and test connected hardware and software to insure that the system performs in accordance with the approved submittals for specifications and sequences of operations.

### 3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train the Owner to adjust, operate, and maintain Mechanical instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

### 3.8 TESTING ADJUSTING AND BALANCING

A. Provide support for the TAB Agent as required to facilitate the TAB process.

## PART 4 - SEQUENCE OF OPERATION

### 4.1 GENERAL

A. Setpoints shall be adjustable.

## 4.2 ALARMS

- A. In addition to alarms specified in the following sequences, provide alarms as follows.
  - 1. Boiler failure alarm.
  - 2. Low leaving air temp
  - 3. Pump failure alarm.

## 4.3 HEATING/COOLING MODE

- A. Heating Mode:
  - 1. Heating mode is automatically enabled when outside air temperature drops below setpoint (60°F, adjustable) or when there is a call for heating from any zone. Heating mode is automatically disabled when the outside air temperature rises above setpoint.
  - 2. Heating control valves are powered from dedicated circuits. When the hot water pump is disabled, control power to the valves is de-energized, allowing the valves to go to failsafe position. This is to prolong actuator life by turning them off in warm weather.
  - 3. Boiler remains hot year-round to provide domestic hot water.
- B. Cooling Mode:
  - 1. Cooling mode is enabled by the DDC system when there is a call for mechanical cooling.
- C. Deadband (Zero-Energy Mode): In spaces and systems with both heating and cooling setpoints, there shall be a difference of at least 4°F between temperature setpoints, unless otherwise specified. When the sensed temperature is between the heating and cooling setpoints, the system shall operate with no heating hot water or cooling except as required to maintain the status quo.

## 4.4 HEATING SUPPLY WATER TEMPERATURE CONTROL

- A. Gas-fired hot water boiler is operated independently of any other system controls.
  - 1. Boiler B-1
    - a. The boiler is enabled on based on system demand.
    - b. When a boiler is energized, its gas burner fires (fully modulating) to maintain setpoint.
  - 2. The heating water supply setpoint is reset based on outdoor air temperature, in a supply temperature range of 150 to 190 degrees F over an outdoor range of 0 to 55 degrees F.
  - 3. The ATC monitors boiler safeties including low water cutoff and flame failure.
- B. The following points and associated control wiring are provided under this Section. Coordinate with boiler controller manufacturer. Provide control wiring required for interface between automatic temperature control system and boiler controllers. Coordinate control signal with boiler controller manufacturer.
  - 1. Analog input to receive signal from controller for calculated system target temperature. Use this signal for control of boiler burner.
  - 2. Analog input to receive signal from controller for boiler temperature (each boiler).
  - 3. Digital input to receive signal from controller for burner command status (on/off).
  - 4. Digital input to receive signal from controller for burner status (on/off /alarm).
  - 5. Digital output to controller to enable/disable boiler system.

#### 4.5 HOT WATER CIRCULATING PUMPS (HWP-1)

- A. Pumps are started and stopped through the DDC system. The pump runs continuously in heating mode.
- B. The variable frequency drive modulates pump speed to maintain system differential pressures.
  - 1. Provide differential pressure sensors at remote locations at least 3/4 of the total system distance from the pump.
  - 2. Differential pressure setpoint is determined by the Testing and Balancing (TAB) Agent and are the value at which design water flow is achieved at each sensor.
  - 3. When the differential pressure sensor calls for increased pressure, the variable frequency drive for the pump modulates the pump motor speed from minimum to maximum to maintain the differential pressure setpoint.
  - 4. The ATC system monitors VFD status, and other data. If a VFD indicates trouble, an alarm is generated.
- C. Differential pressure sensor at the pump monitor pump operation and generate an alarm if differential pressure falls below minimum set point, with time delay on start-up. If the pump fails for 15 seconds or more on initial startup an alarm is sent to the ATC.

#### 4.6 AIR HANDLING UNITS (AHU-1)

- A. The unit is DDC controlled using electric actuation.
- B. Heating: Refer to heating coil control.
- C. Cooling:
  - 1. Unit has a condensing unit and a DX cooling coil for cooling.
- D. The unit is scheduled for automatic operation on a time of day basis for Occupied and Unoccupied modes.
  - 1. Within the Unoccupied mode, Night Heating is available when the space temperature drops below space unoccupied heating set point. The latest start time is the scheduled occupancy for the space.
- E. The unit operates in Warm-Up, Cool-Down, Occupied, Unoccupied, Night Heating, and Safety modes as follows (suggested set points and settings are Owner-adjustable)
  - 1. Occupied Mode
    - a. The fan starts to run. Position return air damper and the mixed air damper open. cooling cycles, to maintain the discharge temperature set point between 65 degrees F and 55 degrees F. Set point shall be based on the zone with the highest cooling demand.
  - 2. Unoccupied Mode (Normal Off)
    - a. The supply fan stops. The outside air dampers close.
  - 3. Night Heating
    - a. The air handling unit shall operate when the zone falls 5 degrees F below night setback temperature. If this should occur, the supply fan starts with the duct mounted heating coil full open. The air handling unit shall remain on until the zone is satisfied. The outside air damper remains closed.
  - 4. Night Cooling: Mechanical cooling is de-energized during the unoccupied mode.

#### 4.7 MAKE-UP AIR UNIT (MUA-1)

- A. The unit is DDC controlled using electric actuation.
- B. Heating:
  - 1. The unit has a hot water coil. The control valve is 2-way modulating type.
- C. The unit is scheduled for automatic operation when the kitchen fan hood is energized.
- D. The fan shall be controlled by the hood manufacturer's control system. The ATC system shall monitor the fan operation and modulate the hot water valve to maintain a discharge air temperature of 63 deg F.
- E. Safeties
  - 1. An automatic reset, capillary tube type freezestat is installed downstream of the heating coil. This freezestat is set to trip at a temperature which is five degrees higher than the manual reset freezestat located downstream of the heating coil. When this freezestat is tripped, the air dampers are placed in 100 percent recirculation air mode for a period of 15 minutes (Owner-adjustable). After 15 minutes have elapsed, the outside/ mixed air dampers are allowed to modulate open to normal control.

#### 4.8 AIR DOORS / AIR CURTAINS

- A. Control stations furnished with the doors start and stop the unit fans.
  - 1. When the door switches senses door opening, the fan starts and continues to run for a set period of time.
  - 2. When a manual start/stop switch is energized, the fan runs continuously.
- B. Provide interconnecting line and low-voltage wiring as required.

#### 4.9 BASEBOARD, FINTUBE RADIATION, AND RADIANT PANELS (STAND-ALONE)

- A. Space Sensor: Wall-mounted, with setpoint selector and occupied/unoccupied override button.
- B. Space sensor cycles 2-position control valve to maintain room temperature (setpoint 70 degrees F occupied/60 degrees F unoccupied, adjustable).

#### 4.10 DUCT-MOUNTED HEAT COILS

- A. Space Sensor: Wall-mounted, with setpoint selector and occupied/unoccupied override button.
- B. The space served by the reheat coil is controlled in Occupied and Unoccupied modes as follows:
  - 1. The control valve modulates to maintain room setpoint (72 degrees F).

END OF SECTION 230900

**This Page Intentionally Left Blank**

## SECTION 232113 – HYDRONIC PIPING

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings For:
  - 1. Heating water piping system.
  - 2. Glycol water piping system.
  
- B. Valves:
  - 1. Gate valves.
  - 2. Globe or angle valves.
  - 3. Ball valves.
  - 4. Plug valves.
  - 5. Butterfly valves.
  - 6. Check valves.

#### 1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Access Doors.

#### 1.3 RELATED SECTIONS

- A. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment.”
- B. Division 23 Section “Identification for HVAC Piping and Equipment.”
- C. Division 23 Section “HVAC Piping Insulation.”
- D. Division 23 Section “Hydronic Specialties.”
- E. Division 23 Section “HVAC Water Treatment”

#### 1.4 REFERENCES

- A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
- B. ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- E. ASME B31.5 - Refrigeration Piping.
- F. ASME B31.9 - Building Services Piping.
- G. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.

- H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - I. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
  - J. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - K. ASTM B32 - Solder Metal.
  - L. ASTM B88 - Seamless Copper Water Tube.
  - M. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
  - N. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
  - O. AWS A5.8 - Brazing Filler Metal.
  - P. AWS D1.1 - Structural Welding Code.
  - Q. AWWA C110 - Ductile - Iron and Grey -Iron Fittings 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
  - R. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- 1.5 SUBMITTALS
- A. Submit under provisions of Division 01 Section "Submittal Procedures."
  - B. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide Manufacturers catalogue information. Indicate valve data and ratings.
  - C. Welders Certificate: Include welder's certification of compliance with ASME SEC 9 and AWS D1.1.
  - D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- 1.6 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Division 01 Section "Closeout Procedures."
  - B. Record actual locations of valves.
- 1.7 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Division 01 Section "Operation and Maintenance Data."
  - B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.



## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years' experience.
- B. Installer: Company specializing in performing the work of this Section with minimum 3 years' experience.
- C. Welders: Certify in accordance with ASME SEC 9 and AWS D1.1.
- D. Pressed Pipe Fittings: Submit documentation of fitting-manufacturer training of installers or their on-site supervisors, with names of individuals.

## 1.9 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01 Section "Product Requirements."
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

## 1.11 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

## PART 2 - PRODUCTS

### 2.1 HEATING WATER AND GLYCOL PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A53, Schedule 40 for sizes less than 12 inch (300 mm), 0.375 inch (10 mm) wall for sizes 12 inch (300 mm) and over, black.
  - 1. Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.
  - 2. Joints: Schedule 40 threaded for pipe sizes 2 inch (50.8 mm) and smaller, and AWS

D1.1, welded for pipe sizes over 2 inch (50.8 mm).

- B. Copper Tubing: ASTM B88, Type L hard drawn.
  - 1. Allowed only for pipe sizes 2 inch (50.8 mm) and smaller.
  - 2. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
  - 3. Joints: Solder or braze, or press fittings.
- C. Stainless Steel Pipe with Press Fittings: See paragraph titled “Press Fittings and Stainless Steel Piping Systems” in this Section.

## 2.2 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53, Schedule 40 galvanized.
  - 1. Fittings: Galvanized cast iron, or ASTM B16.3 malleable iron.
  - 2. Joints: Threaded, or grooved mechanical couplings.
- B. Copper Tubing: ASTM B88, Type L, hard drawn.
  - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
  - 2. Joints: Solder or braze, or press fittings.
- C. Stainless Steel Pipe with Press Fittings: See paragraph titled “Press Fittings and Stainless Steel Piping Systems” in this Section.
- D. PVC Pipe: ASTM D1785, Schedule 40, and Schedule 80 for sizes 8 inch (200 mm) and larger, or ASTM D2241, SDR 21 or 26.
  - 1. Fittings: ASTM D2466, D2665 or D2467, PVC.
  - 2. Joints: ASTM D2855, solvent weld.
- E. ABS Pipe: ASTM D2680 or D2751.
  - 1. Fittings: ASTM D2751.
  - 2. Joints: ASTM D2235, solvent weld.
- F. Pressure Rated Polypropylene Pipe: As specified in this Section.

## 2.3 BRAZING MATERIALS – 15 percent Silver for copper, brass, and bronze

- A. Manufacturers:
  - 1. Harris (Product: Stay-Silv 15).
  - 2. Lucas-Milhaupt (Product: Sil-Fos 15).
  - 3. Wolverine (Product: Silvaloy 15).
  - 4. No substitutions.
- B. Nominal Composition: 5.0 percent phosphorus, 15.0 percent silver, 0.15 percent other elements (total), remainder copper. Cadmium-free.
- C. Physical Properties:
  - 1. Color: Yellow/Gray
  - 2. Solidus: 1190 degrees F (643 degrees C)
  - 3. Liquidus: 1480 degrees F (802 degrees C)
  - 4. Brazing Range: 1300 – 1500 degrees F (704-816 degrees C)
  - 5. Electrical Conductivity: 9.9 percent IACS

6. Electrical Resistivity: 17.40 Microhm-cm

D. Specification Compliance:

1. ANSI/AWS A5.8, class BCuP-5
2. ASME SFA5.8, class BCuP-5
3. Optional:
  - a. QQB 650C, class BCuP-5
  - b. QQB 654A, class BCuP-5
  - c. QQB 654, class BCuP-5

E. Flux:

1. Harris (Stay-Silv For copper-to-brass joints. No flux required for copper-to-copper joints).

2.4 BRAZING MATERIALS – 35 percent Silver for brazing to ferrous metals (steel)

A. Manufacturers:

1. Harris (Product: Safety-Silv 35).
2. Lucas-Milhaupt (Product: Braze 351).
3. Wolverine (Product: Silvaloy A-35).
4. No substitutions.

B. Nominal Composition: 35.0 percent silver, 33 percent Zinc, 0.15 percent other elements (total), remainder copper. Cadmium-free.

C. Physical Properties:

1. Color: Yellow/Gray
2. Solidus: 1250 degrees F (677 degrees C)
3. Liquidus: 1410 degrees F (732 degrees C)
4. Electrical Conductivity: 19.8 percent IACS
5. Electrical Resistivity: 8.2 Microhm-cm

D. Specification Compliance:

1. ANSI/AWS A5.8, class BAg-5
2. ASME SFA5.8, class BCuP-5

E. Flux:

1. Harris (Stay-Silv white flux, or where heating cycles are extended, Stay-Silv black flux).

2.5 SOLDER MATERIALS:

A. Manufacturers:

1. Harris (Product: Stay-Brite).
2. Lucas-Milhaupt (Product: Clean 'n Brite).
3. Wolverine (Product: Silvabrite).
4. No substitutions.

B. Nominal Composition: Alloy of silver and tin (3-6 percent Ag, remainder Sn). Antimony-free.

C. Physical Properties:

1. Color: Bright Silver

2. Solidus: 430 degrees F (221 degrees C)
3. Liquidus: 430 degrees F (221 degrees C)
4. Electrical Conductivity: 16.4 percent IACS
5. Shear Strength: 10,600 psi (73 MPa)
6. Tensile Strength: 14,000 psi (96 MPa)
7. Elongation: 48 percent

D. Specification Compliance:

1. NSF 51
2. ASTM B32-89, Alloy Grade Sn96
3. Federal Spec. QQ-S-571E, Class Sn 96 with exception to QPL paragraph 3.1
4. J-STD-006, Sn96Ag04A

E. Flux:

1. Harris (Product: Stay Clean Paste Flux, Stay Clean Liquid Flux (used with 4 inch or larger copper tubing also stainless steels), or Bridgit Water Soluble Paste Flux).
2. Canfield (Product: Aqua-Brite or AB Cream Flux). Glycerin-based, water soluble.

## 2.6 UNIONS, FLANGES, AND COUPLINGS

A. Unions for Pipe 2 inch (50 mm) and Under:

1. Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.
3. Polypropylene Pipe:
  - a. Manufacturer: Aquatherm, Greenpipe product line, no substitutions.
  - b. Polypropylene with polypropylene nut or brass nut.

B. Flanges for Pipe Over 2 Inch (50 mm):

1. Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
2. Copper Piping: Bronze.
3. Polypropylene Pipe:
  - a. Manufacturer: Aquatherm, Greenpipe product line, no substitutions.
4. Gaskets: 1/16 inch (1.6 mm) thick preformed neoprene or EPDM, reinforced as required for the system operating pressure, up to relief valve setting.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

## 2.7 SLEEVES

A. See Division 23 Section "Sleeves and Escutcheons for HVAC Piping."

## 2.8 VALVES

A. Manufacturers:

1. Nibco.
2. Apollo.
3. Armstrong.
4. Crane.
5. Hammond.
6. Milwaukee.

7. Watts.
  8. Wheatley.
  9. No substitutions.
- B. Gate Valves Over 2 inch (50 mm):
1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.
  2. 125 lb S.W.P., 200 lb W.O.G.
- C. Globe or Angle Valves:
1. Up To and Including 2 inch (50 mm):
    - a. Bronze body, bronze trim, screwed or union bonnet, rising stem and handwheel, inside screw, renewable composition disc and bronze seat, solder or threaded ends.
    - b. 150 lb S.W.P., 300 lb W.O.G.
  2. Over 2 inch (50 mm):
    - a. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.
    - b. 125 lb S.W.P., 200 lb W.O.G.
- D. Ball Valves:
1. Up To and Including 2 inch (50 mm):
    - a. Bronze two piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle, solder or threaded ends.
    - b. 150 lb S.W.P., 600 lb W.O.G.
  2. Over 2 Inch (50 mm):
    - a. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.
    - b. 150 lb S.W.P., 285 lb W.O.G.
  3. Stem Extensions: Provide ball valves in insulated piping with stem extensions to allow for continuous thickness of field-installed insulation.
- E. Plug Valves:
1. Up To and Including 2 inch (50 mm):
    - a. Bronze body, bronze tapered plug, 70 percent port opening, non-lubricated, teflon packing, threaded ends.
    - b. Operator: One plug valve wrench for every ten plug valves minimum of one.
  2. Over 2 Inch (50 mm):
    - a. Cast iron body and plug, 70 percent port opening, pressure lubricated, teflon packing, flanged ends.
    - b. Operator: Each plug valve with a wrench with set screw.
- F. Butterfly Valves:
1. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
  2. Disc: Aluminum bronze or chrome plated ductile iron.
  3. Operator: 10 position lever handle for shut-off service, infinite position lever handle with memory stop for throttling service, handwheel and gear drive for sizes 8" (203 mm) and larger.
  4. Pressure rating shall be 150 psi at 225 degrees F (1034 kPa at 107 degrees C).
- G. Swing Check Valves:

1. Up To and Including 2 inch (50 mm): Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder or threaded ends.
  2. Over 2 inch (50 mm): Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.
- H. Spring Loaded Check Valves: Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems. Refer to Division 23 Section "HVAC Water Treatment."

### 3.2 INSTALLATION

- A. Install in accordance with Manufacturer's instructions.
- B. Install components furnished under other Section and Divisions of the Specifications. Such items may include but are not limited to: Sensors furnished under Division 23 Section "Instrumentation and Control for Mechanical Systems."
- C. Install heating water, glycol, condenser water, and engine exhaust piping to ASME B31.9. Install chilled water piping to ASME B31.5.
- D. Pipe used shall be new material, and threads on piping shall be full length and clean cut with inside edges reamed smooth to full inside bore.
- E. Minimum pipe size allowed for hydronic piping shall be 3/4 inch (19 mm). Piping less than 3/4 inch (19 mm) shall not be allowed for these piping systems.
- F. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- G. Install piping to conserve building space, and not interfere with use of space.
- H. Group piping whenever practical at common elevations.
- I. Erect piping to provide for the easy passage and noiseless circulation of water under working conditions.
- J. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top

of pipe level. Slope water piping 1 inch in 40 feet (1:480) and arrange to drain at low points. Slope piping up in direction of water flow.

- K. On closed systems, equip low points with 3/4 inch (19 mm) drain valves and hose nipples. Provide, at high points of mains, collecting chambers and high capacity float operated automatic air vents, with ball valves on their inlets to valve off after initial system startup. Provide, at high points of branches, manual air vents with air chambers.
- L. Use main sized saddle type branch connections for directly connecting branch lines to mains in steel piping if main is at least 1 pipe size larger than the branch for up to 6 inch (152 mm) mains and if main is at least 2 pipe sizes larger than branch for 8 inch (203 mm) and larger mains. Do not project branch pipes inside the main pipe.
- M. Caulking of threads will not be allowed on any piping.
- N. Pipe joint compound shall be put on male threads only.
- O. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- P. Dissimilar Metals: Use non-conducting dielectric connections whenever jointing dissimilar metals. Cast red-brass (not yellow brass) or bronze-bodied fittings such as valves and couplings may be used when joining steel to copper, steel to stainless steel, or copper to stainless steel. Steel and stainless steel may connect directly to iron, but copper may not connect directly to iron.
- Q. Where welded joints are required, steel piping shall be installed by the use of the oxyacetylene or electric welding process, except immediate connections to accessible equipment may be threaded. Piping shall have butt welds with welding fittings, standard factory fabricated tees, elbows, reducers, caps, and accessories. Branch outlets 2 inch (50.8 mm) and smaller shall be made by the use of approved welding type half-couplings, "Weldolet" or "Threadolet" fittings.
  - 1. Piping smaller than 2 inch (50.8 mm) may be installed at the Contractor's option with welding type, or threaded type fittings, except that piping regardless of size concealed in trenches or inaccessible building construction (for example, concealed behind sheetrock walls or concealed above sheetrock ceilings) shall be welded.
  - 2. Offsets shall be installed with long radius welding elbows.
  - 3. Welding shall be executed only by certified welding mechanics in accordance with the best practice of the trade.
- R. Sleeve pipe passing through partitions, walls and floors:
  - 1. See Division 23 Section "Sleeves and Escutcheons for HVAC Piping."
  - 2. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.
  - 3. Extend sleeves through floors as follows: In locations not otherwise indicated, 2 in. (50 mm) above finished floor level. In normally-dry locations such as finished office spaces under fin tube and baseboard radiation, 1 in. (25 mm) above finished floor level. Finished floor level includes the thickness of floor finish materials such as carpet and tile. Caulk sleeves full depth and provide floor plate.
  - 4. Where piping passes through floor, ceiling or wall, close off space between pipe sleeve

and construction with non-combustible insulation or with approved firestopping material when penetrating fire rated floors, ceilings or walls. Provide tight fitting metal escutcheons on both ends of sleeves to prevent movement of sleeve during piping expansion. Escutcheons shall be sized slightly larger than outside diameter of piping and smaller than diameter of sleeve. Escutcheons shall be rigidly secured to walls.

5. Where piping passes through fire rated floors, ceilings or walls, close off space between pipe insulation and sleeve with approved firestopping material
  6. Install chrome-plated escutcheons where piping passes through finished surfaces.
- S. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Division 23 Section "HVAC Piping Insulation."
- T. In the erection of mains, use special care in the support, working into place without springing or forcing, and proper allowance made for expansion.
- U. Pipes shall be anchored, guided, and otherwise supported, where necessary, to prevent vibration or to control expansion.
- V. Make such offsets as are shown and required to place the pipes and risers in proper position to avoid other work.
- W. Take branch lines off bottom of mains or at 45 degree bottom angle, as space permits.
- X. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- Y. Install a sufficient number of unions or flanged fittings to facilitate making possible future alterations or repairs.
- Z. Install concealed pipes close to building structure to keep furring to a minimum.
- AA. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- BB. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Division 09 Section "Painting."

### 3.3 VALVES

- A. Valve Type Selection:
1. Use gate, ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
  2. Use globe, ball or butterfly valves for throttling, bypass, or manual flow control services.
  3. Use OS&Y Gate Valves at boiler supply and return connection in accordance with applicable State Boiler Rules and Regulations.
  4. Use N.R.S. Gate Valves for general shut-off service in heating system piping 2-1/2 inch (63.5 mm) and larger.
  5. Use Butterfly Valves in chilled water and condenser water piping for general shut-off service at equipment connections 2 inch (50.8 mm) and larger.



6. Use Plug Valves for general throttling applications where indicated.
  7. Use Bronze Globe Valves in throttling applications at control valve bypasses and in expansion tank connection.
  8. Use Bronze Ball Valves for general shut-off service in heating and cooling system piping 2 inch (50.8 mm) and smaller and at heating terminal units 2 inch (50.8 mm) and smaller, including fin-tube radiation, unit heaters, convectors and fan coil units.
  9. Use Combination Balancing, Flow Measuring and Tight Shut-off Valves at terminal heating and cooling units, zone branches and as indicated.
  10. Use Bronze Ball Valves for drain valves with hose connections. Provide valve of size indicated; if size isn't indicated, provide at least 3/4 inch (19 mm) valve size. Provide outlet fitting for standard "garden hose" with 3/4 inch (19 mm) hose threads. Provide brass cap with retainer chain. Compression-type "boiler drain valves" are not allowed.
- B. With the exception of valves which must be properly sized to ensure design flow rates (such as balancing valves), valves shall be line sized.
- C. For isolation valves, control valves and balancing valves located above suspended ceilings and in areas that are not visible to building occupants (for example, mechanical rooms), provide yellow colored surveyors tape. Permanently attach tape to valve handles and run tape down to 10 inches (254 mm) above ceiling or 12 inches (305 mm) below valve handle where ceilings do not exist (for example, mechanical rooms).
- D. Standard details for heating and cooling coils are based on single coil arrangements. For heating and cooling coils that are supplied in a split coil arrangement, with 2 or more individual coils, provide additional piping and balancing valves at each coil to ensure that flow through each coil is proportional to the percentage of total coil face area that the coil occupies.
- E. Install valves with stems upright or horizontal, not inverted.

### 3.4 CLEANING

- A. After satisfactory completion of pressure tests, before permanently connecting equipment, strainers, and the like, clean equipment thoroughly, blow and flush piping for a sufficient length of time as directed, so that interiors will be free of foreign matter. Perform cleaning in the presence of an authorized representative of the Architect. Provide a minimum of 10 days notification to the Architect prior to system cleaning.
- B. Fill, vent and circulate the system with approved solution in accordance with equipment (boiler, piping, coils, and others) manufacturer's recommendation, allowing it to reach design or operating temperatures. After circulating for 6 hours, drain the system completely and remove and clean strainer screens. Perform cleaning in the presence of an authorized representative of the Architect. Provide a minimum of 10 days notification to the Architect prior to system cleaning.
- C. Fill and vent system as required.
- D. Manually vent heat transfer units and high points of the system.
- E. Adjust the pressure reducing valve to provide minimum of 5 psig (35 kPa) pressure at the highest point of the system.

- F. After system has been completely filled, start zone pumps and circulate cold water for a short time to dislodge small air bubbles, and return them to air extraction device.
- G. Raise water temperature to 200 degrees F (93 degrees C) while operating pumps.
- H. Stop pump and vent radiation and high points of the system. Normal operation may now be started at any time.

### 3.5 TESTING

- A. No joint or section of piping shall be left untested.
- B. Before testing piping systems, remove, or otherwise protect from damage, control devices, air vents, and other parts which are not designed to stand test pressures.
- C. Test piping for leaks under 100 psig (689 kPa) air pressure with soap suds prior to hydrostatic testing.
- D. Test and obtain Architect's approval before painting, covering, or concealing piping, including swing joints.

END OF SECTION 232113

## SECTION 232118 – HYDRONIC SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Flexible hose assemblies.
- F. Flow indicators, controls, meters.
- G. Combination valve assemblies.
- H. Relief valves.
- I. Glycol specialties.

#### 1.2 RELATED SECTIONS

- A. Division 23 Section “Meters and Gauges for HVAC Piping”: Test Ports.
- B. Division 23 Section “Hydronic Piping.”
- C. Division 23 Section “HVAC Water Treatment”: Pipe cleaning, and bypass (pot) feeder.

#### 1.3 REFERENCES

- A. ASME - Boilers and Pressure Vessel Codes, SEC 8-D-Rules for Construction of Pressure Vessels.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Division 01 Section “Submittal Procedures.”
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.
- C. Submit inspection certificates for pressure vessels from authority having jurisdiction.
- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01 Section "Closeout Procedures."

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 01 Section "Operation and Maintenance Data."
- B. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01 Section "Product Requirements."
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance of glycol system for 1 year from date of substantial completion.
- B. Monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.

PART 2 - PRODUCTS

2.1 EXPANSION TANKS, BLADDER TYPE

- A. Manufacturers:
  - 1. Taco.
  - 2. Bell & Gossett.
  - 3. Flo-Fab.
  - 4. John Wood.
  - 5. Watts.
  - 6. Wessels.

7. Wheatley.

- B. Construction: Welded steel, tested and stamped in accordance with ASME SEC 8-D; supplied with National Board Form U-1, rated for working pressure of 125 psig (860 kPa), with removable and replaceable flexible butyl or EPDM bladder, full or partial acceptance type as indicated on the Drawings, and integral steel support stand.
- C. Accessories: Schraeder-type air-charging fitting and protective heavy steel cap, drain fitting with plug, and field-furnished pressure gauge.

## 2.2 AIR VENTS

- A. Manual Type: Short vertical sections of 2 inch (50 mm) diameter pipe to form air chamber, with 1/8 inch (3 mm) brass needle valve at top of chamber.
- B. Float Type:
  - 1. Manufacturers:
    - a. Bell & Gossett.
    - b. Caleffi.
    - c. Taco.
    - d. Thrush.
    - e. Wheatley.
  - 2. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
- C. Washer Type:
  - 1. Manufacturers:
    - a. Bell & Gossett.
    - b. Caleffi.
    - c. Taco.
  - 2. Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

## 2.3 AIR SEPARATORS

- A. In-Line Air Scoops:
  - 1. Manufacturers:
    - a. Taco.
    - b. Bell & Gossett.
    - c. Flo-Fab.
    - d. Thrush.
    - e. Wheatley.
  - 2. Cast iron in sizes 1 inch (25 mm) to 3 inch (76 mm), for 125 psig (860 kPa) operating pressure. Internal baffle to promote air separation. Top fittings for air vent and expansion tank, bottom fitting for expansion tank. Enamel paint finish.
- B. In-line Microbubble Air Separators, 1-1/2 inches (38 mm) and Smaller Line Size:
  - 1. Manufacturers:
    - a. Taco, Inc. - 4900 Series.
    - b. Caleffi - Discal 551 Brass NPT Series.

- c. Flamco - Flamcovent Series.
  - d. Spirotherm - Junior Series.
2. Brass body, with venting mechanism components of stainless steel, EPDM, viton, brass, and engineered plastics. Tested for 150 psig (1030 kPa) operating pressure, 25 to 240 degrees F (-3.8 to 115 degrees C) operating temperature, maximum recommended water velocity 5 fps (1.5 m/s), suitable for up to 50 percent glycol, straight-through inlet and outlet connections, top fitting for air vent, bottom fitting for expansion tank, with internal coalescing medium of stainless steel, copper, or PA66GF30 glass-reinforced polymer, and inlet and outlet screens and top filter as required to contain the coalescing medium. Fittings shall be NPT threaded.
  3. Separator shall function on the coalescing principle. Manufacturer shall furnish documentation demonstrating that separator removes air microbubbles as small as 18 microns.
  4. Integral top-mounted float-type automatic air vent with hose-clamp or pipe-thread outlet. Vent shall be serviceable and replaceable. Provide integral or separate valve allowing the vent to be manually closed for its protection during startup and purging.
- C. In-line Combination Air Separators/Strainers, 2 inches (50 mm) and Larger Line Size:
1. Manufacturers:
    - a. Taco, Inc. - 4900 and 4900H Series.
    - b. Armstrong Pumps Inc. - DAS and DASH Series.
    - c. Caleffi - Discal ASME NA551 Series (up to 6 inch (50 mm) line size, up to 500 GPM (1892 liters/minute)).
    - d. Flamco - Flamcovent Series.
    - e. Spirotherm - VSR and VHR Series.
    - f. Thrush Co. - ASF and AHF Series.
  2. Steel body, with brass-or-cast-iron-body venting mechanism with components of stainless steel, EPDM, viton, brass, and engineered plastics. Tested and stamped in accordance with ASME SEC 8-D; for 125 psig (860 kPa) operating pressure, 270 degrees F (132 degrees C) maximum temperature, straight-through inlet and outlet connections, top fitting for air vent, bottom fitting for drain, side fitting with ball valve with hose-thread outlet for skimming and purge, with internal stainless steel or copper coalescing medium. Fittings 3-inch (76 mm) and under shall be NPT threaded or flanged, larger fittings shall be flanged. Primer paint finish.
  3. Separator shall function on the coalescing principle. Manufacturer shall furnish documentation demonstrating that separator removes air microbubbles as small as 18 microns.
  4. Provide a top-mounted automatic air vent with hose-clamp or pipe-thread outlet. Vent shall be serviceable and replaceable. Provide integral or separate valve allowing the vent to be manually closed for its protection during startup and purging.
  5. Provide welded steel base support ring for floor mounting on line sizes 8 inch (203 mm) and larger.

## 2.4 STRAINERS

- A. Manufacturers:
1. Sarco.
  2. Armstrong.
  3. Barnes and Jones.
  4. Bell & Gossett.
  5. Flo-Fab.

6. Keckley Co.
7. Muesco.
8. Wheatley.

- B. Size 2 inch (50 mm) and Under: Screwed brass or iron body for 175 psig (1200 kPa) working pressure, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
- C. Size 2-1/2 inch (65 mm) to 4 inch (100 mm): Flanged iron body for 175 psig (1200 kPa) working pressure, Y pattern with 3/64 inch (1.2 mm) stainless steel perforated screen.
- D. Size 5 inch (125 mm) and Larger: Flanged iron body for 175 psig (1200 kPa) working pressure, basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.

## 2.5 FLOW CONTROLS

- A. Manufacturers:
  1. Griswold Controls.
  2. Armstrong.
  3. Bell & Gossett.
  4. Taco.
  5. Watts.
- B. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
- C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psig (24 kPa).
- D. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.
- E. Accessories: In-line strainer on inlet and ball valve on outlet.

## 2.6 BALANCING VALVES AND COMBINATION BALANCING/SHUT-OFF VALVES.

- A. Manufacturers:
  1. Bell & Gossett.
  2. Armstrong.
  3. Flow Design, Inc.
  4. Gerand.
  5. Griswold Controls.
  6. Mepco.
  7. Nexus Valve.
  8. Taco.
  9. Tour and Andersson.
  10. Watts.
  11. Wheatley.
- B. Valves shall conform to one of the following:
  1. Fixed-Orifice Manual Balancing Valve: Calibrated, ball type balance valve with

precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer with memory stop. Readout valves measure the pressure differential across the fixed orifice plate or venturi. Valve shall be designed for positive shut-off.

2. Variable-Orifice Manual Balancing Valve: Cast iron or bronze, globe style, balance valve with handwheel with vernier type ring setting and memory stop, readout valves equipped with integral check valves and gasketed caps. Readout valves measure the pressure differential across the variable opening between valve plug and valve seat. Valve shall be designed for positive shut-off. Drain valve may be furnished with this valve, and if positioned properly may be substituted for the separate drain valve indicated.

- C. Size balancing valves to allow a reading of 2 to 5 ft wg (6 to 15 kPa) pressure drop at design flow rates. Submittals shall include a chart of valve selections, indicating room number, terminal heating device tag, flow rate, pressure drop, and differential pressure reading.
- D. Insulation: Valves may be furnished with prefabricated thermal insulation. Flame spread reading shall be 25 or less per ASTM E84. R-value shall be 4 hr-sq.ft- F/Btu (0.704 K·m<sup>2</sup>/W) or greater. Install in accordance with Division 23 Section "HVAC Piping Insulation."

## 2.7 COMBINATION VALVE ASSEMBLIES

- A. Manufacturers:
  1. Flow Design, Inc.
  2. Griswold Controls.
  3. Nexus Valve.
- B. Assemblies combining valves and accessories may be furnished in lieu of the individual components, provided that the components are in the arrangement indicated on the Drawings and conform to the individual Specifications. Examples include combinations of manual balancing valves, unions, pressure/temperature test ports, strainers, manual air vents, flexible hose connections, and shutoff valves.

## 2.8 FLEXIBLE HOSE ASSEMBLIES

- A. Manufacturers:
  1. Dadanco.
  2. Flow Design, Inc.
  3. Hays Fluid Controls.
  4. Paragon Performance.
  5. Twin City Hose, Inc.
  6. Unisource.
- B. General Description: This specification includes flexible hoses such as "heat pump hoses" which may be indicated at items of equipment including water-source heat pumps, fan-coil units, and chilled beams. For piping connections which are denoted on the Drawings as "flexible connections", see Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
- C. 18 inch (457 mm) long flexible hoses consisting of a flexible hose with stainless steel wire braided jacket, with stainless steel or brass end fittings suitable for the specified system piping



materials. Inner hose shall be nitrile or EPDM rubber, or PTFE, or fire-retardant thermoplastic conforming to UL 94 with a VO rating.

1. Sizing: Size for a maximum fluid velocity of 4 fps (1.22 m/sec) at scheduled equipment water flow rates. Minimum hose size of ½ inch (12.7 mm) diameter shall have a maximum flow rate of 3 GPM (11.4 l/sec).
- D. Rated for an operating pressure of 300 psig (2068 kPa) at 200 degrees F (93.3 degrees C), and a burst pressure of 1000 psig (6895 kPa). Hoses shall be factory tested for leakage at 100 psig (689 kPa).
- E. Metal ends shall include ferrules crimped to the hose. One end shall be a swivel fitting with NPT pipe threads, and may be tapered threads, or straight threads with fiber gasket or tapered cone seal, to match piping. The other end fitting shall be the same, or shall be fixed tapered NPT threads. Provide piping adapters as necessary.
- F. At the Contractor's option, hoses may be furnished assembled with valves.

## 2.9 RELIEF VALVES

- A. Manufacturers:
  1. Bell & Gossett.
  2. Cash Acme.
  3. Spence.
  4. Taco.
  5. Watts.
  6. Wheatley.
- B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

## 2.10 GLYCOL SYSTEM

- A. Mixing Tank: 55 gallon (205 l)] steel drum with fittings suitable for filling and hand pump for charging, rubber hose for connection of hand pump to system.
- B. Storage Tank: Closed type, welded steel constructed, tested and stamped in accordance with ASME SEC 8-D; [100 psig (690 kPa)] [125 psig (860 kPa)] rating; cleaned, prime coated, and supplied with steel support saddles. Construct with tapings for installation of accessories.
- C. Air Pressure Reducing Station: Pressure reducing valve with shut-off valves, strainer, check valve and needle valve bypass.
- D. Glycol Solution:
  1. Manufacturers:
    - a. Dow Chemical Co.
    - b. No Substitutions.
  2. Heat Transfer Fluid:
    - a. Dowfrost corrosion-inhibited propylene glycol, colorless, 96 percent propylene glycol, 4 percent performance additives. Recommended use temperature range: -50 degrees F (-45 degrees C) to 250 degrees F (120 degrees C).
    - b. Dowfrost HD corrosion-inhibited propylene glycol, dyed bright yellow to aid in

leak detection, 94 percent propylene glycol, 6 percent performance additives. Recommended use temperature range: -50 degrees F (-45 degrees C) to 325 degrees F (160 degrees C).

3. Provide a glycol and water solution mixed by volume as follows, unless otherwise indicated on the Drawings:
  - a. 40 percent Dowfrost - 60 percent water, providing a freezing point temperature of no higher than -6 degrees F (-21 degrees C).
  - b. 40 percent Dowfrost HD - 60 percent water, providing a freezing point temperature of no higher than -6 degrees F (-21 degrees C),
4. Water used in solution shall conform to glycol manufacturer's requirements. Water shall have low levels (less than 25 ppm) of chloride and sulfate, and less than 50 ppm of hard water ions (Ca++, Mg++). Distilled or deionized water is recommended. If good quality water is unavailable, purchase pre-diluted solutions of fluid from the fluid manufacturer or from the distributor.
5. Provide containers of undiluted inhibited glycol as required to compensate for any water left in the system after initial flushing, testing, and draining.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- C. Provide manual air vents at system high points and as indicated.
- D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain, and shutoff ball valve upstream of vent to shut the vent off after initial system startup.
- E. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- F. Provide valved drain and hose connection on strainer blow down connection.
- G. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove fine-mesh temporary startup strainers after flushing and cleaning systems; hang the startup strainer at the pump to demonstrate to the Engineer that it was removed. If strainer's removable cover is insulated (for example, chilled water systems) the insulation shall be removable and reusable.
- H. Suction diffusers shall have adequate space provided for strainer removal.
- I. Support pump fittings with floor mounted pipe and flange supports.
- J. Provide balancing valves on water outlet from terminal heating and cooling units such as radiation, unit heaters, and fan coil units.
- K. Ensure that balancing valves are installed with minimum upstream length of straight pipe as recommended by the manufacturer.

- L. Ensure that balancing valves are installed with the readout valves fully accessible, including space required for insertion of metering probes.
- M. Standard details for heating and cooling coils are based on single coil arrangements. For heating and cooling coils that are supplied in a split coil arrangement, with two or more individual coils, provide additional piping and balancing valves at each coil to ensure that flow through each coil is proportional to the percentage of total coil face area that the coil occupies.
- N. Install combination valve assemblies to account for small offsets between coils connections and hard pipe connections. Assemblies shall not be installed in a manner that forms bends of more than 90 degrees total.
- O. Expansion Tanks (Bladder and Diaphragm Type): Provide pressure gauge per Division 23 Section "Meters and Gauges for HVAC Piping" near point where expansion tank is connected to system, for determining required pre-charge pressure for air side of expansion tank. Isolate expansion tank from system and pre-charge air side of tank to same pressure as static head of system at point where expansion tank is connected to system. Measure static head of system after pressure reducing valve at cold water make-up has been properly set in accordance with this Section. Pre-charge air side of expansion tank only when the temperature of the water in the system is less than 80 degrees F (27 degrees C). Provide drain valve with hose end connection at point of connection to expansion tank to allow for periodic removal of system pressure in order to check expansion tank's pre-charge air pressure. Drain valve shall be located closest to expansion tank, isolation valve shall be immediately upstream of drain valve and pressure gauge shall be within sight upstream of isolation valve.
- P. Relief Valves:
  - 1. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
  - 2. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to not exceed maximum pressure rating of connected equipment.
  - 3. Pipe relief valve outlet to nearest floor drain.
  - 4. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- Q. Glycol Systems:
  - 1. Clean and flush glycol system before adding glycol solution. Refer to Division 23 Section "HVAC Water Treatment."
  - 2. Feed glycol solution to system through make-up line with pressure regulator, venting system high points. [Set to fill at 12 psig (80 kPa).] [Pressure system cold at 5 psig (35 kPa).]
  - 3. Perform tests determining strength of glycol and water solution and submit written test results.

END OF SECTION 232118

**This Page Intentionally Left Blank**

## SECTION 232123 – HYDRONIC PUMPS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. In-line circulators.
- B. Vertical in-line pumps.

#### 1.2 RELATED SECTIONS

- A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”
- B. Division 23 Section “HVAC Piping Insulation.”
- C. Division 23 Section “HVAC Equipment Insulation”
- D. Division 23 Section “Hydronic Piping.”
- E. Division 23 Section “Hydronic Specialties”
- F. Division 26 “Electrical” Electrical characteristics and wiring connections.

#### 1.3 REFERENCES

- A. UL 778 - Motor Operated Water Pumps.
- B. NFPA 70 - National Electrical Code.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading throughout the entire operating range in parallel or individual operation, and operate within 25percent of midpoint of published maximum efficiency curve.

#### 1.5 SUBMITTALS

- A. Submit under provisions of Division 01 Section “Submittal Procedures.”
- B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
- D. Millwright's Certificate: Certify that base mounted pumps have been aligned.

## 1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 01 Section "Operation and Maintenance Data."
- B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

## 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing, assembly, and field performance of pumps with minimum 3 years' experience.
- B. Alignment: Base mounted pumps shall be aligned by a qualified millwright.

## 1.8 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Pumps, General:
  - 1. Taco.
  - 2. Armstrong.
  - 3. Bell & Gossett.
  - 4. Flo-Fab.
  - 5. Grundfos.
  - 6. Paco.
  - 7. Patterson.
  - 8. Peerless.
  - 9. Weinman.
  - 10. Wilo.
- B. Cartridge Circulators with Integral Speed Controller:
  - 1. Grundfos.

C. No Substitutions.

### 2.2 GENERAL

- A. Statically and dynamically balance rotating parts.
- B. Construction shall permit complete servicing without breaking piping or motor connections.
- C. Pumps shall operate at 1750 rpm unless indicated or specified otherwise.
- D. Pump connections shall be flanged.
- E. Wetted parts shall be compatible with circulated fluid.

## 2.3 IN-LINE CIRCULATORS

- A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 175 psig (1200 kPa) maximum working pressure.
- B. Casing: Cast iron, with flanged pump connections.
- C. Impeller: Cadmium plated steel, stamped brass or cast bronze, keyed to shaft.
- D. Bearings: 2 oil lubricated bronze sleeves.
- E. Shaft: Alloy or stainless steel with copper or bronze sleeve, integral thrust collar.
- F. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F (107 degrees C) maximum continuous operating temperature.
- G. Drive: Flexible coupling.

## 2.4 VERTICAL IN-LINE PUMPS

- A. Type: Vertical, single stage, close coupled, radially or horizontally split casing, for in-line mounting, for 175 psig (1200 kPa) working pressure.
- B. Casing: Cast iron, with suction and discharge gage port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.
- C. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.
- D. Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.
- E. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F (107 degrees C) maximum continuous operating temperature.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.
- C. Decrease piping from line size with long radius reducing elbows or reducers.

- D. Pump inlet conditions shall be as recommended by the pump manufacturer to eliminate system effects.
  - 1. Provide suction diffusers where indicated. Suction diffusers shall have adequate space provided for strainer removal. Remove fine-mesh start-up strainers after system startup, and hang adjacent to the pump for Architect/Engineer's approval.
  - 2. Where suction diffusers are not indicated, provide proper straight lengths of inlet piping and long-radius elbows at pump inlets.
- E. Support piping adjacent to pump such that no weight is carried on pump casings. Provide necessary brackets or hanger supports as required to relieve the stress on the pumps and piping. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches (102 mm) and over.
- F. Provide line sized shut-off valve and strainer on pump suction, and properly sized soft seat check valve and balancing/flow-measuring/shutoff valve on pump discharge.
- G. Install pumps with a pressure gauge piped to suction and discharge, with shutoff valves.
- H. Provide air cock and drain connections on horizontal pump casings.
- I. Provide drains for bases and seals, piped to and discharging into floor drains with air gaps.
- J. Lubricate pumps before start-up.
- K. Check, align, and certify alignment of base mounted pumps prior to start-up.
- L. Provide labor and materials required to ensure that pump impellers are adequately sized to provide flow rates as indicated. This shall include, but not be limited to, trimming impellers.

END OF SECTION 232123



## SECTION 232500 – HVAC WATER TREATMENT

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Cleaning of piping systems.
- B. Chemical feeder equipment.
- C. Chemical treatment.

#### 1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Division 23 Section “Hydronic Piping”: Placement of water coupon rack, by-pass (pot) feeder.

#### 1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Division 01 Section “Summary”: Owner-furnished treatment equipment and chemicals.

#### 1.4 RELATED SECTIONS

- A. Division 23 Section “Instrumentation and Controls For Mechanical Systems.”
- B. Division 26 “Electrical”: Electrical characteristics and wiring connections.

#### 1.5 REFERENCES

- A. NFPA 70 - National Electrical Code.

#### 1.6 SUBMITTALS

- A. Submit under provisions of Division 01 Section “Submittal Procedures.”
- B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
- C. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.
- D. Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.

#### 1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”
- B. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years' experience. Company shall have local representatives with water analysis laboratories and full time service personnel.
- B. Installer: Company specializing in performing the work of this Section with minimum 3 years' experience and approved by manufacturer.

## 1.9 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for discharge to public sewage systems.
- B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

## 1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of treatment systems for 1-year from Date of Substantial Completion.
- B. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit 2 copies of field service report after each visit.
- C. Provide laboratory and technical assistance services during this maintenance period.
- D. Include 2-hour training course for Owner's operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Schedule the course at Owner's convenience after start-up of systems.
- E. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

## 1.11 MAINTENANCE MATERIALS

- A. Provide maintenance materials under provisions of Division 01 Section "Product Requirements."
- B. Provide sufficient chemicals for treatment and testing during warranty period.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Chemical Treatment Systems Products, and Services:
  - 1. Barclay Water Management, Inc., Watertown, MA office.
  - 2. Nalco Company, Windham, ME office.

- B. Chemical Treatment Products:
  - 1. Nu-Calgon.
  - 2. Culligan.
  - 3. H-O-H Water Technology, Inc.
  - 4. Wesco Chemicals, Inc.

## 2.2 MATERIALS

- A. System Cleaner:
  - 1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products [[sodium tripoly phosphate and sodium molybdate](#)].
  - 2. Biocide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.
- B. Closed System Treatment (Water):
  - 1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
  - 2. Corrosion inhibitors; liquid boron-nitrite, sodium nitrite and borax, sodium tolyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
  - 3. Conductivity enhancers; phosphates or phosphonates.

## 2.3 BY-PASS (POT) FEEDER

- A. Manufacturers:
  - 1. Neptune Chemical Pump Co.: Model DBF-5HP.
  - 2. General Treatment Products, Inc.: Model DB5-QC-AR.
  - 3. Griswold Water Sytems: Model DB-5-GE-CS-Z-230.
  - 4. Wheatley - a division of Global Flow Products: Model VFT-005-0.
  - 5. No substitutions.
- B. 5.0 gal (18.9 l), with quick opening cap (coarse threaded or Victaulic grooved coupling type), domed (convex) top and bottom, for working pressure of 200 psig (1370 kPa) at 200 degrees F (93 degrees C), fittings as required for piping configuration indicated on the Drawings, minimum of 3/4 inch (19 mm) FPT inlet, outlet, and bottom drain.
- C. Provide fitting for air vent ball valve, either on the feeder or on piping, to allow release of pressure before opening the cap.
- D. Plug any unused openings.
- E. Open fill funnel is not desired. If a fill funnel is provided, provide a lockable ball valve, and padlock with 3 keys, to prevent tampering. If more than one lock is provided, they shall be keyed alike. Furnish keys to the Owner.
- F. Install above the floor with legs or pedestal. For feeders which don't have integral legs or pedestal, provide additional support or concrete housekeeping pad.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.
- C. Verify that electric power is available and of the correct characteristics.

### 3.2 CLEANING SEQUENCE

- A. Concentration:
  - 1. As recommended by manufacturer.
  - 2. 1 pound per 100 gallons (1 kg per 1000 L) of water contained in the system.
  - 3. 1 pound per 100 gallons (1 kg per 1000 L) of water for hot systems and 1 pound per 50 gallons (1 kg per 500 L) of water for cold systems.
  - 4. Fill steam boilers only with cleaner and water.
- B. Hot Water Heating Systems:
  - 1. Apply heat while circulating, slowly raising temperature to 160 degrees F (71 degrees C) and maintain for 12 hours minimum.
  - 2. Remove heat and circulate to 100 degrees F (37.8 degrees C) or less; drain systems as quickly as possible and refill with clean water.
  - 3. Circulate for 6 hours at design temperatures, then drain.
  - 4. Refill with clean water and repeat until system cleaner is removed.
- C. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect/Engineer.
- D. Flush open systems and glycol filled closed systems with clean water for one hour minimum. Drain completely and refill.
- E. Remove, clean, and replace strainer screens.
- F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

### 3.4 CLOSED SYSTEM TREATMENT

- A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.
- B. Introduce closed system treatment through bypass feeder when required or indicated by test.

END OF SECTION 232500

**This Page Intentionally Left Blank**

## SECTION 233113 – METAL DUCTS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Metal Ductwork.
- B. Kitchen Hood Ductwork.

#### 1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Division 23 Section “Air Duct Accessories”: Kitchen hoods.
- B. Division 26 – Electrical: Smoke detectors.

#### 1.3 RELATED SECTIONS

- A. Division 23 Section “Testing, Adjusting and Balancing for HVAC.”
- B. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment”: Sleeves.
- C. Division 23 Section “Duct Insulation”: External insulation and duct liner.]
- D. Division 23 Section “Air Duct Accessories”
- E. Division 23 Section “Air Outlets and Inlets.”

#### 1.4 REFERENCES

- A. ASTM A 36 - Structural Steel.
- B. ASTM A 90 - Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- C. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- D. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- E. ASTM A 568 - Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
- F. ASTM A 653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- G. ASTM A 1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

- H. ASTM A 1011 - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- I. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- J. ASTM C 14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- K. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- L. AWS D9.1 - Welding of Sheet Metal.
- M. NBS PS 15 - Voluntary Product Standard for Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment.
- N. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- O. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
- P. NFPA 91 - Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying.
- Q. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.
- R. SMACNA - HVAC Air Duct Leakage Test Manual.
- S. SMACNA - HVAC Duct Construction Standards - Metal and Flexible (SMACNA HVACDCS).
- T. SMACNA - Fibrous Glass Duct Construction Standards.
- U. UL 181 - Factory-Made Air Ducts and Connectors.
- V. UL 1978 - Grease Ducts.
- W. UL 2221 - Tests of Fire Resistant Grease Duct Enclosure Assemblies.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. No variation of duct configuration or sizes is permitted except by written permission from the Architect. Size proposed substitutions of round ducts in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

#### 1.6 SUBMITTALS

- A. Submit under provisions of Division 01 Section "Submittal Procedures".
- B. Shop Drawings: Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration. Submit prior to start of work.
- C. Product Data: Provide data for duct materials, duct liner and duct connectors.



- D. Test Reports: Submit testing apparatus, procedures, and preliminary forms prior to performing tests. On final reports, indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

#### 1.7 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01 Section "Closeout Procedures."
- B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Indicate additional fittings used.

#### 1.8 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA HVACDCS.

#### 1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years' experience.
- B. Installer: Company specializing in performing the work of this Section with minimum 3 years' experience.

#### 1.10 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 standards.

#### 1.11 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures during and after installation of duct sealants.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Flexible Ducts:
  - 1. Flexible Technologies Group - Thermaflex product line.
  - 2. Buckley Associates - Flexmaster Triple-Lock Buck Duct product line.
  - 3. No substitutions.
- B. Plastic Drawbands:
  - 1. Panduit.
  - 2. Thomas and Betts.
  - 3. Tyton.
- C. Tape for Flexible Ducts:
  - 1. Ideal Tape Co., division of American Biltrite Inc.

2. 3M Company.
3. Nashua Tape Products, division of Berry Plastics Corp.
4. Venture Tape Corporation.
5. No substitutions.

D. Manufactured Ductwork - Round and Flat Oval:

1. McGill AirFlow LLC, a subsidiary of United McGill Corporation.
2. Aero Heating & Ventilating, Inc.; Portland, ME.
3. Air Purchases, Inc.; Manchester, NH – spiral duct lengths.
4. Atlantic Air Products LLC; Bow, NH.
5. Central City Sheet Metal; Brewer, Caribou, and Gorham, ME.
6. Hahnel Brothers; Bangor and Lewiston, ME.
7. Hranec Corporation; Uniontown, PA.
8. Lindab, Inc. – duct fittings only.
9. Macy Industries, Inc.; Hookset, NH.
10. Monroe Metal Mfg. Inc.; Monroe, NC.
11. Northeastern Sheet Metal Inc.; Goffstown, NH.
12. Semco Inc., division of the Flakt Woods Group.
13. S.G. Torrice Co.; Wilmington, MA – spiral duct lengths.
14. Sheet Metal Connectors Inc.; Minneapolis, MN.
15. Spiral Manufacturing Co. Inc.; Minneapolis, MN.
16. Total Air Supply; Nashua, NH – spiral duct lengths.
17. No substitutions.

E. Manufactured Ductwork - Transverse Duct Connection System:

1. Ductmate.
2. HFC Enterprises; Baldwin Park, CA – Dura Flange product line, for round and flat oval ducts only.

F. Sealants:

1. Hardcast, a division of Carlisle Corporation.
2. 3M Company.
3. Ductmate.
4. Foster.
5. McGill AirSeal LLC, a subsidiary of United McGill Corporation.
6. Mon-Eco Industries, Inc - Eco product line.
7. Polymer Adhesive Sealant Systems.

## 2.2 MATERIALS

A. Galvanized Steel Ducts:

1. Steel sheet metal components of galvanized ductwork in this Specification Section shall be galvanized steel sheet, lock-forming quality, having G60 or heavier zinc coating (G90 minimum for outdoor or moist applications) conforming to ASTM A653 rating system and tested in accordance with ASTM A90.
2. Provide paint-grip exterior surfaces for exposed ducts, where available.
3. Sheet metal gauge shall be not less than 26 gauge (0.56 mm).

B. Carbon Steel Ducts: ASTM A1008, A1011. Also known as black iron.

## 2.3 ACCESSORIES

- A. Drawbands for Flexible Ducts:
  - 1. Stainless Steel: ½ inch (13 mm) wide with screw-driven worm gear.
  - 2. Plastic: Panduit PLT5H or PLT8H; Thomas and Betts Dukt-Rap, VAL-26-50, or VAL-275X-25; or Tyton T150L or LX. Install with manufacturer's lever-action tightening tool.
- B. Tape for Flexible Ducts: Ideal-Seal 587A/B, UL 181B-FX listed, aluminum foil with pressure-sensitive acrylic adhesive, -20 to 250 degrees F (-28 to 121 degrees C) temperature range, 25.0 lb/in. width (109.4 N/25.4 mm width) tensile strength.
- C. Coating for Buried Ducts: Asphalt base.
- D. Concrete Ducts: ASTM C14; hub and spigot concrete sewer pipe with ASTM C443 joints, rubber gaskets.
- E. Fasteners: Rivets, bolts, or sheet metal screws.
- F. Sealants: See Duct Sealant portion of this Specification.
- G. Hanger Rod: ASTM A36; galvanized steel; threaded both ends, threaded one end, or continuously threaded.

## 2.4 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVACDCS, as specified or as indicated on the drawings. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- B. SMACNA Duct Construction Manuals:
  - 1. The SMACNA recommendations shall be considered as mandatory requirements.
  - 2. Substitute the word "shall" for the word "should" in these manuals.
  - 3. Where the Contract Specifications differ from SMACNA recommendations, the more stringent requirements (as determined by the Architect) shall take precedence.
  - 4. Details on the Contract Drawings take precedence over SMACNA standards.
- C. Sheet metal shall be galvanized steel as specified in Part 2 paragraph "Materials" in this Section, unless otherwise indicated or specified.
- D. Construct Tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline.
  - 1. Where space is too restricted for full-radius elbows, provide mitered (square-throat) elbows with single wall turning vanes. Do not use air foil turning vanes.
  - 2. Mitered elbows in round or flat-oval ductwork shall be factory-manufactured.
  - 3. Radiused elbows with throat radius 1/2 times width of duct (centerline radius 1 width of duct) may be used instead of mitered elbows, but only where space is too restricted for full radius.
  - 4. Fittings not conforming to these requirements will be ordered removed and replaced with proper fittings.

- E. Increase duct sizes gradually, not exceeding 15 degrees divergence or convergence (per side) wherever possible; maximum 30 degrees divergence (per side) upstream of equipment and 45 degrees convergence (per side) downstream.
- F. Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch (100 mm) cemented slip joint, brazed or electric welded. Prime coat welded joints.
- G. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- H. Longitudinal locks or seams known as “button-punch-snap-lock” and other “snap-lock” types will not be permitted in rectangular duct. Snap-lock longitudinal seams may be used on round ducts up to 8 inches diameter, with screws provided to secure the seams at 24 inches (609 mm) on center maximum spacing.
- I. Exposed Ducts: Select and handle materials with care for a neat appearance. Joint connections on round and flat oval ducts shall be sleeve or flanged type; drawbands are not acceptable.

## 2.5 MANUFACTURED DUCTWORK AND FITTINGS

- A. Manufactured ductwork and fittings listed below are acceptable alternatives to standard ductwork systems. For exposed round and flat oval ductwork, factory-manufactured ductwork and fittings are required.
- B. Manufacture in accordance with SMACNA HVACDCS, and as specified or as indicated on the drawings. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- C. Exposed Round and Flat Oval Ductwork: Shall be manufactured ductwork by one of the listed manufacturers.
  - 1. Spiral Ductwork Acceptable Products:
    - a. McGill Airflow: Standard Uni-Seal product line (smooth surface between spiral lockseams) or Uni-Rib product line (one standing seam reinforcement between each pair of spiral lockseams).
    - b. Monroe Metal Inc.: Standard spiral product line (smooth surface between spiral lockseams). V-Rib product line is not allowed.
    - c. Other Manufacturers: Standard spiral product line (smooth surface between spiral lockseams).
    - d. Ductwork and fittings shall be products of a single manufacturer.
- D. Exposed Ducts:
  - 1. Select and handle materials with care for a neat appearance.
  - 2. Joint connections on round and flat oval ducts shall be sleeve or flanged type; drawbands are not acceptable. Joint connections on flat oval ducts 42 inches (1.07 m) and wider shall be flanged type to ensure tight fit and good appearance.
  - 3. Provide exterior reinforcing only where required, with prior approval from the Architect.
  - 4. External reinforcement of flat-oval ducts shall be full-perimeter angle rings. Straight angles along flat sides only are not allowed.

- E. Galvanized and stainless steel sheet metal used in fabrication shall be not less than 26 gauge (0.551 mm) thickness. Aluminum shall be not less than 0.025 in. (0.635 mm) nominal thickness. This requirement supersedes SMACNA requirements.
- F. Round and Flat Oval Duct and Fittings:
  - 1. Shall be suitable for at least 4 in. WG (996 Pa) positive pressure and 2 in. WG (498 Pa) negative pressure in accordance with SMACNA HVACDCS standards. This is a minimum; provide higher ratings where required.
  - 2. Fittings shall be fabricated of sheet metal at least one gauge heavier than straight duct of the same size.
  - 3. Fittings shall be factory-sealed so that no field sealing of joints between gores or segments is required. Acceptable methods of construction are fully welded, spot-welded with inner sealant, or standing-seam crimped joints.
- G. Radiused Elbows in Round and Flat Oval:
  - 1. In exposed ductwork shall be non-adjustable type, factory-sealed.
  - 2. In concealed ductwork may be adjustable type, with full long radius as detailed on the Drawings. Short-radius elbows are not allowed.
  - 3. Shall be constructed of the following minimum number of segments or gores: 90-degree: 4 gores; 60-degree: 3 gores; 45-degree: 3 gores; 30-degree: 2 gores; 22-1/2-degree: 2 gores.
  - 4. 1-piece stamped elbows are acceptable up to 12 inches (305 mm) diameter. Pleated elbows are acceptable up to 10 inches (254 mm) diameter.
- H. Mitered Elbows in Round and Flat Oval:
  - 1. Available in both 90-degree and 45-degree elbows.
  - 2. Shall have minimum number of welded single-wall vanes as follows (size is duct width in plane of bend):
    - a. 3 to 9 inch (76 to 229 mm): 2.
    - b. 10 to 14 inch (254 to 356 mm): 3.
    - c. 15 to 19 inch (381 to 483 mm): 4.
    - d. 20 to 60 inch (508 to 1524 mm): 5.
    - e. Larger Sizes: 12-inch (305 mm) maximum spacing.
- I. Inner tie-rod reinforcement is not allowed. Increase duct sheet metal gauge or external reinforcement as required.
- J. Flat Oval Ducts: Machine made from round spiral lockseam duct.
- K. Transverse Duct Connection System: SMACNA "F" rated or SMACNA "J" rated rigidity class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips. Product shall be Ductmate factory-manufactured connectors, or field-formed flanges using a specialized machine.

## 2.6 CASINGS

- A. Fabricate casings in accordance with SMACNA HVACDCS and construct for operating pressures indicated.
- B. Mount floor mounted casings on 4 inch (100 mm) high concrete curbs. At floor, rivet panels on

8 inch (200 mm) centers to angles. Where floors are acoustically insulated, provide liner of 18 gauge (1.20 mm) galvanized expanded metal mesh supported at 12 inch (300 mm) centers, turned up 12 inches (300 mm) at sides with sheet metal shields.

- C. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
- D. Fabricate acoustic casings with reinforcing turned inward. Provide 16 gauge (1.50 mm) back facing and 22 gauge (0.80 mm) perforated front facing with 3/32 inch (2.4 mm) diameter holes on 5/32 inch (4 mm) centers. Construct panels 3 inches (75 mm) thick packed with 4.5 lb/cu ft (72 kg/cu m) minimum glass fiber media, on inverted channels of 16 gauge (1.50 mm).

## 2.7 KITCHEN GREASE HOOD EXHAUST DUCTWORK

- A. Fabricate in accordance with SMACNA HVACDCS and NFPA 96.
- B. Construct of 16 gauge (1.50 mm) carbon steel or 18 gauge (1.21 mm) type 304 or 316 stainless steel, using continuous external welded joints. Ductwork exposed to view or exposed to weather shall be stainless steel unless otherwise indicated.
- C. Gaskets and sealants shall be rated for 1500 degrees F (815.6 degrees C) continuous operation.
- D. Connection to Fan: Provide transition plate to fan base, of same material as duct. Outer perimeter shall be full size of fan base or curb. Inner opening shall be same size as duct and similar to fan inlet size. Inner opening shall be centered in plate to align with fan inlet and to maintain clearances. Duct shall be welded smoothly and continuously to the transition plate, preferably butt-welded to the underside of the plate or with plate corners turned down into duct, rather than duct turned out onto plate. Provide a smooth flat surface for installation of high-temperature gasket between transition plate and fan base. Fasten transition plate to the roof curb (or non-combustible wall opening).
- E. Elbows:
  - 1. Mitered: Internal turning vanes are not allowed. Mitered elbows should be avoided in grease ducts except where indicated.
  - 2. Radiused: Provide full radius (centerline radius 1-1/2 times the duct width), continuously curved for rectangular duct, gored for round duct. In manufactured round duct, elbows may be manufacturer's standard, with throat radius as little as 6 inches (75 mm).

## 2.8 PRESSURE CLASSIFICATION

- A. Ratings as indicated on the Drawings or as specified. See Ductwork Pressure Class Schedule in Part 3 of this Section.
- B. If no ratings are indicated, ductwork shall be rated for the external static pressure of the system plus 25 percent.
  - 1. If 4 dampers (of any type) or fewer can isolate a duct system, that portion of the system shall be rated for the shut-off pressure of the system fans.

## 2.9 DUCT SEALING

- A. Seal ductwork as outlined in the SMACNA HVACDCS. Seal ductwork to a minimum of class A (transverse joints, longitudinal seams, and duct wall penetrations), regardless of pressure class.
- B. Seal ductwork systems as required to ensure that maximum duct leakage does not exceed that allowed by the latest edition of the SMACNA HVAC Air Duct Leakage Test Manual. Allow sealant to dry in accordance with manufacturer's requirements of time and environmental conditions before ductwork systems are pressurized.
- C. Duct sealing materials used shall be non-flammable and non-combustible in both liquid and solid states.
- D. Seal Pittsburgh hammered lockseams by flooding the joint with sealant prior to assembly.
- E. Seal exposed ducts by applying mastic-type or gasket-type sealer just before the joint or seam is made; remove excess sealant for a neat appearance.
- F. Fill (with matching duct material such as sheet metal) any gaps in duct which exceed the recommendations of the sealant manufacturer, and in no case shall liquid or mastic sealant be used to fill gaps or openings which exceed 1/8 inch (3.2 mm) in any direction. Verify that system air pressure acting on a wide gap will not exert enough force to damage or loosen the sealant.
- G. Materials for Sealing:
  - 1. Hardcast: Flex-Grip 550 or Iron-Grip 601 mastic.
  - 2. Hardcast: gypsum-based tape and mastic, waterproof type when used on moist-air exhaust or in humid or outdoor locations.
  - 3. Ductmate: Flanged lateral joints with gaskets.
  - 4. Ductmate: PROseal.
  - 5. Foster: Duct-Fas or Safetee mastic sealant. Duct-Fas is UV resistant and recommended for applications exposed to sunlight.
  - 6. Mon-Eco: Eco-Duct Seal 4450 (red color) or 4452 (grey color). Use grey color where ducts will be unpainted and exposed to public view.
  - 7. Polymer Adhesives Sealant Systems: Airseal No. 11 premium sealant.
  - 8. [PVC tape for PVC-coated metal ducts.]
  - 9. [Joints for FRP ducts]
  - 10. [Joints for Concrete ducts.]

## 2.10 UNIFORMITY OF MATERIALS

- A. Ductwork accessories, including but not limited to volume dampers, smoke dampers, fire dampers, combination fire/smoke dampers, backdraft dampers and motorized dampers, shall be fabricated of materials that are similar to the ductwork in which they are installed.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components furnished under other Section and Divisions of the Specifications. Such items may include but are not limited to: Sensors and airflow measuring stations furnished under Division 23 Section "Instrumentation and Control for Mechanical Systems"; gauges and meters; and smoke detectors furnished under Division 26 – Electrical.
- C. Install ducts in accordance with SMACNA HVACDCS.
- D. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- E. "Fishmouth" duct connections are not allowed.
- F. Inner tie-rod reinforcement is not allowed. Increase duct sheet metal gauge or external reinforcement as required.
- G. Exposed Ducts:
  - 1. Handle with care for a neat appearance. Repair or replace dented or damaged ductwork as required by the Architect. Select hangers for appearance, and to prevent sagging or distortion of duct.
  - 2. Remove labels attached to ducts before receiving paint.
- H. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- J. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with crimp in direction of air flow.
- K. Use double nuts and lock washers on threaded rod supports. Strap hangers shall be minimum 16 gauge (1.50 mm) x 1 inch (25 mm) galvanized straps. Hanger and support components including but not limited to "unistrut" shall be galvanized steel except that where other duct materials are used, the hanger materials shall be compatible and non-corrosive to the duct. Wire hangers are not acceptable.
- L. Flexible Ducts:
  - 1. Connect diffusers or light troffer boots to low pressure supply ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.
  - 2. Minimum bend radius shall be one and one half times the duct diameter. Support the bend to maintain this radius.
  - 3. Bends shall not exceed 45 degrees.
  - 4. Connect flexible ducts to metal ducts with 2 turns of duct tape and metal draw bands. Plastic drawbands may be used if they are installed using the band manufacturer's lever-



action tightening tool. On insulated flexible ducts, provide an additional seal of tape and drawband on the insulation's vapor barrier.

- M. Set plenum doors 6 to 12 inches (150 to 300 mm) above floor. Arrange door swings so that fan static pressure holds door in closed position.
- N. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Do not start ducted air moving equipment until construction is completed to a stage where airborne construction dust is no longer present. At the time of substantial completion, the entire air distribution system shall be turned over to the Owner clear of construction dust and debris. If the interior surfaces of any ducted air moving equipment or the interior surfaces of any portion of the ductwork distribution system are found, as determined by the Architect, to contain significant construction dust and debris, the entire air distribution system shall be cleaned in accordance with **Division 23**. If proper precautions are taken to prevent construction dust and debris from entering the ductwork during construction and if the Architect finds all ductwork to be free from such dust and debris, air duct cleaning shall not be required.
- O. For fresh air intake and exhaust plenums connected to louvers or brick or block vents, pitch bottom of plenums down to bottom of louver at minimum 1/4 inch per foot (2 percent). Seal connections and joints on bottom of plenums watertight with mastic. Connect bottom of plenum to top-inside edge of bottom louver blade or waterstop as detailed on the Drawings, to ensure positive drainage
- P. Provide floor drains in fresh air and exhaust plenums. Pitch bottom of plenums to floor drains and provide deep seal traps. Pipe traps to nearest floor drains.
- Q. Install duct-mounted components furnished under other Sections of this Specification, such as smoke dampers, control dampers, control sensors, and smoke detectors. Install with straight lengths of duct as required for proper operation. Provide access at such components as required. Install in accessible locations for maintenance; notify the Architect if a location indicated or selected requires addition of access by other trades.
- R. Kitchen Grease Hood Exhaust Ductwork:
  - 1. Seams, joints, and penetrations shall have a liquidtight continuous external weld.
  - 2. Connect to hood as required by the Mechanical Code, NFPA 96, and manufacturer's instructions. If a factory raised angle collar is provided with the hood, provide a compatible angle on the duct end, and weld continuously or provide a bolted and gasketed connection to allow disassembly. If no factory collar is provided, insert the duct 1 inch into the hood and weld continuously. Do not field-modify or cut the hood with written permission from the Architect.
  - 3. At fan, provide a fan adapter of same construction as duct, with flat plate the full size of fan base or curb. Weld duct continuously to the plate, centered to maintain clearances to curb and straight inlet to fan. Provide a smooth flat surface for installation of fan gasket.
  - 4. Ducts shall not pass through fire walls or fire partitions.
  - 5. Clearances: Maintain minimum 18 inches (460 mm) from ductwork to combustible materials and minimum 3 inches (77 mm) from ductwork to limited combustible materials. Clearances may be reduced in accordance with manufacturer's UL listing for fire-resistive duct wrap.
  - 6. Provide approved access doors at changes of direction of kitchen exhaust ductwork.

Provide nameplate of suitable material on access doors stating "ACCESS PANEL - DO NOT OBSTRUCT". Install access doors on top or sides of duct; in horizontal ducts, locate opening above the bottom of the duct to form a grease dam.

7. Provide mechanical sealing adapter by Ansul Fire Protection (or equal by Kidde) to allow access by balancing contractor for balancing hood system. Coordinate size of mechanical sealing adapter with balancing contractor. Provide cap for adapter when not in use. Install mechanical sealing adapter in exhaust ductwork as close to exhaust fan as possible.

### 3.2 SCHEDULES

#### A. Ductwork Material Schedule

AIR SYSTEM	MATERIAL
Low Pressure Supply (Heating Systems)	Galvanized Steel
Low Pressure Supply (System with Cooling Coils)	Galvanized Steel
Return and Relief	Galvanized Steel
General Exhaust	Galvanized Steel
Kitchen Grease Hood Exhaust	Steel
Outside Air Intake	Galvanized Steel

END OF SECTION 233113

## SECTION 233300 – AIR DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Dampers:
  - 1. Backdraft Dampers.
  - 2. Volume Control Dampers.
- B. Duct Access Doors.
- C. Duct Sleeves, Prepared Openings and Closure Collars.
- D. Duct Test Holes.
- E. Flexible Duct Connections.
- F. Roof Curbs.
- G. Turning Vanes.
- H. Kitchen Exhaust Hoods.
- I. Kitchen Hood Fire Extinguishing Systems.

#### 1.2 RELATED SECTIONS

- A. Division 23 Section “Identification for HVAC Piping and Equipment.”
- B. Division 23 Section “Instrumentation and Control for Mechanical Systems.”
- C. Division 23 Section “Metal Ducts.”
- D. Division 26 “Electrical”: Electrical characteristics and wiring connections.

#### 1.3 REFERENCES

- A. ASTM C423-02a - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- B. ASTM E477-99 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- C. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- D. NFPA 92A - Smoke Control Systems.
- E. NFPA 70 - National Electrical Code.
- F. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from

Commercial Cooking Equipment.

- G. SMACNA - HVAC Duct Construction Standards - Metal and Flexible, Third Edition - 2005 (HVACDCS).
- H. SMACNA - Seismic Restraint Manual - Guidelines for Mechanical Systems (SRMGMS).
- I. UL 33 - Heat Responsive Links for Fire-Protection Service.
- J. UL 94 - Safety of Flammability of Plastic Materials for Parts in Devices and Appliances Testing.
- K. UL 555 - Fire Dampers and Ceiling Dampers.
- L. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.
- M. UL 1995 - Heating and Cooling Systems.

1.4 SUBMITTALS

- A. Submit under provisions of Division 01 Section "Submittal Procedures."
- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.
- C. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01 Section "Closeout Procedures."
- B. Record actual locations of access doors and test holes.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years' experience.

1.7 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01 Section "Product Requirements."

- B. Protect dampers from damage to operating linkages and blades.

## PART 2 - PRODUCTS

### 2.1 GALVANIZED STEEL

- A. Steel sheet metal components of accessories in this Specification Section shall be galvanized steel sheet, lock-forming quality, having G60 or heavier zinc coating conforming to ASTM A653 rating system and tested in accordance with ASTM A90. Provide paint-grip exterior surfaces for exposed ducts, where available.

### 2.2 DAMPERS

- A. Manufacturers:
  - 1. Ruskin.
  - 2. Air Balance, Inc.
  - 3. Arrow.
  - 4. Cesco.
  - 5. Greenheck.
  - 6. NCA.
  - 7. Tamco.
  - 8. Ventex.
  - 9. Vent Products, Inc.
  - 10. No substitutions.
- B. Backdraft Dampers:
  - 1. Gravity Backdraft Dampers, Size 18 x 18 inches (450 x 450 mm) or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.
  - 2. Multi-Blade, Parallel Action Gravity Backdraft Dampers: Frames of 16 ga (1.5 mm) thick galvanized steel, or extruded aluminum, with blades of maximum 6 inch (150 mm) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball or sintered bronze bearings, and plated steel pivot pin; [adjustment device to permit setting for varying differential static pressure.] Pressure and velocity ratings shall be suitable for the application.
- C. Volume Control Dampers:
  - 1. Factory-fabricate in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings.
  - 2. Shop fabrication is permitted for single blade dampers [and splitter dampers] only.
  - 3. Height is the dimension perpendicular to the blade rod or shaft. Width is the dimension parallel to the blade rod.
  - 4. Single Blade Dampers: For duct sizes (height x width) up to 7 x 30 inch (175 x 760 mm). When height or width exceeds its respective maximum, provide multi-blade damper.
  - 5. Multi-Blade Damper: Opposed blade pattern with maximum blade sizes (height x width) 8 x 72 inch (200 x 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
  - 6. End Bearings: Except in round ductwork 6 inches (150 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings. Provide retainer clips or other devices to prevent bearings from pulling out.

For single-blade dampers, plastic bearings are allowed.

- a) Manufacturers:
    - 1) Duro Dyne.
    - 2) Elgen Manufacturing.
    - 3) Rossi.
    - 4) Ventfabrics.
  - b) Snap-in Plastic Bearings for Single-Blade Dampers: Designed to push into hole in sheet metal, with retaining tabs. Flame Retardant, Glass Reinforced, "Zytel" polymer by Dupont, conforming to UL 1995 and UL 94 with the required flammability rating of 5VA or lower. Acceptable materials include Polyamide 66 (PA66) (glass-reinforced Dupont Zytel), nylon and acetyl. Submit manufacturer's verification of the suitability of these bearings for the application, including operating pressures and temperatures.
7. Quadrants:
- a) Manufacturers:
    - 1) Duro-Dyne.
    - 2) Elgen Manufacturing.
    - 3) Rossi.
    - 4) Ventfabrics.
  - b) Duro-Dyne Specline SR and SRH series; Quadline series; or Stampline dial regulators and wedge-loc regulators. Or equal by Elgen, Rossi, or Ventfabrics. Factory-manufactured dampers shall have damper manufacturer's choice of quadrant equal to the Duro-Dyne products specified.
  - c) Provide locking, indicating quadrant regulators on single and multi-blade dampers. Regulators shall include lever handle, locking wing nut and graduated indicator dial. Provide shaft seals, bushings, or gaskets for duct penetrations. Quadrants without these features are not allowed.
    - 1) Rossi Everlock Regulators: Locking lever handle of Polyamide 66 (PA66) (glass-reinforced Dupont Zytel) plastic, thumb trigger with stainless steel spring, with at least 9 latching positions in a 90 degree rotation.
  - d) On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters, with open space to run insulation through.
  - e) Where rod lengths exceed 30 inches (750 mm) provide regulator at both ends, with a single rod so that either regulator will control the entire damper.
8. Provide required operating wrenches for balancing, and furnish to the Owner at project completion.

## 2.3 DUCT ACCESS DOORS

- A. Manufacturers:
1. Standard Doors:
    - a) Ruskin.
    - b) Air Balance, Inc.
    - c) Arrow.
    - d) Buckley Associates.
    - e) Cesco.
    - f) DuctMate.
    - g) Greenheck.
    - h) Nailor.
    - i) Vent Products, Inc.
    - j) Shop fabricated.

2. Grease Duct Doors:
  - a) Ductmate.
  - b) Shop fabricated.
  
- B. Fabricated in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings. Standard access doors and access doors for grease ducts may be shop-fabricated. Pressure rating shall be equal to the rating of the associated ductwork; see Part 3 Division 23 Section "Metal Ducts" for schedule of pressure classes.
  
- C. Standard Doors: Removable, with retainer chain. Rigid and close-fitting with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum 1 inch (25 mm) thick insulation with galvanized steel sheet metal airstream-side cover.
  1. 16 inches (406 mm) Square and Smaller: Secure with two sash locks.
  2. Over 16 inches (406 mm), up to 24 inches (610 mm) Square: Provide four sash locks.
  3. Larger Sizes: Hinges and two compression latches with outside and inside handles.
  4. Clamping-type doors with knob handles, as manufactured by Ductmate, may be substituted for standard sizes.
  5. Material: Galvanized steel in galvanized steel ductwork. Stainless steel in stainless steel ductwork. Aluminum as manufactured by Arrow in aluminum ductwork.
  6. Provide in negative-pressure systems, and in positive-pressure systems with specified pressure class at or below 2 in. WG (498 Pa).
  
- D. Medium- and High-Pressure Positive-Pressure Ducts:
  1. Ruskin ADHP-3 high pressure access door rated up to 12 in. WG (2985 Pa), with spring latches to allow the door to open temporarily to relieve negative pressures.
  2. Provide in positive-pressure systems with specified pressure class above 2 in. WG (498 Pa).
  
- E. Access Doors For Grease Duct Applications:
  1. Shop-fabricated:
    - a) Material to match duct.
    - b) High-temperature ceramic gasket, suitable for at least 1500 degrees F (815.6 degrees C).
  2. Ductmate Industries, Inc. HI-TEMP access door, or approved equal.
    - a) 16 gage (1.61 mm) black iron backing plate.
    - b) High temperature ceramic gasket, 2300 degrees F (1260 degrees C) maximum.
    - c) Zinc plated conical springs, zinc coated wing nuts and zinc plated carriage bolts.
  3. Ductmate Industries, Inc. ULtimate or ULtimate II access door.
    - a) UL 1978 Listed.
    - b) UL label and "Do Not Obstruct" label.
    - c) 2 layers of 11 gage metal (provide black iron (carbon steel) or Type 304 stainless to match ductwork).
    - d) High temperature ceramic gasket, 2300 degrees F (1260 degrees C) maximum.
    - e) The ULtimate door is sandwich style, and requires no welding and special tools, but requires extra duct size.
    - f) The ULtimate II door has a welded frame, and is available with or without a piano hinge.
    - g) Collapsible loop handle welded to outer door.
    - h) Corner thumb bolts. ULtimate door has studs with wingnuts welded to inner door.
    - i) Can be used with high temperature insulation.
  4. For factory-manufactured round grease ducts, access doors may be furnished by the duct

manufacturer. For double-wall ducts, access doors shall include inner and outer stainless steel and inner layer of insulation.

5. Duct openings in horizontal ducts shall be above the bottom of duct to form a grease dam.
6. Meet NFPA 96 requirements for use in grease duct systems.

F. Access doors with sheet metal screw fasteners are not acceptable.

G. Sizing: Select sizes to allow testing, service, and maintenance within the ductwork. Such access may require the insertion of one or both hands, arms, and shoulders as appropriate. Doors sized for viewing-only are not acceptable. Doors found to be of inadequate size shall be replaced with proper size.

## 2.4 DUCT SLEEVES, PREPARED OPENINGS AND CLOSURE COLLARS

A. Duct Sleeves and Closure Collars: Fabricate from minimum 20 ga (1.0 mm) galvanized steel or equivalent thickness of aluminum, select material to match duct material. Where sleeves are installed in bearing walls, provide structural steel sleeves.

B. Prepared Openings: Provide 1 inch (25.4 mm) clearance between the duct and the sleeve.

## 2.5 DUCT TEST HOLES

A. Manufacturers:

1. Ductmate.
2. Carlyle Corporation.
3. Duro-Dyne.
4. Ventfabrics.

B. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

C. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

## 2.6 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:

1. Ductmate.
2. Ventfabrics.
3. Duro-Dyne.
4. No substitutions.

B. Fabricate in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings.

C. Connector: Fabric crimped into metal edging strip.

1. Connectors shall be Ductmate PROFLEX Commercial series.
2. Fabric: UL listed coated woven glass fiber fabric meeting the requirements of NFPA 90A and NFPA 701. Resistant to weather and most chemicals, fat, grease, and oil.
  - a) Supply Ducts: Neoprene coated, minimum density 30 oz per sq yd (1.0 kg/sq m).



- Fire-retardant coating. Black color. Temperature range -40 to 200 degrees F (-40 to 93 degrees C).
- b) Exhaust Ducts Serving Fume Hoods: Hypalon coated, minimum density 24 oz per sq yd (0.8 kg/sq m). Flame proof coating. White color. UV and ozone resistant. Temperature range -40 to 250 degrees F (-40 to 121 degrees C).
- 3. Net Fabric Width: Approximately 3 inches (75 mm) wide.
- 4. Metal: 3 inch (75 mm) wide, 24 ga (0.6 mm thick).
  - a) Supply Ducts: G-60 galvanized steel.
  - b) Exhaust Ducts Serving Fume Hoods: Type 316 stainless steel.
- 5. Connectors shall have double fold seams. Single fold seams (metal folded once only) shall not be accepted.

## 2.7 ROOF CURBS

- A. Manufacturers:
  - 1. Greenheck.
  - 2. Acme Engineering and Manufacturing Corp.
  - 3. Loren Cook.
  - 4. Thybar Corporation.
- B. For miscellaneous duct applications requiring roof curbs which are not specified with equipment in other Sections, provide curbs as specified in this Section.
- C. Construction: Galvanized steel or aluminum, with continuously welded seams, 1-1/2 in. (38 mm) thick rigid fiberglass insulation with 3.0 lb/cu.ft (48 kg/m<sup>3</sup>) density and coated for airstream exposure, base flashing flange at least 1-1/8 in. (38 mm) wide, and factory installed wood nailer strip installed with notched and lapped joints for strength. For curbs where duct is not continuous thru the curb (such as curbs with sound baffles), provide metal liner to keep the wood nailer out of the airstream. For curbs with hot ducts where clearance to combustibles is a concern, wood nailer may be omitted.
- D. Height: For installations where base of curb is under the roof insulation, curb shall be 16 inch (400 mm) high (unless otherwise indicated or specified) with built-in cant strips. For installations where base of curb is not under any roof insulation (but may be under thin roof finish material such as membrane, shingles, or metal roofing), curb shall be at least 12 inch (300 mm) high (unless otherwise indicated) with no cant strips.
- E. Pitched Roof Curbs: Curbs for pitched and double-pitched roofs shall have base with built-in slopes to match roof pitches. Height of these curbs shall be at least the height specified above, measured at the highest point on the sloped base.
- F. Curb Seal: Provide rubber curb seal for installation between curb and equipment.

## 2.8 SMOKE DETECTORS

- A. Whether or not indicated on the Drawings, air handling systems operating at 2000 CFM and above shall have duct mounted smoke detection equipment in accordance with the requirements of NFPA 90A and BOCA.
- B. Provide ionization type smoke detectors, duct mounted, universal voltage 120V AC, 24V DC, with sampling tube extending full width of duct.

- C. Wire contact to shut down respective fans and remotely initiate alarm in existing fire alarm panel upon detection of smoke.
- D. Provide a wall mounted test station which shall permit remote reset of alarms and LED indication of alarm conditions.]

## 2.9 TURNING VANES

- A. Manufacturers for Turning Vanes and Vane Rails:
  - 1. Ductmate Industries - PROrail 2 inch Turning Vane Rail.
  - 2. Duro Dyne - Junior Vane Rail.
  - 3. Hardcast, a division of Carlisle Corporation - Dyn-O-Rail Jr.
- B. Factory-fabricated and factory-or-field-assembled units consisting of curved turning vanes for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide curved single thickness vanes for mitered elbows with change in direction of 45 degrees or greater, conforming to SMACNA HVACDCS single vane schedule for small vanes. Each vane shall form a 90 degree arc. Fill the entire duct cross-section with vanes. Orient leading edge of vanes parallel to the side of the duct (directed straight into the entering airstream).
- C. Turning vanes shall be minimum 16 gauge (1.61 mm), regardless of gauges that are recommended by SMACNA. Double thickness turning vanes are not allowed.
- D. Turning vanes in rectangular ductwork and shop-fabricated round ductwork shall conform with details on the Drawings. If not detailed, the SMACNA detail for small-radius small-spacing single-thickness vanes shall be used.
- E. Turning vanes in manufactured round and flat oval duct elbows shall be the duct manufacturer's standard size, spacing, and gauge, but must be single-wall and not less than 16 gauge (1.61 mm).
- F. Factory-fabricated turning vane rails shall be a minimum of 24 ga (0.7 mm) galvanized steel.
- G. Material for vanes and rails shall be the same as the duct sheet metal.

## 2.10 EXHAUST HOODS - KITCHEN GREASE TYPE

- A. Manufacturers
  - 1. Captive Aire
  - 2. Greenheck.
  - 3. GreaseMaster
  - 4. Halton.
- B. Hood Types: UL 710 Listed, Type I for grease-laden vapors, with NSF seal of approval. Style as indicated on the Drawings, including exhaust-only, exhaust with integral makeup air supply, wall-mounted canopy type, island canopy type, and backshelf type.
- C. Hood Construction:
  - 1. Hood shall be constructed of a minimum of 18 ga (1.31 mm), type 304 stainless steel with #4 finish.

2. Hood shall be constructed using the standing seam method for optimum strength.
3. Seams, joints, and penetrations of the hood enclosure that direct and capture grease-laden vapors and exhaust gases shall have a liquid-tight continuous external weld to the hood's lower outermost perimeter. Exposed external welds shall be ground and polished to match the original finish of the metal.
4. Construction shall include corrosion-resistant steel framing members for strength. Unexposed interior surfaces shall be constructed of a minimum 18 gauge (1.31 mm) corrosion-resistant steel.
5. Filter Housing: Integral to the hood, constructed of the same material as the hood. Filters shall be in sufficient numbers and sizes to ensure optimum performance as specified as the filter manufacturer. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease drawer. Filters shall be installed at an angle not less than 45 degrees from the horizontal.
6. Filters: Stainless steel. UL classified or listed in accordance with UL Standard 1046. Filter grease particle collection efficiency shall be tested to ASTM Standard F2519-05 by an independent third party. Submittals shall include the third-party test results.
  - a) Single-Stage High-Efficiency Baffle Filters: Rated grease-extraction efficiencies at particle sizes as follows: At least 50 percent at 5 microns (0.005 mm).
    - 1) Greenheck Hoods: GX Grease-X-Tractor filters
    - 2) CaptiveAire Hoods: Captrate Solo filters.
    - 3) Gaylord Hoods: XGS filters.
    - 4) Halton Hoods: KSA filters.
7. The hood shall be constructed as UL listed and shall be built in accordance with NFPA bulletin #96, ICBO, BOCA, SBCCI, and shall bear the NSF seal of approval. The exhaust airflow shall be based on the thermal updrafts produced by the cooking equipment and calculated by using the thermal updraft velocity method. The hood manufacturer shall provide, on request, the necessary data that confirms compliance with the above mentioned code authorities (NER report required).
8. Hoods shall extend a minimum of 6 inches (152 mm) beyond the sides of the equipment and 12 inches (300 mm) over the front of the equipment.
9. Stand-Offs:
  - a) Provide hood with integral 3 inch (77 mm) stand-offs to maintain clearance from limited combustible materials as required by NFPA 96. Provide on back, sides, and top as required.
  - b) Most hood manufacturers have a UL Listing on rear stand-offs which taper toward the bottom edge. Where local Authority requires, the stand-off shall provide a full 3 inch (77 mm) air space to the bottom edge of the hood. Contractor shall verify requirements with the local Authority.

D. Accessories:

1. Enclosure Panels: Where required, the hood manufacturer shall provide panels constructed of the same steel as the exposed hood surfaces. A mounting clip shall be factory welded to the top of the hood to accommodate field installation of enclosure panels. Panels shall be sized to extend from the top of the hood to 2 inches (50 mm) above the drop ceiling.
2. End and Back Panels: Where indicated, the hood manufacturer shall provide panels constructed of the same steel as the exposed hood surfaces. The panels shall extend from the bottom edge of the hood downward, to reduce interference from drafts. Panels shall be rear quarter style, or full style, as indicated. Provide mounting hardware.
3. Lights: Vaporproof, UL listed incandescent light fixtures shall be prewired to a junction box situated at the top of the hood for field connection. For fluorescent type, provide

ballasts as required. Wiring shall conform to the requirements of the National Electric Code (NEC #70 - Latest Edition).

4. Provide each hood with a master electrical panel which shall consist of one starter per motor, a main disconnect switch, terminal block wiring and control circuits prewired, contained in a NEMA 1 enclosure.
5. CaptiveAire Fully Modulating Energy Management System (Variable-Speed Fan Control): Provide a system of heat sensors, variable-frequency drives, NEMA 1 enclosure, and accessories, to start the fan whenever heat is detected under the hood and vary the fans' speeds in response to the temperature. Setpoints (high and low speeds, fan activation and high-speed temperatures, and ramp rate) shall be full adjustable. Associated fan wall switch for the user shall be an On-Auto type to allow automatic operation. System shall be ETL listed and in conformance with International Mechanical Code requirements for automatic fan operation.]
6. MeLink System: ...Includes heat detection and visible smoke detection...]
7. Fan and Light Switches: Provide with stainless steel wall plate with identifying lettering. Ship loose for field mounting on wall at accessible height.

E. Fire Protection Systems: See paragraph 2.2 Kitchen Exhaust Hood Fire Extinguishing Systems in Part 2 of this Section.

## 2.11 KITCHEN EXHAUST HOOD FIRE EXTINGUISHING SYSTEMS

### A. Manufacturers

1. Ansul - R-102 system and Ansulex liquid suppressant.
2. Amerex - KP system and KP liquid suppressant.
3. Kidde - WHDR system and APC wet chemical agent.
4. No substitutions.

### B. Hood Fire Extinguishing System:

1. The hood shall contain an Ansul R-102 wet chemical fire suppression system. The system shall be properly sized for the duct, plenum and appliances. The system shall be completely installed by factory trained personnel. Field hook-up shall be subcontracted to an authorized factory representative and shall be performed after hood installation.
2. The installation shall be in accordance with UL listing and conform to local and state codes and standards, including NFPA 17A and U. L. Standard 300, November 1994.
3. Materials:
  - a) Liquid Extinguishing Agent: Ansulex Low-PH Liquid Fire Suppressant, or Kidde APC wet chemical agent.
  - b) Cylinders shall be manufactured, tested and marked in accordance with DOT Specifications. Charge with liquid extinguishing agent and pressurize with nitrogen. Provide suitable brackets for mounting.
  - c) Piping shall be Schedule 40, black steel with malleable iron fitting. Discharge nozzles shall be of the proper design for the intended use (duct nozzle, plenum nozzle, appliance nozzle) and orifices shall be protected with appropriate seals.
4. Controls:
  - a) System activation shall be by fusible link connected to automatic release or manual pull station. Controls for automatic operation and manual release shall be mechanical in design, using fusible metallic links, stainless steel cabling, corner pulleys and manual pull-station. Provide a pressure release device for automatic opening of the cylinder valves. Manual pull station shall be mounted where indicated, in the main path of egress, 42-48 inches above the floor, 10-20 feet from

- the hood.
  - b) Provide relays to shut down under-hood cooking appliances and actuate the building fire alarm system. Relays for interface with fire alarm system shall be suitable for use in supervised systems. Wiring to this equipment through these devices is included in the Electric Section of these Specifications. Instruct the Owner in the operation and maintenance of the system.
  - c) Gas fuel sources and electrical power sources to equipment under the hood must be shut off on system activation. Provide a mechanical gas valve (coordinate with Plumbing Drawings for correct size).
  - d) Exhaust fan shall continue to run during extinguishing system operation.
  - e) Pull device shall be located next to exit from space. Pull device shall be fully recessed in wall and conduit shall be concealed.
5. Coverage: Provide nozzles to protect the hood and exhaust duct. Provide appliance-protection nozzles, distributed to protect the appliances indicated on the Contract Drawings.
6. Tests:
- a) Provide factory-authorized technicians for startup and testing services.
  - b) A start-up test is required. Submit copies of the test records for approval.
  - c) Perform tests and submit certificates of approval as required by local officials. Also submit manufacturer's report certifying final inspection and system test.

## 2.12 UNIFORMITY OF MATERIALS

- A. Ductwork accessories, including but not limited to volume dampers, smoke dampers, fire dampers, combination fire/smoke dampers, backdraft dampers and motorized dampers, shall be fabricated of materials that are similar to the ductwork in which they are installed.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

### 3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVACDCS. Refer to Division 23 Section "Metal Ducts" for duct construction and pressure class.
- B. Install components furnished under other Section and Divisions of the Specifications. Such items may include but are not limited to: Sensors and airflow measuring stations furnished under Division 23 Section "Instrumentation and Control for Mechanical Systems"; gauges and meters; and smoke detectors furnished under Division 26 – Electrical.
- C. Provide duct access doors in horizontal return air, exhaust air and fresh air intake ductwork to facilitate the removal of accumulations of dust and combustible materials in accordance with NFPA 90A. Install access doors at maximum 20 foot (6 m) intervals and at the base of each vertical riser.
- D. Provide duct access doors for inspection, servicing, and cleaning before filters, before and after

coils, before and after fans, before automatic dampers, at fire dampers, at smoke dampers, at combination fire and smoke dampers, at smoke detector sampling tubes (upstream of the sampling tube), at multiple blade volume dampers, at backdraft and counterbalanced dampers, and elsewhere as specified or as indicated on the Drawings. Provide at changes in direction of kitchen exhaust ductwork and as otherwise required for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Provide minimum 8 x 8 inch (200 x 200 mm) size for hand access, 18 x 18 inch (450 x 450 mm) size for shoulder access, and as specified or as indicated on the Drawings. Review locations prior to fabrication.

- E. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- F. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- G. For volume dampers located above suspended ceilings and in areas that are not visible to building occupants (e.g. mechanical rooms), provide fluorescent orange colored surveyor's tape. Permanently attach tape to damper handles and run tape down to 10 in. (254 mm) above ceiling or 12 in. (304 mm) below damper handle where ceilings do not exist (e.g. mechanical rooms).
- H. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and support by vibration isolators. Staple and seal connections airtight.
- I. Duct Sleeves and Prepared Openings: Install for ducts passing through roofs, ceilings, walls and floors. Field determine the proper size and location of sleeves and prepared openings.
  - 1. Duct Sleeves: Allow one-inch (25 mm) clearance between duct and sleeve or one-inch (25 mm) clearance between insulation and sleeve for insulated ducts, except at grilles, registers, and diffusers.
  - 2. Prepared Openings: Allow one-inch (25 mm) clearance between duct and opening or one-inch (25 mm) clearance between insulation and opening for insulated ducts, except at grilles, registers, and diffusers.
- J. Closure Collars:
  - 1. Provide not less than 4 inches (100 mm) wide on each side of walls or floors where sleeves or prepared openings are installed. Fit collars snugly around ducts. Grind smooth edges of collar to prevent tearing or puncturing insulation covering or vapor barrier.
  - 2. Where insulated ducts penetrate non-fire-rated walls, insulation shall be continuous through the closure collars and the closure collars shall be installed tight to the insulation.
  - 3. Where insulated ducts penetrate fire rated walls, insulate ducts on both sides of closure collars and seal points of contact between closure collar and insulation with vapor proof adhesive.
  - 4. Where ducts penetrate fire rated walls, provide fire proof sealant at closure collar. Refer to Division 07 Section "Through Penetration Firestop Systems," for fire proof sealant requirements.
  - 5. Secure closure collars to ducts with sheet metal screws at maximum 6 inch (152 mm) centers and secure closure collars to walls or floors with sheetrock screws, nails or other appropriate fastener at maximum 6 inch (152 mm) centers.
  - 6. Packing: Pack with non-combustible glass fiber insulation in spaces between

sleeve/opening and duct/duct insulation. Cover or seal edges of packing to contain loose fibers.

- K. Duct Hangers and Supports: SMACNA HVACDCS, Section 4. Hang ducts up to and including 36 inches (914 mm) in width by a minimum of 1 in x 16 ga (25 mm x 1.61 mm) flat straps on each side of the duct on 4 ft (1.22 m) centers, bent under bottom of duct a minimum of 2 inches (50 mm) and securely fastened to duct. Hang ducts larger than 36 inches (914 mm) in width by 3/8 inch (9.5 mm) steel rods and 2 x 2 x 1/4-inch (50x50x6.3 mm) steel angle trapeze hangers, spaced 4 ft (1.22 mm) on center. [Provide seismic restraint complying with SMACNA SRMGMS.] Anchor risers in the center of the vertical run to allow ends of riser free vertical movements. 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 anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing. [Where C clamps are used, use retainer clips.]
1. Flexible Ducts: Support ducts by hangers every 3 feet (0.9 m), unless supported by ceiling construction. Stretch flexible air ducts to smooth out corrugations, and long radius elbows, where possible, using a minimum length to make connections.
  2. Flexible Connectors: Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts, securely fasten flexible connectors by zinc-coated steel clinch-type draw-bands. For rectangular ducts, lock flexible connectors to metal collars.
  3. Ducts with Extra Weight Such As Lead Lining or Lagging: Include the extra weight in determination of suitable hangers and supports.

END OF SECTION 233300

**This Page Intentionally Left Blank**



## SECTION 233400 – HVAC FANS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Centrifugal Fans:
  - 1. Upblast Centrifugal Roof Exhaust Fans for Kitchen Hood Exhaust.
- B. Power Ventilators:
  - 1. Ceiling Exhaust Fans.

#### 1.2 RELATED SECTIONS

- A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”
- B. Division 23 Section “Duct Insulation.”
- C. Division 23 Section “Metal Ducts.”
- D. Division 23 Section “Air Duct Accessories”: Backdraft dampers.
- E. Division 23 Section “Instrumentation and Controls for Mechanical Systems”: Sequence of Operation.
- F. Division 26 “Electrical.”

#### 1.3 REFERENCES

- A. Division 01 Section “Quality Requirements.”
- B. ANSI/ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- C. ANSI/ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- D. AMCA 99 - Standards Handbook.
- E. AMCA 210 - Laboratory Methods of Testing Fans for Rating.
- F. AMCA 261 - Directory of Products Licensed to Use the AMCA Certified Ratings Seal.
- G. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- H. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- I. NEMA MG1 - Motors and Generators.
- J. NFPA 70 - National Electrical Code.
- K. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

- L. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Vapors from Commercial cooking Equipment.
- M. UL 705 - Power Ventilators.
- N. UL 762 - Power Roof Ventilators For Restaurant Exhaust Appliances.

#### 1.4 SUBMITTALS

- A. Division 01 Section “Submittal Procedures.”
- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate assembly of fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

#### 1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Division 01 Section “Closeout Procedures”: Procedures for submittals.
- B. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years experience.

#### 1.7 REGULATORY REQUIREMENTS

- A. [Kitchen Grease Hood Exhaust Fans: Comply with requirements of NFPA 96.]
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

#### 1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Division 01 Section “Product Requirements”: Transport, handle, store, and protect products.
- B. Protect motors, shafts, and bearings from weather and construction dust.

#### 1.9 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 Section “Product Requirements”: Environmental conditions affecting products on site.
- B. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test-run under observation.

## PART 2 - PRODUCTS

### 2.1 ELECTRONICALLY-COMMUTATED (EC) MOTORS - ALSO KNOWN AS BRUSH-FREE DC (BFDC)

- A. Manufacturers:
  - 1. Greenheck Fan Corporation - "Vari-Green" motor.
  - 2. General Electric.
  - 3. Twin City Fan Co.
- B. Applications: Ceiling and cabinet fans, centrifugal inline fans, centrifugal roof exhaust fans, and centrifugal upblast exhaust fans, in sizes up to 3/4 hp (0.56 kW). Voltage 115V/1ph/60Hz.
- C. See Division 23 Section "Common Motor Requirements for HVAC Equipment" for general requirements.
- D. Speed Control:
  - 1. Typical motor speed range is 350 RPM to 1725 RPM.
  - 2. Motor operates on a voltage signal of 2-10 VDC, with 15-20 percent speed at 2V and 100 percent speed at 10V. Motor is switched off when the signal is 0-1.9 VDC.
  - 3. Control method furnished with the motor shall be one of the following, as indicated on the Drawings or in the Specifications:
    - a. Motor-mounted potentiometer with screwdriver setting. Provide this unless otherwise indicated or specified.
    - b. Remote-mounted Belimo potentiometer with calibrated 0-100 percent dial. Potentiometer includes a toggle switch to select an output range of 0-10V or 2-10V, so that with the 0-10 V setting the control can turn the fan off. Factory-mounted 24 VDC transformer in a junction box.
    - c. Factory-furnished circuitry to accept a 0-10V signal from the building control system. Requires an additional 24 VDC power supply to the motor's controls, 0.70 VA capacity.
  - 4. Provide field-furnished metal 2 x 4 in. (50 x 100 mm) junction box for mounting remote potentiometer dials.
  - 5. Provide field-furnished interconnecting power and control wiring as required, including separate flexible conduits for line-voltage and low-voltage wiring. ]

### 2.2 UPBLAST CENTRIFUGAL ROOF AND WALL EXHAUST FANS FOR KITCHEN HOODS

- A. Manufacturers:
  - 1. Captive Aire.
  - 2. Acme.
  - 3. Loren Cook.
  - 4. Greenheck.
  - 5. Penn Barry.
  - 6. Twin City Fan Co.
- B. Description: The exhaust fan shall be supplied by the hood manufacturer. The fan shall be belt or direct driven, as scheduled on the Drawings. Base shall be reinforced aluminum construction. Fan housing shall be heavy-duty spun aluminum. The motor compartment shall be isolated and forced cooled by air drawn from outside the fan through breather tubes. The

fan shall be U. L. rated under Standard 762 for grease laden vapors. The motor shall be continuous duty type with shielded ball bearings. Belt drives shall be the adjustable speed V-belt type.

- C. Performance:
  - 1. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
  - 2. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
  - 3. Fabrication: Conform to AMCA 99.
  - 4. Performance Base: Sea level conditions.
  - 5. Temperature Limit: Maximum 300 degrees F (150 degrees C)
  - 6. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.
  
- D. Wheel and Inlet: Backward inclined, aluminum construction with smooth curved inlet, backwardly curved blades, cast aluminum hub keyed to shaft with set screws.
  
- E. Bearings and Drives:
  - 1. Bearings: Heavy duty cast iron pillow block type, self-aligning, grease-lubricated ball bearings, with ANSI/ABMA 9-rated L-50 life at least 200,000 hours at maximum catalogued operating speed.
  - 2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated.
  - 3. Drive Frame Assembly: Heavy ga steel, mounted on vibration isolators.
  - 4. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp (11.2 Kw) and under, selected so required rpm is obtained with sheaves set at mid-position. Fixed sheave for 20 hp (15 Kw) and over. Matched belts. Drive rated as recommended by manufacturer, with minimum 1.5 times nameplate rating of the motor.
  
- F. Grease Trough: Provide integral trough at base of housing.
  
- G. Hinged Subbase: Provide with flexible weatherproof electrical cable and service hold-open retainer to permit proper inspection and cleaning.
  
- H. Compression Latches: Stainless steel, padlockable. Provide at least 2 on side of fan subbase and curb opposite hinge, for ease of cleaning.
  
- I. Roof Curb: Provide factory-fabricated roof curb with proper height (but in no case less than 18 inches (457 mm) high) to ensure 18 inch (457 mm) clearance from fan to combustibles and ensure that the fan discharges a minimum of 40 inches (1016 mm) above the roof surface.
  - 1. Curb shall be constructed of galvanized steel with no insulation or combustible materials, and shall incorporate a field-installed high-temperature non-combustible gasket around perimeter top, and be designed for installation on flat roof. Curb shall have ventilation openings where required by Code.
  - 2. Curb shall be installed, shimmed for roof pitch, leveled and flashed by Roofing Subcontractor.

## 2.3 POWER VENTILATORS

- A. Manufacturers:
  - 1. Greenheck.
  - 2. Acme.
  - 3. Hartzell.
  - 4. Loren Cook.
  - 5. Penn Barry.
  - 6. Twin City Fan Co.
  
- B. Product Requirements:
  - 1. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
  - 2. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
  - 3. Fabrication: Conform to AMCA 99.
  - 4. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
  
- C. Cabinet and Ceiling Exhaust Fans:
  - 1. Centrifugal Fan Unit: Centrifugal impeller, V-belt or direct driven as scheduled on the Drawings, with galvanized steel housing, resilient mounted motor, gravity backdraft damper in discharge.
  - 2. Grille: Molded white plastic
  - 3. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
  - 4. Vibration Isolation: Provide mounting brackets to accept rubber hangers as specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment". Vibration isolators furnished by the fan manufacturer are not allowed.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Division 01 Section "Quality Requirements": Manufacturer's instructions.
  
- B. Install fans with resilient mountings and flexible electrical leads. Refer to Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
  
- C. Secure roof fans with hex-head lag screws to roof curb, minimum of 2 screws on each side of fan, minimum 8 screws total. Screw threads shall be wood type or sheet metal type as appropriate, #12 (7/32 inch (5.6 mm) minimum sheet metal screw size, 3/16 inch (4.8 mm) shank minimum wood screw size. For aluminum fans with aluminum curbs, or steel curbs with wood nailers, use aluminum screws. For aluminum fans with steel curbs (without wood nailers, such as kitchen grease exhaust fans), use galvanized steel screws with rubber or plastic washers to isolate dissimilar metals. For steel fans with steel curbs, use galvanized steel screws.

- D. Provide safety screen where inlet or outlet is exposed.
- E. Provide backdraft dampers on discharge of exhaust fans and as indicated; refer to Division 23 Section "Air Duct Accessories"

END OF SECTION 233400

## SECTION 233433 - AIR CURTAINS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes air curtains.

#### 1.3 DEFINITIONS

- A. For convenience, a few definitions are indicated herein. Capacities, ratings and other specified and scheduled air curtain criteria are based on these definitions.
  1. Air Curtain: An air moving device which produces a directionally-controlled airstream, moving across the entire height and width of an opening.
  2. Unit Airflow Rate: The airflow volume which leaves the discharge nozzle, at standard air conditions, and reported in CFM.
  3. Average Outlet Velocity: The airflow rate produced by the air curtain divided by the cross sectional area of the discharge nozzle plane at free-air delivery, and reported in FPM.
  4. Outlet Air Velocity Uniformity: An indicator of the consistency of air velocities across the air curtain width, expressed as a percentage.
  5. Air Discharge Angle: The angle between the plane of the protected opening and the direction in which the air stream leaves the discharge.

#### 1.4 SYSTEM DESCRIPTION

- A. An air curtain is an air moving device which produces a directionally-controlled airstream, moving across the entire height and width of an opening.

#### 1.5 SUBMITTALS

- A. Submittals are required to show full compliance with the Contract Documents.
- B. Indicate each air curtain tag/mark number on the submittal as applicable.
- C. Product Data:
  1. Product Data must have the specific Contract Document air curtain mark/tag on each submittal with information associated with each unit clearly identified. Where information does not apply to the product being provided then such information must be marked off on the submittal.
  2. Rated capacities showing compliance with Contract Document requirements scheduled on Drawings. Capacities shall include but are not limited to: Airflow (CFM), discharge velocity (FPM), noise rating (dBA), motor quantity and horsepower, electrical ratings (FLA, volts/phase/hertz), outlet velocity uniformity (%), unit assembly weight (lbs).
  3. Mechanical Drawings.

4. Wiring Diagrams.
5. Standard product features.
6. Optional product features and accessories.

D. Shop Drawings:

1. Provide drawings showing air curtain assembly and parts.
2. Wiring Diagrams: Power, signal, and control wiring. The wiring diagram must indicate a clear distinction between manufacturer's factory furnished and installed wiring, and Contractor furnished and installed wiring for power, signal and control wiring and accessories.

E. Installation Instructions: Manufacturer's installation instructions with diagrams, instructions and manufacturer's contact information.

F. Operation and Maintenance Data: Complete documentation of manufacturer's recommended operation and maintenance procedures for the air curtain including commissioning procedures.

G. Manufacturer's Warranty statement for products and parts.

H. Contractor's Warranty statement for repair and replacement of products and parts.

#### 1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years' experience.

B. The Contract Document Drawings and Specifications indicate the "basis-of-design" manufacturer, model, size, profiles, and dimensional requirements of air curtains.

C. Comply with applicable ordinances, Codes and standards as required by the Authorities Having Jurisdiction.

D. Comply with NFPA 70 - National Electrical Code.

E. ETL Listed (Tested in accordance with ANSI/UL 1995, 2nd edition, 1995-09-29 Rev: 1999-08031).

#### 1.7 COORDINATION

A. Coordinate layout and installation of air curtains, mounting system and components associated with the air curtains with other construction.

B. Notify the architect/engineer of any coordination conflicts prior to installation of the air curtain or other associated parts and accessories so that the installation can be coordinated prior to installation. Any installation that is commenced or completed without coordination is subject to rejection of the work and must be redone as required to meet the intent of the Contract Documents.

#### 1.8 WARRANTY

A. Provide manufacturer's standard warranty for replacement of parts for a period of 24 months from the time of shipment from the manufacturer. The air curtain manufacturer's warranty



must cover parts, components, and accessories provided with the air curtain whether or not the parts, components or accessories are manufactured by the air curtain manufacturer.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Berner International, New Castle, PA 16101
- B. Approved equal

### 2.2 EQUIPMENT BASIC DESCRIPTION

- A. Each unit consists of a factory assembled casing, centrifugal fans, raised inlet screen, discharge nozzle, and motor(s). Additional accessories as specified. The air curtain provides a specific CFM and a uniform outlet velocity across the entire length of the discharge nozzle area.

### 2.3 CASING

- A. Unit Support: Integral to the unit frame or casing. Units shall be furnished in single increments of sufficient structural strength to be supported from the top or back per manufacturer's instructions.

### 2.4 AIR INLET GRILLE

- A. Inlet screen shall be perforated steel.

### 2.5 AIR DISCHARGE NOZZLE

- A. Discharge nozzle shall be high efficiency discharge plenum. The air curtain shall create a positive air seal with directional airfoil vane. The vane shall facilitate a deflection of the air stream by +/- 20 degrees.

### 2.6 FANS

- A. Wheels: Galvanized forward curved centrifugal type, double inlet design, with zinc plated hubs.
- B. Drives: Direct Drive. Belt drive is not acceptable.

### 2.7 MOTORS

- A. Type: Open Drip Proof (ODP), multi-speed, resiliently mounted, continuous duty, air over with integral thermal-overload protection.
- B. Bearings: Heavy duty type permanently lubricated, shielded ball bearings of equal size.

### 2.8 ACCESSORIES

- A. Mounting Brackets: Steel construction of shape and size as coordinated with the mounting location. Need offset distance “

- B. Disconnect: unit mounted, non-fused
- C. Automatic Magnetic Door Switch: Remotely installed in the door area to activate the unit each time the door opens and deactivate the unit each time the door closes.
- D. High/Off/Low Selector Switch: Manually enables and disables air curtain allowing air curtain to operate on High or Low Speed. {remote mounted}

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the installation location where each air curtain will be installed to confirm that the installation location is in accordance with the Contract Documents and the Manufacturer's Installation Instructions.
- B. If there are any concerns regarding the installation location with respect to any aspect of the installation or performance of the air curtain, notify the Architect/Engineer in order to resolve the concern.

### 3.2 INSTALLATION

- A. Install each air curtain in accordance with the Installation Instructions provided by the manufacturer of the air curtain.
- B. Provide interconnecting line- and low-voltage wiring to motors, starters, disconnects, and control devices for a complete and operating installation.

### 3.3 SYSTEM STARTUP

- A. Startup each air curtain in accordance with the manufacturer's Operations and Maintenance Manual and Installation Instructions.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  1. After installing air curtains completely, perform visual and mechanical check of individual components.
  2. After electrical circuitry has been energized, start unit to confirm motor rotation and unit operation.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Repair or replace malfunctioning units and retest as specified above.

### 3.5 ADJUSTING

- A. Adjust air-directional vanes.

3.6 CLEANING

- A. Clean the outside of each air curtain of any dirt, debris, grease, grime or other material.
- B. Clean the inside of each air curtain of any dirt, debris, grease, grime or other material as necessary to ensure proper operation. Remove any loose debris that may be of harm to the air curtain operation.

3.7 DEMONSTRATION

- A. Contractor shall instruct the Owner's maintenance personnel on how to adjust, operate, and maintain air curtains. Provide at least 4 hours for training. Schedule at the Owner's convenience, at or prior to Substantial Completion.

END OF SECTION 233433

**This Page Intentionally Left Blank**

## SECTION 233700 - AIR OUTLETS AND INLETS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Diffusers.
- B. Registers/Grilles.
- C. Brick Vents and Block Vents.
- D. Louvers.

#### 1.2 RELATED SECTIONS

- A. Division 23 Section "Instrumentation and Controls for Mechanical Systems."

#### 1.3 REFERENCES

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
- B. ADC 1062 - Certification, Rating and Test Manual.
- C. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
- D. AMCA 511 - Certified Ratings Program for Air Control Devices
- E. ARI 650 - Air Outlets and Inlets.
- F. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- G. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- H. ASTM E413 - Classification for Rating Sound Insulation.
- I. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- J. NFPA 70 - National Electrical Code.
- K. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Division 01 Section "Submittal Procedures."
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets indicating type, size, application, rated airflow, noise level, pressure drop, and throw distance as applicable. Submit both manufacturer's standard performance tables and graphs, AND

tabulated selection data specific to this project. NOTE: Submittals without complete and sufficient information, to verify the performance specified and scheduled on the Drawings, shall be rejected.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01 Section "Closeout Procedures."
- B. Record actual locations of air outlets and inlets.

#### 1.6 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 3 years' experience.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Diffusers, Registers, Grilles, and Drum Louvers:
  - 1. Titus.
  - 2. Anemostat.
  - 3. Krueger.
  - 4. Metalaire.
  - 5. Price.
- B. Brick Vents and Block Vents:
  - 1. Greenheck.
  - 2. Airolite.
  - 3. American Warming and Ventilating.
  - 4. Arrow.
  - 5. Ruskin.
  - 6. United Enertech.
- C. Louvers (Non-acoustical Type):
  - 1. Greenheck.
  - 2. Airolite.
  - 3. American Warming and Ventilating.
  - 4. Arrow.
  - 5. Ruskin.
  - 6. United Enertech.
- D. No substitutions.

## 2.2 WALL SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing with spring or other device to set blades, vertical or horizontal face as indicated, double deflection.
- B. Frame: 1-1/4 inch (32 mm) margin with concealed mounting and gasket.
- C. Fabrication: Steel with 20 gauge (0.90 mm) minimum frames and 22 gauge (0.80 mm) minimum blades, steel and aluminum with 20 gauge (0.90 mm) minimum frame, or aluminum extrusions, as indicated, with factory off-white enamel finish.
- D. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.
- E. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

## 2.3 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with blades set at 45 degrees, vertical or horizontal face as indicated.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.
- C. Fabrication: Steel with 20 gauge (0.90 mm) minimum frames and 22 gauge (0.80 mm) minimum blades, steel and aluminum with 20 gauge (0.90 mm) minimum frame, or aluminum extrusions, as indicated, with factory off-white enamel finish.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.
- E. Gymnasiums: Provide front pivoted or welded-in-place blades, securely fastened to be immobile.

## 2.4 SPIRAL DUCT SUPPLY REGISTERS

- A. Type: Streamlined and individually adjustable blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing with spring or other device to set blades, vertical or horizontal face as indicated, double deflection. Radius end caps and foam gaskets sized to match the spiral duct for a tight seal.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.
- C. Fabrication: Aluminum with heavy-duty aluminum extrusions, with factory off-white enamel finish.
- D. Damper: Integral, air scoop extractor type with removable key operator, operable from face.

## 2.5 BRICK VENTS AND BLOCK VENTS

- A. Vents shall be one-piece cast #319 aluminum alloy. Nominal wall thickness shall be at least

0.125 inches (3 mm). Blades shall be at 35 to 45 degree angle from horizontal. Features shall include integral water stop in frame, integral storm drip on each blade, and aluminum insect screen at inside face of blades. Free area of maximum size vent shall be at least 35 percent.

- B. Finish: Factory baked enamel finish. Submit manufacturer's standard color chart. The Architect will select color.

## 2.6 LOUVERS (4-INCH)

- A. Louvers shall be equal to, and shall have free areas no less than, Greenheck Model ESD-403. Acceptable substitutes by other listed manufacturers (subject to performance specified and scheduled on Drawings) shall be:
  1. Airolite: Model
  2. American Warming & Ventilating: Model LE-23.
  3. Arrow: Model EA-415-D.
  4. Ruskin: Model ELF445DX.
- B. For reference, free area of a model ESD-403 in 48 inch x 48 inch (1.2 m x 1.2 m) size is 8.0 sq. ft (0.74 m<sup>2</sup>).
- C. Free area velocity at beginning of water penetration shall be at least 1000 fpm (5.0 m/sec). Beginning of water penetration is defined by AMCA as 0.01 oz. per sq. ft (3 g/m<sup>2</sup>).
- D. Air pressure drop for intake air at an air velocity of 1000 fpm (5.0m/sec) in intake mode shall not exceed 0.20 in.wg (49.8Pa).
- E. Testing for water penetration and air performance shall be in accordance with AMCA Standard 511, using a 48 inch x 48 inch (1.2 m x 1.2 m) louver.
- F. Type: 4 inch (100 mm) deep with drainable blades on approximately 37 to 45 degree slope, heavy channel frame, removable expanded aluminum bird screen with 1/2 inch (13mm) mesh mounted on interior face.
- G. Fabrication: 0.081 inch (2.05 mm) thick 6063-T5 extruded aluminum alloy, welded assembly.
- H. Mounting: Furnish with standard box frame and angles for installation.
- I. Finish: Factory baked enamel finish. Submit manufacturer's standard color chart. The Architect will select color.
- J. Louvers shall bear the AMCA rating seal for water penetration and air performance.

## 2.7 ROOF CURBS

- A. Construction: Galvanized steel or aluminum, with continuously welded seams, 1-1/2 in. (38 mm) thick rigid fiberglass insulation with 3.0 lb/cu.ft (48 kg/m<sup>3</sup>) density and coated for airstream exposure, base flashing flange at least 1-1/8 in. (38 mm) wide, and factory installed wood nailer strip installed with notched and lapped joints for strength. For curbs where duct is not continuous thru the curb (such as curbs with sound baffles), provide metal liner to keep the wood nailer out of the airstream.



- B. Height: For installations where base of curb is under the roof insulation, curb shall be 16 inch (400 mm) high (unless otherwise indicated or specified) with built-in cant strips. For installations where base of curb is not under any roof insulation (but may be under thin roof finish material such as membrane, shingles, or metal roofing), curb shall be at least 12 inch (300 mm) high (unless otherwise indicated) with no cant strips.
- C. Pitched Roof Curbs: Curbs for pitched and double-pitched roofs shall have base with built-in slopes to match roof pitches. Height of these curbs shall be at least the height specified above, measured at the highest point on the sloped base.
- D. Curb Seal: Provide rubber curb seal for installation between curb and equipment.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.
- C. Install outlets and inlets to ductwork with air tight connection.
- D. Slope ducts or plenums at louvers, and at brick or block vents, to drain outward, and seal bottoms watertight.
- E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- F. Paint ductwork visible behind air outlets and inlets matte black. Refer to Division 09 Section "Painting."
- G. Surfaces exposed to view shall be clean, and free of stains, smudges, and scratches.
- H. Provide hex-head fasteners to curb in each hole in curb caps or bases of roof-mounted units. Provide protection between dissimilar metals.

END OF SECTION 233700

**This Page Intentionally Left Blank**

## SECTION 234100 – PARTICULATE AIR FILTRATION

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Disposable, Pleated-Media Extended Area Panel Filters.

#### 1.2 RELATED SECTIONS

- A. Division 01 Section “Temporary Facilities and Controls”: Filters for temporary heating and ventilating.
- B. Division 26 Section “Equipment Wiring”: Electrical characteristics and wiring connections.

#### 1.3 REFERENCES

- A. ARI 850 - Commercial and Industrial Air Filter Equipment.
- B. ASHRAE 52.2-2007 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- C. IEST - Recommended Practice IEST-RP-CC001.
- D. ISO 14644-1 - Cleanrooms and Associated Controlled Environments.
- E. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and related Products: Performance-Test Methods.
- F. NFPA 70 - National Electrical Code.
- G. UL 586 - Test Performance of High Efficiency Particulate, Air Filter Units.
- H. UL 867 - Electrostatic Air Cleaners.
- I. UL 900 - Test Performance of Air Filter Units.

#### 1.4 DEFINITIONS

- A. MERV: Minimum Efficiency Reporting Value, in accordance with ASHRAE Standard 52.2.
- B. MERV-A: Minimum Efficiency Reporting Value, in accordance with ASHRAE Standard 52.2 Appendix J, using an aerosol to neutralize electrostatic charge.

#### 1.5 PERFORMANCE TOLERANCES

- A. Conform to ARI 850 Section 7.4.
- B. Particle Size Efficiency: Plus or minus 5 percent, relative to the ASHRAE 52.2-2007 rating standards.

## 1.6 SUBMITTALS

- A. Submit under provisions of Division 01 Section “Submittal Procedures.”
- B. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.
- C. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.

## 1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”
- B. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years experience.

## 1.9 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

## 1.10 EXTRA MATERIALS

- A. Furnish under provisions of Division 01 Section “Closeout Procedures.”
- B. Provide one set of filters.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Filter efficiency (MERV) ratings shall be in accordance with ASHRAE Standard 52.2-2007. Filter ratings shall incorporate particle size vs. efficiency.
- B. Particulate Filters (other than electrostatic precipitators):
  - 1. Ratings shall be MERV-A in accordance with the Standard's Appendix J (part of Addendum B, approved in 2008), which requires a conditioning step using a KCl aerosol to neutralize electrostatic charge.
  - 2. If the manufacturer has not completed MERV-A testing, submittals shall include a statement that the filtration and MERV rating are entirely mechanical and does not rely on an electrostatic charge.
  - 3. Fine fiber media, which maintain their efficiency over time, are required, as opposed to coarse-fiber media which rely on electrostatic charge and lose efficiency over time as the charge dissipates.

- C. Gas-Phase filters such as activated carbon shall be rated for gas absorption, and installed with MERV-rated prefilters.

## 2.2 MANUFACTURERS

- A. Filters, Frames, and Housings:
  - 1. Camfil Farr.
  - 2. AAF International (American Air Filter and AAF brands).
  - 3. Airguard - a Clarcor company.
  - 4. Cleanrooms International (products: ceiling HEPA filter housings and fan-filter units).
  - 5. Columbus Industries (product: Polysorb carbon filtration).
  - 6. Eco-Air - division of Flanders Corporation.
  - 7. Fiberbond Corporation.
  - 8. Flanders Corporation.
  - 9. GlasFloss Industries.
  - 10. Purolator - a Clarcor company.
  - 11. No substitutions.
- B. Gauges:
  - 1. Dwyer.

## 2.3 DISPOSABLE, PLEATED-MEDIA EXTENDED AREA PANEL FILTERS

- A. Product: Camfil Farr 30-30.
- B. Media: UL 900 Class 2, pleated, lofted, non-woven, reinforced cotton and synthetic fabric; supported and bonded to wire grid.
  - 1. Frame: High-wet-strength beverage board.
  - 2. Pleats: Rounded radial type for full usage of media area.
  - 3. Nominal thickness: 2 inches (50 mm), unless otherwise indicated.
- C. Performance Ratings:
  - 1. MERV (ASHRAE 52.2): 8.
  - 2. MERV-A (ASHRAE 52.2, Appendix J): 8.
  - 3. Maximum Initial Resistance:
    - a. At 350 Fpm (1.78 m/sec) Face Velocity:
      - 1) 1 inch thick (25 mm) Filter: 0.23 inch WG (77 Pa).
    - b. At 500 Fpm (2.54 m/sec) Face Velocity:
      - 1) 2 inch thick (25 mm) Filter: 0.31 inch WG (77 Pa).
      - 2) 4 inch thick (50 mm) Filter: 0.27 inch WG (77 Pa).
  - 4. Recommended Final Resistance: 1.0 inch WG (249 Pa).
  - 5. Guaranteed Pressure Drop Without Failure: 2.0 inch WG (498 Pa).
  - 6. Maximum Operating Temperature: 180°F (82°C) continuous, 200°F (93°C) intermittent.
  - 7. Total Media Area, 24 inch x 24 inch (610 mm x 610 mm) Nominal Size:
    - a. 1 inch (12.5 mm) Thick: 9.8 sq. ft (0.9 m<sup>2</sup>).
    - b. 2 inch (25 mm) Thick: 17.3 sq. ft (1.6 m<sup>2</sup>).
    - c. 4 inch (25 mm) Thick: 27.7 sq. ft (2.5 m<sup>2</sup>).

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install air cleaning devices in accordance with manufacturer's instructions.
- B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- C. Provide new filters in air handling systems immediately before the systems are balanced by the approved balancing contractor. Air handling systems shall be balanced with clean filters.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Once air handling systems are in operation and before substantial completion, provide filter replacement as required. Filters shall be replaced when their pressure drop (as measured by the approved balancing contractor) reaches the manufacturer's recommended changeout pressure drop. At the time of substantial completion, provide air handling systems with a new set of filters. After substantial completion, provide any air handling systems that are subjected to significant dust and debris as a result of continued construction with filter changeouts as specified above, and provide new filters when construction is completed.

END OF SECTION 234100

## SECTION 235100 – BREECHINGS, CHIMNEYS, AND STACKS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Manufactured breechings.
- B. Manufactured stacks.
- C. Manufactured vent systems for high-efficiency gas fired equipment.

#### 1.2 RELATED SECTIONS

- A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”
- B. Division 23 Section “HVAC Equipment Insulation.”
- C. Division 26 Section “Electrical.”

#### 1.3 REFERENCES

- A. ANSI Z21.66 - Electrically Operated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.
- B. ANSI Z21.67 - Mechanically Actuated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.
- C. ANSI Z21.68 - Thermally Operated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.
- D. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- E. ASTM A525 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements.
- F. ASTM A527 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
- G. ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent) Hot-Rolled Commercial Quality.
- H. ASTM C64 - Refractories for Incinerators and Boilers.
- I. ASTM C105 - Ground Fire Clay as a Refractory Mortar for Laying-up Fireclay Brick.
- J. ASTM C401 - Classification of Castable Refractories.
- K. NEMA MG1 - Motors and Generators.
- L. NFPA 31 (ANSI Z95.1) - Standard for the Installation of Oil Burning Equipment.

- M. NFPA 54 (ANSI Z223.1) - The National Fuel Gas Code.
- N. NFPA 70 - National Electrical Code.
- O. NFPA 82 - Standard on Incinerators, Waste, and Linen Handling Systems and Equipment.
- P. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.
- Q. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- R. UL 103 - Standard for Factory Built Low Heat Chimneys.
- S. UL 127 - Standard for Factory Built Fireplaces.
- T. UL 378 - Standard for Draft Equipment.
- U. UL 441 - Standard for Gas Vents.
- V. UL 641 - Standard for Low Temperature Venting Systems.
- W. UL 959 (ANSI Z181.1) - Medium Heat Appliance Factory Built Chimneys.
- X. UL 1738 - Venting Systems for Gas-Burning Appliances, Categories II, III, and IV.

#### 1.4 DEFINITIONS

- A. Breeching: Vent Connector.
- B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.
- C. Smoke Pipe: Round, single wall vent connector.
- D. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.
- E. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

#### 1.5 DESIGN REQUIREMENTS

- A. Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

#### 1.6 SUBMITTALS FOR REVIEW

- A. Division 01 Section "Submittal Procedures": Procedures for submittals.
- B. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory built units are used.



- C. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.
- D. Clearances to Combustibles: Submit requirements for clearances. The required clearances to combustible materials for submitted products shall be equal to or less than the clearances required for the basis-of-design products. The basis-of-design clearances are generally not listed in this Section, but are nonetheless a criterion for the review of submitted products; consult the basis-of-design manufacturer's literature for more information.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years experience.
- B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years experience.
- C. Design stacks under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the place where the Project is located.

#### 1.8 REGULATORY REQUIREMENTS

- A. Conform to NFPA 54 (ANSI Z223.1) code for of natural gas and liquefied petroleum (LP) gas burning appliances and equipment.
- B. Conform to NFPA 31 (ANSI Z95.1) for installation of oil burning appliances and equipment.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

### PART 2 - PRODUCTS

#### 2.1 BREECHING AND CHIMNEY (STACKS) WITH 1-INCH (25 mm) AIR CAVITY SPACE

- A. Manufacturers:
  1. Selkirk, Model PS.
  2. Ampco, Model VSI-II.
  3. Industrial Chimney Company (ICC), VIP product line.
  4. Metal Fab, Model PIC.
  5. Schebler, Model PA.
  6. Van-Packer, Model DW.
- B. The factory-built modular connector, manifold and stack system shall be laboratory tested and listed by Underwriters Laboratories, for use with building heating equipment and appliances which produce exhausted flue gases at a temperature not exceeding 1000°F under continuous operating conditions and not exceeding 1400°F under intermittent operating conditions (see UL 103 Sections 17 and 18 respectively) when burning gaseous, solid or liquid fuels as described in NFPA 211. The stack system shall be designed and installed to be gas tight and thus prevent

leakage of combustion products into a building. The system shall be designed to compensate for flue gas induced thermal expansions.

- C. The double wall stack shall have an inner gas carrying pipe of type 304 stainless steel. There shall be a nominal 1 inch air space between the walls. The outer jacket shall be 304 stainless steel. The materials and construction of the modular sections and accessories shall be as specified by the terms of the product's UL listing.
- D. The stack system shall be installed according to the manufacturer's installation instructions and shall comply with the local codes or standards.
- E. Inner pipe joints shall be sealed by use of factory supplied V bands and sealant as specified in the manufacturer's installation instructions.
- F. Roof penetrations shall be suitable for a combustible roof and shall be according to the manufacturer's detail drawings and installation instructions.
- G. When installed according to the manufacturer's installation instructions, the piping and its supporting system shall resist side loads (whether system is horizontal or vertical) at least 1.5 times the weight per foot of the piping. Wall supports shall support (as verified by manufacturer testing) 40 feet of pipe with a factor of safety of at least four (4). Plate supports shall support (as verified by manufacturer testing) 200 feet of pipe in 6 inch through 20 inch ID sizes and 100 feet of pipe in 24 inch ID and larger sizes with a factor of safety of at least four (4).
- H. The entire stack system from each boiler or appliance to the termination including accessories (except as indicated or specified) shall be from one manufacturer.
- I. The breeching and the stack shall be warranted against functional failure due to defects in material and manufacturer's workmanship for a period of ten years from date of delivery. For the warranty to be in effect, the following three actions must be performed by the Contractor:
  - 1. Drawings showing the actual layout and drawn to scale shall be provided by the manufacturer.
  - 2. Install the system as designed by the manufacturer and in accordance with the terms of the manufacturer's 10 year warranty and in conjunction with sound engineering practice.
  - 3. The inner diameter for breeching and stack shall be verified by the manufacturer's computations. The computation shall be technically sound, shall follow ASHRAE calculation methods, and incorporate the specific flow characteristics of the inner pipe. The contractor shall furnish the exact boiler model and operating characteristics to the factory representative. Operating characteristics shall include flue gas flow rate, fuel input (Btuh), outlet temperature, local altitude, stack layout, and available external pressure at boiler outlet, and other conditions necessary to determine system operation at maximum and minimum levels of burner turndown range.
  - 4. [Aluminized steel surfaces exposed to the elements shall be protected by a minimum of one base coat of primer and one finished coat of corrosion-resistant paint suitable for outer jacket skin temperatures of the particular installation (such as series 4100 or 9400 as manufactured by Rust-Oleum). Paint to be supplied by the installing Contractor. Outer wall of type 304 or 316 stainless steel may be substituted for paint.]
- J. Technical Services Support: The factory-built modular stack system shall be furnished by a vendor organization which assures design, installation and services coordination; and provides

in-warranty and post-warranty unified responsibility for Owner, Architect, Consulting Engineer and Contractor.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 54 (ANSI Z223.1).
- C. Install breechings with a minimum of joints. Align accurately at connections, with internal surfaces smooth.
- D. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot (4 m) spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.
- E. Install concrete inserts for support of breechings, chimneys, and stacks in coordination with formwork.
- F. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.
- G. Coordinate installation of dampers, and induced draft fans. Refer to Division 26.
- H. Insulate breechings in accordance with Division 23 Section "HVAC Equipment Insulation."
- I. Install vent dampers, locating close to draft hood collar, and secured to breeching.
- J. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement to ASTM C105. Connect base section to foundation using anchor lugs.
- K. Level and plumb chimney and stacks.
- L. Clean breechings, chimneys, and stacks during installation, removing dust and debris.
- M. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.
- N. Provide minimum length of breeching to connect appliance to chimney.
- O. Manufacturer's field verification: A factory approved manufacturer's representative shall witness the installation of the entire manufactured chimney system and shall submit a letter certifying that the installation is in compliance with the manufacturer's recommendations.

END OF SECTION 235100

**This Page Intentionally Left Blank**

## SECTION 235216 - CONDENSING BOILERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes packaged, factory-fabricated and assembled, gas-fired, condensing boilers, trim, and accessories for generating hydronic heating-system hot water.
- B. [This section includes a boiler sequencing and modulation control system, known as a "hydronic system control." This system also is capable of integrated control of the connected pumps, valves, dampers, and draft devices.]

#### 1.3 SUBMITTALS

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
- B. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. The term "withstand" means ["the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."] ["the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."]
- C. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.
- H. Warranty: Special warranty specified in this Section.

- I. Other Informational Submittals:
  - 1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years experience.
- B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years' experience.
- C. 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.
- D. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.
- E. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- F. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."
- G. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
- H. Source Quality Control: Test and inspect boilers according to the ASME Boiler and Pressure Vessel Code, Section IV. Boilers shall be test fired in the factory, and a report attached permanently to the exterior cabinet of the boiler for field reference.

#### 1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers which fail in materials or workmanship within specified warranty period.
  - 1. One-Year Warranty: Free from defects in material and workmanship for one (1) year from the date of installation
  - 2. Ten-Year Warranty: Free from defects from condensate corrosion and in material and workmanship for a period of ten (10) years from the date of shipment from the factory.
  - 3. Twenty-One Year Thermal Shock Warranty: Against thermal shock.

## PART 2 - PRODUCTS

### 2.1 BOILER TYPES

- A. Basis of Design Boiler Type:
  - 1. Cast iron heat exchanger type.
- B. Allowable Substitute Boiler Types:
  - 1. Condensing boiler with integral power vent and seal combustion.

### 2.2 CONDENSING BOILERS – CAST IRON HEAT EXCHANGER TYPE

- A. Manufacturers:
  - 1. HydroTherm – KN Series.
  - 2. Approved equal.
- B. Design: Boilers shall be CSA design certified as a condensing boiler. Boilers shall be designed for a minimum of 5:1 continuous turn down with constant CO<sub>2</sub> over the turndown range. The boiler shall operate with natural or propane gas and have a CSA International certified input rating as noted on the drawings, and a thermal efficiency rating up to 99 percent at minimum input. The boiler shall be symmetrically air-fuel coupled such that changes in combustion air flow or flue flows affect the BTUH input without affecting combustion quality. The boiler will automatically adjust input for altitude and temperature induced changes in air density. The boiler will use a proven pilot interrupted spark ignition system. The boiler shall use a UL approved flame safeguard ignition control system using UV detection flame sensing. The UV detector shall be air cooled to prevent condensate formation and so designed as to prevent misalignment. The design shall provide for silent burner ignition and operation. The boiler shall be down fired counter flow such that formed condensate always moves toward a cooler zone to prevent re-evaporation. An aluminum corrosion resistant condensate drain designed to prevent pooling and accessible condensate trap shall be provided. [In some jurisdictions, a means of neutralizing the condensate Ph levels may be required.] Boiler shall be able to vent a horizontal distance of 80 (120 for KN-30) equivalent feet with a vent diameter equivalent to the combustion chamber outlet diameter.
- C. Service Access: The boilers shall be provided with access covers for easily accessing all serviceable components. The boilers shall not be manufactured with large enclosures, which are difficult to remove and reinstall. Accesses must seal completely as not to disrupt the sealed combustion process. Components must be accessible and able to adjust with the removal of a single cover or cabinet component.
- D. Indicating lights: Each boiler shall include a diagnostic control panel with a full text display indicating the condition of all interlocks and the BTUH input percentage. Access to the controls shall be through a completely removable cover leaving diagnostic panel intact and not disrupted.
- E. Components:
  - 1. Combustion Chamber: The combustion chamber shall be constructed of cast-iron. It shall be a downfired design utilizing light weight refractory around the burner housing.
  - 2. Heat Exchanger: Boilers shall be a cast iron sectional unit designed for pressure firing and shall be constructed and tested for 100 psig (689 kPa) water working pressure, in accordance with the A.S.M.E. Section IV Rules for the Construction of Heating Boilers.

Individual sections will have been subjected to a hydrostatic pressure test of 250 psig (1723 kPa) at the factory before shipment and they shall be marked, stamped or cast with the A.S.M.E. Code symbol. The sections shall be of a down fired counter flow single-pass design. Water ports shall be sealed with steel push nipple connectors. The sections shall be fully machined for metal to metal sealing of the gas side surfaces. The design shall provide for equal temperature rise through all sections. The iron shall have a minimum thickness of 1/4 in. (6 mm). The heat exchanger design shall have no limitations on temperature rise or restrictions to inlet water temperature.

3. Jacket: Insulated, stainless steel or powder coated steel.
4. Gas Burner: The burner shall be metal fiber mesh construction, allowing high turndown of the fuel-air mixture. The burner flame shall burn horizontally and be of the pre-mix type with a forced draft fan. Burner shall fire to provide equal distribution of heat throughout the entire heat exchanger. The burner shall be easily removed for maintenance without the disruption of any other major component of the boiler. A window view port shall be provided for visual inspection of the boiler during firing. The gas distribution components and burner shall be enclosed with a cast-aluminum housing.
5. Ignition Components: Alumina ceramic insulated ignition electrodes and UV sensing tube permanently arranged to ensure proper ignition electrode and UV alignment.
6. Rated Capacity: The boiler shall be capable of operating at rated capacity with gas pressures as low as 2 in.WC (500 Pa) (3 in.WC (750 Pa) for size KN-30) at the inlet to the burner gas valve.
7. The burner shall be capable of 99 percent efficiency without exceeding an NOX reading above 11 ppm.
8. The burner and gas train shall be provided with the following trim and features:
  - a. Burner Firing: Full modulation with 5:1 turndown at continuous CO2.
  - b. Burner Ignition: Intermittent spark.
  - c. Safety Controls: Energize ignition, limit time for establishing flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, and allow gas valve to open.
  - d. Flue-Gas Collector: Enclosed combustion chamber with single venting connection.
  - e. Combustion-Air Blower: Integral to the flue-gas collector, suitable for sealed combustion air ducted from outdoors, and suitable for combustion air taken from the room air.
  - f. Gas Train: 2 manual ball type gas valves, main gas solenoid valve, manual test and check valves, pilot gas pressure regulator, and automatic pilot gas valve. Components shall be factory mounted and CSD-1 compliant.
  - g. Safety Devices, Factory Mounted: Low gas pressure switch, airflow switch, blocked flue detection switch, low water cutoff (manual reset), high temperature manual reset.
  - h. Individual gas regulator furnished by factory, shipped loose for field installation, one per boiler.
9. Motors: Refer to Division 23 Section "Motors, Drives and Accessories" for factory-installed motors. Boiler blower motor shall be externally mounted for ease of service. There shall be no requirement to remove covers or gas train components to remove the blower motor.

F. Boiler Trim:

1. Controls: The boiler control package shall be a MTI HeatNet or equivalent, integrated boiler management system. The control system must be integral to each boiler, creating a control network that eliminates the need for a "wall mount" stand-alone boiler system



control. Additional stand-alone control panels, independent of a Building Management System (BMS), shall not be allowed to operate the boiler network. The HeatNet control shall be capable of operating in the following ways:

- a. As a stand alone boiler control system using the HeatNet protocol, with one “Master” and multiple “Member” units.
- b. As a boiler network, enabled by a Building Management System (BMS), using the HeatNet protocol, with one “Master” and multiple “Member” units.
- c. As “Member” boilers to a Building Management System (BMS) with multiple input control methods.
- d. HeatNet control in the boiler network shall have the following standard features:
  - 1) Digital Communications Control:
    - a) Boiler to Boiler: HeatNet.
    - b) Building Management System (BMS): Modbus standard protocol.
    - c) Building Management System (BMS): BACnet and LonWorks optional protocols.
  - 2) Analog 4-20 milliamp and 0-10vdc also supported.
  - 3) Distributed control using HeatNet protocol for up to 16 total boilers.
  - 4) System/Boiler operating status in English text display.
  - 5) Interlock, Event, and System logging with a time stamp.
  - 6) Advanced PID algorithm optimized for specific boilers (KN-Series).
  - 7) 4 dedicated temperature sensor inputs for: Outside Air Temperature, Supply (Outlet) Temperature, Return Temperature (Inlet), and Header Temperature.
  - 8) Automatically detects the optional temperature sensors on start up.
  - 9) Menu driven calibration and setup menus with a bright 4-line Vacuum Fluorescent Display.
  - 10) 8 dedicated 24 vac interlock monitors and 8 dedicated 120 vac system monitors used for diagnostics and providing feedback of faults and system status.
  - 11) Multiple boiler pump or motorized boiler valve control modes.
  - 12) Combustion Air Damper control with proof time.
  - 13) Standard USB/RS485 network plug-in to allow firmware updates or custom configurations.
  - 14) Optional BACnet and LonWorks interface.
  - 15) Alarm contacts.
  - 16) Runtime hours.
  - 17) Outdoor Air Reset with programmable ratio.
  - 18) Time of Day clock to provide up to 4 night setback temperatures.
  - 19) Failsafe mode when a Building Management System (BMS) is controlling setpoint.
  - 20) If communications is lost, the boiler/system shall run off the Local Setpoint.
  - 21) Support for domestic hot water (DHW) using a 10k sensor or a dry contact input from a tank thermostat and a domestic hot water relay (pump/valve).
  - 22) Continuous Daily Runtime Restart feature that monitors the runtime of each boiler and if any in the network have exceeded 24 hours of continuous runtime, the boiler is restarted to protect the UV flame scanner.
  - 23) Allows for selection of any boiler in the network to act as Lead Boiler.
  - 24) Adaptive Modulation feature in which the Master boiler adjusts the system modulation rate to a lower value when a new boiler in the network is started to compensate for the added heat input to the system. Once the newly added boiler fires and the adjustable timer expires, the Master resumes control of the system modulation to maintain setpoint temperature.

- 25) Priority Firing: Allows mixing of condensing, non-condensing, base load and/or other combination of 2 functional boiler types utilizing 2 priority levels.
  - 26) Available priority start/stop qualifiers shall be configured using any combination of modulation percentage, outdoor air temperature, or return water temperature.
  - 27) Base Loading: Provides the ability to control 1 base load boiler with enable/disable and 4-20mA modulating signal (if required).
2. Safety-Relief Valve: ASME rated, factory set to protect boiler and piping. Pressure setting as schedule on the Drawings, but no higher than the 100 psig (689 kPa) maximum allowable working pressure.
  3. Gauge: Combination water pressure and temperature shipped factory installed. LCD outlet temperature readout shall be an integral part of the front boiler control panel display, factory mounted and wired.
  4. Burner Controls: Honeywell RM7800 series digital flame safeguard with UV rectification, capable of both pre- and post-purge cycles.
  5. High Limit: Temperature control with manual reset, wired in series with the operating control. Factory mounted in a dry well to sense the outlet temperature.
  6. Aluminum condensate receiver pan.
  7. Low air pressure switch.
  8. Blocked flue detection switch.
  9. Modulation control.
  10. Temperature/pressure gauge.
  11. Manual reset high limit.
  12. Low gas pressure safety switch.
  13. Low water cutoff with manual reset (CSD-1 factory mounted and wired).
  14. Gas pressure regulator, upstream of main gas valve, shipped loose for field installation.
  15. Air inlet filter.
  16. Supply outlet temperature display.
  17. Full digital text display for all boiler series of operation and failures
  18. Variable frequency drive [not required on KN-30] and combustion air fan with safety interlock.
  19. Condensate drain.

- G. Venting Requirements: Connect breeching to boiler outlet, full size of outlet. The boiler shall operate under positive (Category IV) or negative (Category II) stack pressure. Vent material must be listed AL29-4C stainless double wall stack for condensing appliances.

### 2.3 LOW-WATER CUT OFF

- A. Manufacturers:
1. McDonnell & Miller - Model 751P-MT-120.
  2. Hydrolevel Company – Safgard Model 550.
- B. Probe-type control to prevent burner operation when boiler water falls below safe level, with manual reset button with memory circuit to meet the requirements of ASME CSD-1, test button, green power indicator LED, red low water LED, probe to fit threaded pipe connection, and NEMA 1 enclosure. Power failures and air bubbles will not cause a lockout, and power failures will not cause the control to come out of a low-water lockout. Maximum water pressure 160 psig (1103 kPa). UL and CSA listed, FM approved.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
  - 1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 BOILER INSTALLATION

- A. Install boilers level on concrete housekeeping base, sized at least 4 inches (100 mm) larger than boiler base. Fasten boiler to base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.
- B. Install, start, and test boilers and their accessories in accordance with the manufacturer's instructions and these Specifications. In the case of conflicting instructions, the more stringent shall apply.
- C. Install gas-fired boilers according to NFPA 54.
- D. Assemble and install boiler trim.
- E. Assemble and install boiler accessories
- F. Install electrical devices furnished with boiler but not specified to be factory mounted.
- G. Provide control wiring to field-mounted electrical devices.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler with clearances and fittings to allow service and maintenance.
- C. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Division 23 Section "Common Work Results for HVAC."
- D. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.
- E. Pipe safety relief valves to above nearest floor drain with an air break. Piping shall be at least full size of connection. Do not combine piping from individual valves, unless recommended and sized by the boiler manufacturer.

- F. Pipe equipment drain connections to above the nearest floor drain with an air break. Piping shall be at least full size of connection. Provide an isolation valve at each connection if not factory-furnished.
- G. Boiler Venting:
  - 1. Install flue venting kit and sealed combustion-air intake.
  - 2. Connect full size to boiler connections.
  - 3. Comply with requirements in Division 23 Section "Breechings, Chimneys, and Stacks."
- H. See Division 22 – for gas piping. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.
- I. Ground equipment according to Division 26 Section "Grounding and Bonding."
- J. Connect wiring according to Division 26 Section "Wire and Cable."

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Perform installation and startup checks according to manufacturer's written instructions.
  - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
    - a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
    - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Performance Tests:
  - 1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
  - 2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
  - 3. Perform field performance tests to determine capacity and efficiency of boilers.
    - a. Test for full capacity.
    - b. Test for boiler efficiency at low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20 percent of full capacity. Determine efficiency at each test point.
  - 4. Repeat tests until results comply with requirements indicated.
  - 5. Provide analysis equipment required to determine performance.
  - 6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
  - 7. Notify Architect in advance of test dates.
  - 8. Document test results in a report and submit to Architect.

3.5 START-UP, INSTRUCTION AND WARRANTY SERVICE

- A. The boiler manufacturer's representative shall provide start-up and instruction of each new boiler, including burner and boiler control system as specified herein. Start-up and instruction shall cover components assembled and/or furnished by the manufacturer, whether or not of their own manufacture.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 235216

**This Page Intentionally Left Blank**

## SECTION 236200 - PACKAGED COMPRESSOR AND CONDENSER UNITS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Condensing unit package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Refrigerant piping connections.
- E. Motor starters.
- F. Electrical power connections.

#### 1.2 RELATED SECTIONS

- A. Division 23 Section "Common Motor Requirements for HVAC Equipment."
- B. Division 23 Section "Air Coils."
- C. Division 23 Section "Indoor Central-Station Air-Handling Units."
- D. Division 23 Section "Instrumentation and Controls for Mechanical Systems" - Sequence of Operation.
- E. Division 26 "Electrical."

#### 1.3 REFERENCES

- A. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- C. ARI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.
- D. ASHRAE 14 - Methods of Testing for Rating Positive Displacement Condensing Units.
- E. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- F. ASHRAE 90A - Energy Conservation in new Building Design.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. NEMA MG 1 - Motors and Generators.
- I. UL 207 - Refrigerant-Containing Components and Accessories, Non-Electrical.

- J. UL 303 - Refrigeration and Air-Conditioning Condensing, and Air-Source Heat Pump Equipment.

#### 1.4 SUBMITTALS

- A. Division 01 Section "Submittal Procedures": Procedures for submittals.
- B. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections.
- C. Product Data: Provide rated capacities, weights specialties and accessories, electrical nameplate data, and wiring diagrams.

#### 1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Submit under provisions of Division 01 Section "Closeout Procedures": Procedures for submittals.
- B. Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories. Submit under provisions of Division 01 Section "Operation and Maintenance Data."

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years' experience.

#### 1.7 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

#### 1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Division 01 Section "Product Requirements": Transport, handle, store, and protect products.
- B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- C. Protect units on site from physical damage. Protect coils.

#### 1.9 WARRANTY

- A. Provide a 5 year warranty to include coverage for refrigerant compressors.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Trane.



- B. McQuay.
- C. Carrier.
- D. York.

## 2.2 MANUFACTURED UNITS

- A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver and screens.
- B. Construction and Ratings: In accordance with ARI 210/240, ARI 365 and UL 207 and UL 303. Testing shall be in accordance with ASHRAE 14.
- C. Performance Ratings: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE 90A.

## 2.3 CASING

- A. House components in welded steel frame with galvanized steel panels with weather resistant, baked enamel finish.
- B. Mount starters and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.
- C. Provide removable access doors or panels with quick fasteners and piano hinges.

## 2.4 CONDENSER COILS

- A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 425 psig (2900 kPa), and dehydrate.
- B. Coil Guard: PVC coat steel wire.

## 2.5 FANS AND MOTORS

- A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge.
- B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built in current and thermal overload protection.
- C. Motors as indicated, in compliance with Division 23 Section "Common Motor Requirements for HVAC Equipment."

## 2.6 COMPRESSORS

- A. Compressor: Hermetic scroll type.
- B. Mounting: Statically and dynamically balance rotating parts and mount on rubber-in-shear vibration isolators. Internally isolate hermetic units on springs.

- C. Lubrication System: Oil pump with oil charging valve, oil level sight glass, and magnetic plug or strainer.
- D. Motor: Constant speed suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting. Furnish with starter.

## 2.7 REFRIGERANT CIRCUIT

- A. Provide each unit with one refrigerant circuit.
- B. For Each Refrigerant Circuit, Provide:
  1. Filter dryer replaceable core type
  2. Liquid line sight glass and moisture indicator.
  3. Thermal expansion valve for maximum operating pressure.
  4. Insulated suction line.
  5. Suction and liquid line service valves and gage ports.
  6. Liquid line solenoid valve.
  7. Charging valve.
  8. Discharge line check valve.
  9. Compressor discharge service valve.
  10. Condenser pressure relief valve.

## 2.8 CONTROLS

- A. On unit, mount weatherproof steel control panel, NEMA 250, containing power and control wiring, factory wired with single point power connection.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. Complete structural, mechanical, and electrical connections in accordance with manufacturer's installation instructions.
- C. Provide for connection to electrical service. Refer to Division 26.
- D. Install units on concrete base as indicated. Refer to Division 01 Section "Submittal Procedures."
- E. Provide connection to refrigeration piping system and DX coil.
- F. Furnish charge of refrigerant and oil.

### 3.2 DEMONSTRATION AND INSTRUCTIONS

- A. Division 01 Section "Closeout Procedures": Demonstrating installed work.
- B. Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil

or refrigerant prior to end of correction period.

- C. Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.
- D. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.
- E. Provide cooling season start-up, and winter season shut-down for first year of operation.

END OF SECTION 236200

**This Page Intentionally Left Blank**

## SECTION 237300 – INDOOR CENTRAL-STATION AIR-HANDLING UNITS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Packaged Air Handling Units.

#### 1.2 RELATED SECTIONS

- A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”
- B. Division 23 Section “Duct Insulation.”
- C. Division 23 Section “Packaged Compressor and Condenser Units.”
- D. Division 26 – Electrical.

#### 1.3 REFERENCES

- A. Division 01 Section “Quality Requirements” and Division 01 Section “References”: Requirements for references and standards.
- B. AATCC TM 30 – Antifungal Activity, Assessment on Textile Materials: Mildew and Rot Resistance of Textile Materials.
- C. AATCC TM 100 – Antibacterial Finishes on Textile Materials: Assessment of.
- D. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.
- E. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings.
- F. AMCA 99 - Standards Handbook.
- G. AMCA 210 - Laboratory Methods of Testing Fans for Rating.
- H. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- I. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- J. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- K. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- L. ANSI/UL 900 - Test Performance of Air Filter Units.
- M. ARI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.
- N. ARI 430 - Standard for Central-Station Air-Handling Units.
- O. ARI Guideline D - Application and Installation of Central Station Air-Handling Units.

- P. ARI 610 - Central System Humidifiers.
- Q. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
- R. NEMA MG1 - Motors and Generators.
- S. NFPA 70 - National Electrical Code.
- T. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- U. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- V. UL 900 - Standard for Air Filter Units.
- W. UL - Fire Resistance Directory.
- X. UL 1995 - Heating and Cooling Equipment

#### 1.4 SUBMITTALS

- A. Division 01 Section "Submittal Procedures".
- B. Product Data:
  1. Published Literature: Indicate dimensions, weights, capacities, ratings, gauges and finishes of materials, operation and service clearances, and electrical characteristics and connection requirements. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.
  2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
  3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
  4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
  5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring. Include recommended wire and fuse sizes or MCA, sequence of operation, connection points, safety and start-up instructions.
  6. Submit unit performance including: capacity, nominal and operating performance.
  7. Submit Mechanical Specifications for unit and accessories describing construction, components and options.

#### 1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Division 01 Section "Closeout Procedures": Procedures for submittals.
- B. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

#### 1.6 QUALITY ASSURANCE

- A. Product of manufacturer regularly engaged in production of components, who issues complete catalog data on product offering. Manufacturer shall have minimum 3 years' experience.

- B. Certify air volume, static pressure, fan speed, brake horsepower and selection procedures in accordance with ARI 430. If air handling units are not certified in accordance with ARI 430, Contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the Contractor.
- C. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with ARI 410-2001.

#### 1.7 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

#### 1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Division 01 Section "Product Requirements": Transport, handle, store, and protect products.
- B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units shipped not fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Each section shall have lifting lugs to allow for field rigging and final placement of section.
- C. Deliver units to site with fan motors, sheaves, and belts completely assembled and mounted in units.
- D. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- E. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

#### 1.9 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 Section "Product Requirements": Environmental conditions affecting products on site.
- B. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

#### 1.10 EXTRA MATERIALS

- A. Division 01 Section "Closeout Procedures."
- B. Provide 1 set pleated media filters.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Trane.

B. McQuay.

C. York.

## 2.2 INDOOR AIR HANDLING UNITS

### A. General Description:

1. Configuration: Fabricate with fan and coil section plus accessories, including:
  - a. Cooling coil section.
  - b. Heating coil.
  - c. Combination filter/mixing box section.
2. Performance Base: Sea level conditions.
3. Fabrication: Conform to AMCA 99 and ARI 430.

### B. Casing:

1. Unit shall be double wall constructed in sections. Exterior wall shall be minimum 18 gauge galvanized steel. Interior wall shall be minimum 20 gauge solid galvanized steel for sections except intake plenums, discharge plenums and fan sections. Interior wall shall be minimum 20 gauge perforated plate galvanized steel for intake plenums, discharge plenums and fan sections. Portions of the interior of the unit exposed to the airstream shall be covered with steel to allow cleaning and prevent fiberglass erosion into the airstream. Foil facing on insulation shall not be acceptable as a substitute for double wall construction. If casing sections are not provided by the unit manufacturer with double wall construction, the Contractor shall be responsible for covering exposed insulation with galvanized steel. Unit shall be designed and constructed such that exterior panels are non-load bearing. Removal of exterior panels shall not affect the structural integrity of the unit. Units with welds on exterior surfaces or welds that have burned through from interior welds shall also receive a final shop coat of zinc-rich protective paint in manufacturer's standard color.
2. Insulate sections handling conditioned air with 1 inch (25.4 mm) thick 3/4 lb./cu. ft. density matt faced fiberglass. Install insulation with adhesive. If edges of fiberglass insulation are exposed, the Contractor shall be responsible for sealing exposed edges with mastic sealer to prevent erosion into the airstream. Insulation, adhesive, and mastic sealer (if required) shall conform to NFPA 90A.
3. As required for routine service access, unit shall be supplied with full height, galvanized, double wall, hinged, removable access doors. Access door shall have a full perimeter automotive type gasket to prevent air leakage, and Ventlock style handle that can be opened from unit interior.
4. Units shall have internal motor and drives and shall be provided with a full size removable service door on the drive side of the fan(s).
5. On units provided with cooling coils and/or humidifiers, the drain pan shall extend under the complete coil section and/or humidifier section. Provide drain connections on both sides of each drain pan. Drain pans shall be of sealed double wall galvanized construction with the manufacturer's standard insulation sandwiched between the pan layers. The cooling coil section of the air handling unit as well as the next section downstream of the cooling coil section shall be provided with drain pans.
6. Lights: Provide in accessible sections suitable for damp locations with wire guards, factory wired to switch and duplex outlet mounted on casing exterior.
7. Strength: Provide structure to brace casings for suction pressure of 2.5 in. wg (600 Pa), with maximum deflection of 1 in 200.



C. Fans:

1. Type: Forward curved or air foil, single width, double inlet, centrifugal type fan.
2. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.
3. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.
4. Bearings: Self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to exterior of casing with aluminum or copper tube and grease fitting rigidly attached to casing.
5. Mounting: Locate fan and motor internally on welded steel base coated with corrosion resistant paint. Factory mount motor on slide rails. Provide access to motor, drive, and bearings through removable casing panels or hinged access doors. Mount base on vibration isolators.
6. Flexible Connection: Separate fan and coil, and adjacent sections

D. Bearings and Drives:

1. Bearings: Heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA 9, L-50 life at 200,000 hours or roller bearings with ABMA 11, L-50 life at 200,000 hours.
2. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
3. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor. Minimum of 2 belts per motor.
  - a. Sheaves on fans with variable-frequency drives shall be fixed type.
  - b. Sheaves on fans without variable-frequency drives shall be as follows: Variable and adjustable pitch type for motors 15 hp (11.2 kW) and under, selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp (14.9 kW) and over.

E. Coils:

1. Casing: Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.
2. Drain Pans: 24 inch (600 mm) downstream of coil and down spouts for cooling coil banks more than 1 coil high.
3. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410. Refer to Division 23 Section "Air Coils".
4. Fabrication:
  - a. Tubes: Seamless copper expanded into fins, brazed joints. Tubing diameter shall be 1/2 inch (12.7 mm) or 5/8 inch (15.9 mm) OD for hydronic (water) coils, 1/2 inch (12.7 mm) or 5/8 inch (15.9 mm) OD for refrigerant coils, and 5/8 inch (15.9 mm) OD or larger for steam coils. Tube wall thickness shall be at least 0.024 inch (0.61 mm) for hydronic (water) and refrigerant coils, and at least 0.031 inch (0.787 mm) for steam coils.
  - b. Fins: Aluminum.
  - c. Casing: Die formed channel frame of galvanized steel.
5. Water Heating Coils:
  - a. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
  - b. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type

- with return bends on smaller sizes and return headers on larger sizes.
- 6. Refrigerant Coils:
  - a. Headers: Seamless copper tubes with silver brazed joints.
  - b. Liquid Distributors: Brass or copper venturi distributor with seamless copper distributor tubes.
  - c. Configuration: Down feed with bottom suction.
- F. Filters:
  - 1. Filter Box: Section with filter guides, access doors from both sides, for side loading with gaskets and blank-off plates.
  - 2. Filter Media: UL 900 listed, Class I or Class II, approved by local authorities.
  - 3. Angle: 2 inches deep disposable, extended area panel filters.
- G. Dampers:
  - 1. Factory mounted outside air and dampers of galvanized steel with vinyl bulb edging and edge seals in galvanized frame, with galvanized steel axles in self-lubricating brass or stainless steel bearings, in opposed blade arrangement.
  - 2. Damper Leakage: Maximum 2 percent at 4 inch wg (1 kPa) differential pressure when sized for 2000 fpm (10 m/s) face velocity.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Division 01 Section "Quality Requirements": Manufacturer's instructions.
- B. Install in accordance with ARI 435.
- C. Bolt sections together with gaskets. Isolate fan section with flexible duct connections; refer to Division 23 Section "Air Duct Accessories."
- D. Install flexible connections specified in Division 23 Section "Air Duct Accessories" between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 1 inch (25 mm) flex between ductwork and fan while running.
- E. Make connections to coils with unions or flanges.
- F. Hydronic Coils:
  - 1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
  - 2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
  - 3. Locate water supply at bottom of supply header and return water connection at top.
  - 4. Provide manual air vents at high points complete with stop valve.
  - 5. Ensure water coils are drainable and provide drain connection at low points.
- G. Refrigerant Coils: Provide sight glass in liquid line within 12 inches (300 mm) of coil.
- H. Extend coil drain and vent ports through the unit housing and terminate with ball valves and

caps. Provide sealing collars or grommets at penetrations through unit housing to eliminate air leakage.

- I. Support piping near the unit with isolators. Refer to Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- J. Insulate coil headers located outside air flow as specified for piping. Refer to Division 23 Section "HVAC Piping Insulation."
- K. Foundations:
  - 1. Where floor mounting is indicated, locate equipment on supports as indicated on the Drawings. As a minimum if supports are not detailed on the Drawings, provide concrete housekeeping pads (specified in Division 23 Section "Common Work Results for HVAC") for concrete floor slab construction, or pressure-treated lumber sleepers for wood floor construction. Provide raised structural steel frames where additional height for drainage is required. Supports shall be of adequate size with anchors and base plates as required. Coordinate pad and steel sizes and location with the approved equipment.
- L. Lights: Provide field-furnished 100-watt-equivalent compact fluorescent lamps in the light fixtures furnished within the unit sections.

### 3.2 TESTING

- A. After the entire installation is completed, ready for operation, test the systems. The Owner will provide electric current for the tests. Provide necessary labor, test pump, gauges, meters, other instruments and materials. Perform tests in the presence of the Architect. Dampers and fan speed controllers shall operate smoothly through their entire range. Unit shall operate without objectionable noise.

### 3.3 CLEANING

- A. The entire system installations including apparatus, motors, inside of ducts, and other components, shall be left in first-class condition including cleaning, oiling and packing.
- B. Provide filters at system start-up. Replace filters after air systems have been adjusted and balanced. Provide the Owner with 1 additional set of filters for air handling units.

### 3.4 ADJUSTMENTS

- A. After completion of the installation work called for in this Specification, furnish necessary Mechanics or Engineers for the adjustment and operation of the plant, to the end that the plant may be perfectly adjusted and turned over to the Owner in perfect working order. Further instruct the Owner's authorized representative in the care and operation of the installation, providing required framed instruction charts, directions, and other relevant information and documentation.

### 3.5 NAMEPLATES, TAGS AND CHARTS

- A. Provide engraved plastic nameplates to identify equipment, controls, and other components. Refer to Division 23 Section "Identification for HVAC Piping and Equipment." Provide nameplates secured to each air handling unit indicating quantity and size of filters required.

### 3.6 ALTERATIONS

- A. Execute alterations, additions, removals, relocations or new work, and other work, as indicated or required to provide a complete installation in accordance with the intent of the Contract Documents.
- B. Any existing work disturbed or damaged by the alterations or new work shall be repaired or replaced to the Architect's satisfaction and at no additional cost to the Owner.
- C. Existing ductwork, piping, and other systems, indicated to be removed, shall be removed from the site. Cap off existing services remaining. The Owner retains the right to ownership of heating and ventilating equipment scheduled to be removed; store such equipment where requested by the Owner. Material not retained by the Owner shall be removed from the site.

END OF SECTION 237300

## SECTION 238200 – CONVECTION HEATING AND COOLING UNITS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Finned Tube Radiation.
- B. Radiant Ceiling Panels.

#### 1.2 RELATED SECTIONS

- A. Division 23 Section “Common Motor Requirements for HVAC Equipment.”
- B. Division 23 Section “Hydronic Piping.”
- C. Division 23 Section “Hydronic Specialties.”

#### 1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.

#### 1.4 SUBMITTALS FOR REVIEW

- A. Division 01 Section “Submittal Procedures.”
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
  - 1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
  - 2. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
  - 3. Indicate mechanical and electrical service locations and requirements.

#### 1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Division 01 Section “Closeout Procedures”: Procedures for submittals.
- B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.
- C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner’s name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings. Submit under provisions of Division 01 Section “Operation and Maintenance Data.”

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum 3 years experience.

## 1.7 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

## 1.8 EXTRA MATERIALS

- A. Division 01 Section "Closeout Procedures": Maintenance Data.
- B. Provide 2 sets of filters.

## PART 2 - PRODUCTS

### 2.1 FINNED TUBE RADIATION

- A. Manufacturers:
  - 1. Sterling Hydronics.
  - 2. Rittling.
  - 3. Slant-Fin.
  - 4. Vulcan.
- B. Heating Elements: Seamless copper tubing, mechanically expanded into evenly spaced aluminum fins and suitable for soldered fittings [, or steel tube, mechanically expanded into evenly spaced steel fins].
- C. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
- D. Enclosures: 0.0478 inch (1.2 mm) steel up to 18 inches (450 mm) in height, 0.0598 inch (1.5 mm) steel over 18 inches (450 mm) in height [or aluminum as detailed], with easily jointed components for wall to wall installation. Support rigidly, on wall or floor mounted brackets [at least 3 feet (1000 mm) on center maximum].
- E. Finish: Factory applied baked enamel of color as selected by the Architect on visible surfaces of enclosure [and backplate].
- F. Damper: Where not thermostatically controlled, provide knob-operated internal damper at enclosure air outlet.
- G. Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, 6 x 7 inch (150 x 175 mm) minimum size, integral with cabinet.
- H. Capacity: As scheduled, based on 65 degrees F (18 degrees C) entering air temperature.

## 2.2 RADIANT CEILING PANELS

- A. Manufacturers.
  - 1. Sterling Hydronics.
  - 2. Aero Tech Mfg. Inc.
  - 3. Price Industries.
  - 4. Rittling.
  - 5. Titus.
- B. Ceiling Panels: Constructed of modular 24 x 48 inch (600 x 1200 mm) aluminum pans; manufactured and assembled to sizes and configurations indicated.
- C. Pipe Coil: 24 x 48 inch (609 x 1219 mm) aluminum pan module to incorporate continuous 1/2 inch (15 mm) copper pipe thermally bonded. Provide return bends for 2 water connections to each panel.
- D. Cross brace entire assembly with structural members.
- E. Factory-furnish poly-or-foil-encapsulated fiberglass insulation suitable for return plenum ceilings. Insulate the entire top-side surface.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.
- C. Protection: Provide finished cabinet units with protective covers during balance of construction.
- D. Finned Tube Radiation: Locate on outside walls and run cover wall-to-wall unless otherwise indicated. Where drawings show elements located under windows, install with elements centered under windows. Install wall angles where units butt against walls.

### 3.2 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION 238200

**This Page Intentionally Left Blank**



## SECTION 238216 - AIR COILS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Water Coils.

#### 1.2 REFERENCES

- A. ANSI/ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- B. ANSI/NFPA 70 - National Electrical Code.
- C. SMACNA - HVAC Duct Construction Standards, Metal and Flexible (HVACDCS).
- D. ANSI/UL 1995 - Heating and Cooling Equipment.
- E. ANSI/UL 1996 - Electric Duct Heaters.

#### 1.3 SUBMITTALS

- A. Submit under provisions of Division 01 Section "Submittals". Indicate coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
- B. Submit manufacturer's installation instructions under provisions of Division 01 Section "Submittal Procedures".
- C. Submit manufacturer's certificate, under provisions of Division 01 Section "Quality Requirements", that coils are tested and rated in accordance with ANSI/ARI 410.

#### 1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years' experience.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 01.
- B. Store and protect products under provisions of Division 01.
- C. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.
- D. Protect coils from entry of dirt and debris with pipe caps or plugs.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Hydronic Coils:
  - 1. Trane.
  - 2. McQuay.
  - 3. York.

### 2.2 FABRICATION - HYDRONIC COILS

- A. Fins: Aluminum continuous plate type with full fin collars or individual helical finned tube type wound under tension.
- B. Casing: Die formed channel frame of 16 ga (1.8 mm) galvanized steel with 3/8 inch (9.5 mm) mounting holes on 6 inch (150 mm) centers. Provide tube supports for coils longer than 36 inches (0.9 m).

### 2.3 WATER HEATING COILS

- A. Headers: Cast iron with tubes expanded into header, seamless copper tube with silver brazed joints, or prime coated steel pipe with brazed joints.
- B. Tubes: 5/8 inch (16 mm) OD seamless copper arranged in parallel or staggered pattern, expanded into fins, brazed joints.
- C. Testing: Air test under water to 300 psig (2070 kPa) for working pressure of 200 psig (1380 kPa) and 220 degrees F (104 degrees C).
- D. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with air filters mounted upstream of coil and downstream of any entering airstream, so that no unfiltered air reaches the coil.
- C. Install in ducts and casings in accordance with SMACNA HVACDCS.
- D. Support coil sections independent of piping on steel channel or double angle frames and secure to casings. Provide frames for a maximum of 3 coil sections. Arrange supports to avoid piercing drain pans.
- E. Provide airtight seal between coil and duct or casing.
- F. Protect coils to prevent damage to fins and flanges. Comb out bent fins.

- G. Install coils level. Install cleanable tube coils with 1:50 pitch.
- H. Make connections to coils with unions and flanges.
- I. Locate water supply at bottom of supply header and return water connection at top. Provide manual air vents at high points complete with stop valve. Ensure water coils are drainable and provide drain connection at low points.
- J. On water heating coils, connect water supply to leaving air side of coil (counterflow arrangement).
- K. Insulate headers located outside air flow as specified for piping.

END OF SECTION 238216

**This Page Intentionally Left Blank**

## SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Basic Electrical Requirements specifically applicable to all Division 26 Sections.
- B. Intent Is to Provide and Install Complete Electrical Systems, as Required to Accommodate the renovations to the existing Building.
- C. Access Panels: Where required by NFPA 70 (N.E.C.)
- D. All Cable Bundles Shall Be Limited to a Maximum of 12 Cables, Individual Bundles of Cables Shall Be Separated by at Least 2 Inches in All Directions.

#### 1.2 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Examine all contract documents for requirements affecting the work.

#### 1.3 DEFINITIONS

- A. As used in this section, "provide" shall mean, "furnish and install". "Furnish" shall mean "to purchase and deliver to the project site complete with every necessary appurtenance and support", and "Install" shall mean "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project".

#### 1.4 WORK BY OWNER

- A. The Owner will award contracts for Technology equipment soliciting proposals from factory authorized vendors. Installation will occur during building construction. Purchase may include installation, wiring, testing and training. Cooperate and coordinate with successful vendors to allow for the installation to occur during construction. Systems which may be purchased include:
  - 1. Music / Sound System.
  - 2. Telephone / data / networking System.
  - 3. .
- B. All wiring, connectivity, terminations and testing for complete systems.

#### 1.5 SUBSTITUTIONS

- A. Refer to Division 01 for Substitutions and Product Options.

#### 1.6 REFERENCES

- A. NEMA Standards.

- B. NECA "Standard of Installation."
- C. NFPA 70 (N.E.C.) latest edition.
- D. NFPA 101 Life Safety Code.
- E. U.L. Standards.
- F. ANSI Standards.
- G. Maine Uniform Building and Energy Codes (MUBEC) which include provisions of:
  - 1. (IBC) International Building Code.
  - 2. (IEBC) International Existing Building Code.
  - 3. (IRC) International Residential Code.
  - 4. (IECC) International Energy Conservation Code.
  - 5. ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality.
  - 6. ASHRAE 62.2 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings.
  - 7. ASHRAE 90.1 Energy Standard for Buildings except Low-Rise Residential Buildings.
  - 8. ASTM E1465-06 Radon Standard for new residential construction - (Maine Model Standard).

#### 1.7 SUBMITTALS

- A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures".
- B. Include products specified in Division 26 individual sections.
- C. Submit Shop Drawings and product data grouped by individual Sections to include complete submittals of related systems, products, and accessories. Label each with Section number and title. Partial Section submittals will not be reviewed.
- D. Include access panels.
- E. Include fire-stop seals and fillers.

#### 1.8 RECORD DRAWINGS

- A. Submit under provisions of Division 01 Section "Project Management and Coordination".
- B. Keep a marked set of Drawings at the site as a record set indicating all revisions in the work as the work progresses. At the completion of the work, mark the Drawings "As-Built Drawings" with the Contractor's name and date, and deliver to the Architect.

#### 1.9 PERFORMANCE REQUIREMENTS

- A. Conform to requirements of the latest edition of ANSI/NFPA 70 National Electrical Code (N.E.C.).
- B. Conform to requirements of all local, State and Federal laws and regulations, plus local electric utility company's rules, and the Fire Underwriters' requirements.

- C. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.
- D. Secure and pay for all permits and certificates as required by local, State and Federal laws.
- E. Request inspections from authority having jurisdiction.
- F. Run separate circuits for lighting and receptacle outlets as indicated.
  - 1. Circuits shall be balanced and loads and capacities shall be in accordance with requirements of local electric light company and National Board of Fire Underwriters.
  - 2. Do not share neutral on branch circuits.
- G. The entire electrical system shall be permanently and effectively grounded in accordance with Code requirements.
- H. The Drawings indicate only diagrammatically the extent, layout and the general location and arrangement of equipment, conduit and wiring. Become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment will be properly located and readily accessible.
  - 1. Note that drawings do not show all junction boxes and fixture whips for lighting fixtures recessed in accessible ceilings. Although not specifically shown on the drawings, these fixtures shall be wired from junction boxes and 6'-0" unsupported whips. Provide number of junction boxes as required to allow for the 6'-0" whips. Wiring from fixture to fixture is not allowed. See Division 26 Section "Luminaires".
  - 2. Lighting and Devices shown with same panel and circuit designation with no home run symbol may share same home runs to panelboards provided that the furthest device on the circuit does not exceed 2-1/2% voltage drop.
  - 3. Where home run symbols are shown, use separate run to panelboard for each symbol, and do not share home run with other devices having same panel and circuit designation.

#### 1.10 PROJECT/SITE CONDITIONS

- A. Coordinate with all other trades to ensure proper access and space requirements.
- B. Where project conditions occur necessitating departures from the drawings, submit for approval the details of and reasons for departures prior to implementing any change.
- C. Alterations
  - 1. Visit the site and become familiar with the existing conditions, and the requirements of the Plans and Specifications. No claim will be recognized for extra compensation due to failure of becoming familiar with the conditions and extent of the proposed work.
  - 2. Execute all alterations, additions, removals, relocations, or new work, etc., as indicated or required to provide a complete installation in accordance with the intent of the Drawings and Specifications.
  - 3. Repair or replace to the Owner's satisfaction, all existing work disturbed or damaged by the alterations.
  - 4. Except as follows, Retain ownership and remove from site all existing materials, equipment, fixtures, wiring and devices disconnected and not reused; Pay all charges for proper disposal of materials:
    - a. Materials specifically indicated to be returned to Owner.
    - b. Deliver to Owner: lighting fixtures
    - c. Obtain receipt of delivery from Owner's Representative.

5. Do not reuse existing wiring except as specifically indicated. Existing conduit raceways may be reused, provided that the existing wires are removed and new wires are installed.
6. Provide finished blank plates on all existing ceiling and wall boxes which can not be removed.
7. Ensure all circuits in existing buildings are re-energized where existing panelboards are replaced, or existing wiring is rerouted, disconnected, or disturbed. Provide and install new wiring as required to meet this condition. Verify breaker/fuse sizes on existing circuits and do not load wiring to beyond 75% of their ampacities.

#### 1.11 SEQUENCING AND SCHEDULING

- A. Construct Work in sequence under provisions of Division 01 Section "Summary".
- B. Schedule and coordinate all work with Division 02, "Selective Structure Demolition and Alterations". Schedule and coordinate all work with Division 31, 32, 33. Demolition and removal of electrical items are included as part of Division 26. Patching of existing structure left by removals is specified under Division 02.
- C. Arrange to execute the work at such times and in such locations as may be required to provide uninterrupted services for the occupied sections of the building or any of its sections. If necessary, install temporary work to provide for this condition. Authorization for interrupting services shall be obtained, in writing, from the Owner. Costs for overtime work and temporary work shall be included in the bid.

#### 1.12 TEMPORARY LIGHT AND POWER

- A. "Temporary Light and Power" specified under Division 01 Section "Temporary Facilities and Controls".
- B. Furnish all temporary equipment, wiring, lamps, etc., as required for the completion of the work, including the work of all Subcontractors.
- C. Temporary electrical work shall comply with OSHA and NEC requirements.
- D. Lighting level in all areas for the duration of construction period shall be a minimum of 5 foot candles or per OSHA requirements, whichever is greater. Provide a minimum of 50 foot candles for taping and painting of all surfaces, and for surfaces receiving finishes, including flooring and tile. When permanent light fixtures are installed, these units may be used to provide required lighting level, but shall be relamped with correct lamps prior to building turnover to Owner."

### PART 2 - PRODUCTS

#### 2.1 PAINTING

- A. Refer to Division 09 Section "Painting".

#### 2.2 ACCESS PANELS

- A. Access panels required for items furnished under Division 26 shall be provided under this Division and installed under Divisions 08 and 09.



- B. Standard panels: 12" x 16" except as indicated. Doors: flush type 14-gauge steel, hinged to 16-gauge frame. Latch: Flush face screw. All factory primed and painted to match in the field.
  - 1. Same U.L. fire rating as wall, floor, or ceiling in which they are installed.
  - 2. Equal To: Inryco/Milcor style "M" and Miami-Carey "HM".

### PART 3 - EXECUTION

#### 3.1 WORKMANSHIP AND INSTALLATION

- A. Execute all work in a neat manner acceptable to the Local and State Electrical Inspector. Follow manufacturer's installation recommendations.
- B. All electrical components and their attachments shall be properly supported and where required shall be designed for seismic forces.
- C. Lighting fixtures shall be supported from structural members. Provide unistrut channels or equal to span between beams. Paint to match. See Division 26 "Luminaires".
- D. Perform all electrical work by licensed electricians well skilled in the trade and supervised by a Master Electrician.
- E. Replace or repair to new condition, defective equipment and equipment damaged during installation or testing.

#### 3.2 TESTING AND ADJUSTING

- A. The entire installation shall be free from short circuits and improper grounds. Test in the presence of the Architects or their representatives.
- B. Test feeders with the feeders disconnected from the branch circuit panels.
- C. Test each individual branch circuit at the panel. In testing for insulation resistance to ground, the power equipment shall be connected for proper operation. In no case shall the insulation resistance be less than that required by the National Electrical Code and the manufacturer's recommendations. Correct failure in a manner satisfactory to the Architect and Engineers.
- D. Completely test and adjust each system specified under Division 26 for proper operation.

#### 3.3 SLEEVES, INSERTS AND OPENINGS

- A. Sleeves:
  - 1. Furnish and install all sleeves required for the work.
  - 2. Sleeves through exterior building walls or through concrete construction shall be rigid galvanized steel.
  - 3. Sleeves shall be sized to provide a total of not less than 1/2-inch clearance around conduit.
  - 4. Sleeves for setting into walls shall be flush with finished construction. Sleeves for setting into floor shall be embedded in concrete slab and extend approximately 2 inches above finished floors.
  - 5. All sleeved openings within building shall be sealed airtight using fire barrier caulking with a UL classification for use as a fire penetration seal for walls and floors with up to a 3-hour fire rating expanded.

6. Sleeves shall be provided in all locations where cables and conduits penetrate walls and floors.
7. Selection of firestopping materials and installation shall be in accordance with specifications Division 07 Section "Through Penetration Firestop Systems" for Firestopping".

END OF SECTION 260010

## SECTION 260111 – CONDUIT

### PART 1 - GENERAL

#### 1.1 WORK INCLUDES

- A. Metal Conduit.
- B. Flexible Metal Conduit.
- C. Liquidtight Flexible Metal Conduit.
- D. Electrical Metallic Tubing (EMT).
- E. Non-Metallic Conduit.
- F. Fittings and Conduit Bodies.

#### 1.2 RELATED SECTIONS

- A. Division 01 Section “Submittal Procedures”.
- B. Division 07 Section “Thermoplastic Membrane Roofing.” For penetrations.
- C. Division 07 Section “Through Penetration Firestop Systems.”
- D. Division 26 Section “Basic Electrical Requirements”.

#### 1.3 REFERENCES

- A. NECA "Standard of Installation."
- B. NEMA Standards.
- C. NFPA 70 N.E.C. latest edition.
- D. U.L. Standards.

#### 1.4 DESIGN REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70 (N.E.C.)
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.
- C. Conduit Size: ANSI/NFPA 70 (N.E.C.) for conductors indicated. Increase size as required to include bonding conductors specified.

#### 1.5 SUBMITTALS

- A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section “Submittal Procedures”.

- B. Include only nonmetallic conduit (PVC) with associated fittings and describe intended use.
- C. Include expansion fittings for all conduit types used on the project.
- D. Include fire-stop seals and fillers.

#### 1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01 Section "Project Management and Coordination".
- B. Accurately record actual routing of conduits larger than 1 inch.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Division 01.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

#### 1.8 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to meet project conditions.
- D. Where conduit routing is not shown, and destination only is indicated, determine exact routing and lengths required.

### PART 2 - PRODUCTS

#### 2.1 CONDUIT REQUIREMENTS

- A. Except as otherwise specifically noted, all wiring throughout the building, including each of the systems specified, shall be enclosed in minimum size 1/2 inch conduit.
- B. Underground Installations:
  - 1. Use rigid galvanized steel conduit, intermediate metal conduit, plastic coated steel conduit, thickwall nonmetallic conduit PVC-80, thinwall nonmetallic conduit PVC-40.
  - 2. In or Under Slab on Grade:
    - a. Use rigid galvanized steel conduit, intermediate metal conduit, plastic coated steel conduit, thickwall nonmetallic conduit PVC-80 and thinwall nonmetallic conduit PVC-40.
    - b. Rise through slab in rigid galvanized steel conduit.
    - c. Conduit larger than 3/4" shall run below slab.

3. Minimum Size: 3/4 inch.
  4. Under paved areas: rigid galvanized steel conduit or concrete encased PVC-40.
  5. Metallic conduits buried in soil: Coated with Bitumastic #50.
  6. Communications (telephone, data, catv) service entrance conduits from riser into building: PVC-40, concrete encased where indicated.
- C. Outdoor Locations, Above Grade: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit.
- D. In Slab Above Grade:
1. Use rigid galvanized steel conduit, intermediate metal conduit, electrical metallic tubing with water tight connectors.
  2. Maximum Size Conduit in Slab: 3/4 inch.
  3. Rise through slab in rigid galvanized steel conduit.
- E. Interior Wet and Damp Locations: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit.
- F. Dry Locations:
1. Concealed: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing.
  2. Concealed/ Accessible: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing.
  3. Exposed: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing.
    - a. Finished areas: Exposed galvanized conduit run high between framing members.
- G. Panel Feeders: Use rigid galvanized steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing in accordance with locations herein specified.
- H. Couplings and connectors for electrical metallic tubing up to 2" shall be steel set screw or compression type. Set-screw connection shall be used for all tubing sizes with a minimum of four set-screws for coupling and two set-screws for connectors and fittings for sizes 1-1/4" and larger.
- I. Couplings and connectors for rigid and intermediate metal conduit shall be threaded.
- J. Termination for all conduit and tubing shall have insulated bushings or insulated throat connectors in accordance with code requirements.
- K. Permanent Connection to Motors: Dry locations, use flexible metal conduit. Damp or wet locations, use flexible liquidtight Type UA conduit with approved liquidtight fittings. Maximum length two feet (2').

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. In general, all raceways shall be concealed within finished walls - securely supported in accordance with code requirements. Wiring in areas with no finished ceilings (exposed construction) shall be exposed overhead such that all raceways are parallel or perpendicular to

joists, columns or beams and all drops to wall devices shall be concealed in walls.

- B. Aluminum conduits shall not be installed below grade or in poured concrete or masonry.
- C. Install conduit in accordance with NECA "Standard of Installation."
- D. Install nonmetallic conduit in accordance with manufacturer's instructions.
- E. Arrange supports to prevent misalignment during wiring installation.
- F. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- G. Group Related Conduits:
  - 1. Support using conduit rack of Power-Strut, or approved equal.
  - 2. Parallel runs shall be neatly clustered with all bends and offsets of uniform pattern
  - 3. Provide space on each for 25 percent additional conduit.
- H. Substantially support with approved clips or hangers spaced not to exceed ten feet (10') on centers except 1/2" rigid conduit and 1/2" and 3/4" electrical metallic tubing shall have supports spaced not to exceed six feet (6').
- I. Fasten conduit supports to building structure.
  - 1. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
  - 2. Do not attach conduit to ceiling support wires.
  - 3. Conduits larger than 2" shall be supported from suitable structure.
- J. Arrange conduit to maintain headroom and present neat appearance.
- K. Route conduit parallel and perpendicular to walls.
- L. Route conduit in and under slab from point-to-point.
  - 1. Install only where specifically indicated or required.
  - 2. Obtain approval from the Architect before installation.
- M. Do not cross conduits in slab.
- N. Maintain adequate clearance between conduit and piping.
- O. Maintain 6 inch clearance between conduit and surfaces with temperatures exceeding 104°F.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- Q. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- R. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction. Use factory elbows or hydraulic one-shot bender to fabricate bends in metal conduit 2 inches or larger in size.

- S. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- T. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control and expansion joints.
- U. Provide suitable labeled nylon pull string in each empty conduit.
- V. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Use sleeves when passing through floors and walls.
- X. When serving roof top equipment, conduit shall enter within the weather-proof curbing. Maintain water tight roofing system.
- Y. Ground and bond conduit under provisions of Division 26 Section "Grounding and Bonding."
- Z. Identify conduit under provisions of Division 26 Section "Electrical Identification."
- AA. All elbows in nonmetallic conduit runs shall be rigid galvanized steel to eliminate "burn through" when pulling in conductors.

### 3.2 FIELD QUALITY CONTROL

- A. No wire shall be installed until work which might cause damage to wires or conduits has been completed.
- B. Conduits shall be thoroughly cleaned of water or other foreign matter before wire is installed.

### 3.3 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire-resistance rating of partitions and other elements, using approved seals, fillers and materials.

END OF SECTION 260111

**This Page Intentionally Left Blank**



## SECTION 260123 - WIRE AND CABLE

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Building wire and cable.
- B. Underground feeder and branch circuit cable.
- C. Service entrance cable
- D. Metal clad cable.
- E. Wiring connectors and connections.

#### 1.2 RELATED SECTIONS

- A. Division 26 Section 260010 "Basic Electrical Requirements."
- B. Division 26 Section 260111 "Conduit."
- C. Division 26 Section 260112 "Surface Raceways."
- D. Division 26 Section 260130 "Boxes."
- E. Division 26 Section 260195 "Electrical Identification."

#### 1.3 REFERENCES

- A. NEMA Standards.
- B. NFPA 70 N.E.C. Latest Edition.
- C. U.L. Standards.

#### 1.4 DESIGN REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)
- B. Furnish products listed and classified by Underwriters' Laboratories, Inc. as suitable for purpose specified and shown.
- C. Unless Indicated Otherwise, Conductor Sizes Shown Are Based on Copper:
  - 1. If aluminum option for conductors No. 4 AWG and larger is chosen, increase the conductor size to have the same ampacity and same or less impedance as the copper size indicated; increase the conduit and pull box sizes to accommodate the larger size aluminum conductors in accordance with NFPA 70; assure that the pulling tension rating of the aluminum conductor is sufficient; relocate equipment, modify equipment terminations, re-size equipment, and resolve to the satisfaction of the Architect all problems that are the results of the use of aluminum conductors in lieu of copper.

2. Equipment Manufacturer Requirements: Where equipment is provided whose manufacturer requires copper conductors at the terminations, or requires that only copper conductors be provided between components of equipment, provide copper conductors, or all necessary splices, splice boxes, and other work required to satisfy manufacturer's requirements.

- D. Manufacturer's name, wire size and insulation type shall be clearly marked on the insulation or jacket.

#### 1.5 SUBMITTALS

- A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures."
- B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency.
- C. Include MC manufacturer's specification sheets indicating construction, diameter, ampacity and bending radius.
- D. Include aluminum wire; type, sizes, locations used.

#### 1.6 PROJECT CONDITIONS

- A. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.
- B. Where wire and cable routing is not shown, and destination or circuit number only is indicated, determine exact routing and lengths required.

#### 1.7 COORDINATION

- A. Locate such that outlets are readily accessible.
- B. Determine required separation between cable and other work.
- C. Determine cable routing to avoid interference with other work.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. American Insulated Wire Corp.
- B. Alcan Cable
- C. Carol Cable.
- D. General Cable.
- E. The Okonite Co.

- F. Parante Essex Group.
- G. Triangle PWC, Inc.
- H. Prysmian Cables and Systems.
- I. Superior Essex Inc.
- J. Southwire Company.

## 2.2 WIRE AND CABLE

- A. Description: Single conductor insulated wire.
- B. Conductors: Sizes #6 AWG and Smaller: Copper. Sizes #4 AWG and larger: Copper or aluminum unless the type of conductor material is specifically indicated, specified, or required by equipment manufacturer.
- C. Aluminum Conductors: Aluminum alloy that is listed by Underwriters' Laboratories, Inc. Standard 486B, marked "AL9CU" for 90EC. rated circuits and shall be equal to Annealed Stabiloy compact stranded (Aluminum Association 8000 series aluminum alloy) as manufactured by Alcan Cable - Atlanta, GA.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation: ANSI/NFPA 70 (N.E.C.), Type THHN/THWN, XHHW, rated 90 degrees C.

## 2.3 METAL CLAD CABLE

- A. Description: ANSI/NFPA 70 (N.E.C.), Type MC with separate insulated ground.
- B. Conductor: Copper, [maximum # 10 AWG].
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90°C.
- E. Armor Material: Aluminum.
- F. Armor Design: Interlocked Metal Armor or Corrugated tube
- G. Jacket: None

## 2.4 WIRING CONNECTORS

- A. Use the Following Types As Herein Specified:
  1. Split bolt connectors.
  2. Solderless pressure connectors.
  3. Spring wire connectors.
  4. Compression connectors.
  5. Insulation piercing connectors.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

### 3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

### 3.3 WIRING METHODS

- A. Concealed Dry Interior Locations: Use only wire Type THHN/THWN insulation, in raceway or metal clad cable.
- B. Accessible Dry Interior Locations (such as above acoustical ceilings): Use only wire Type THHN/THWN insulation, in raceway or metal clad cable.
- C. Exposed Dry Interior Locations:
  - 1. Use exposed wiring only where specifically indicated.
  - 2. Use only building wire Type THHN/THWN insulation, in raceway. Type MC cable may be exposed in mechanical rooms and where specifically indicated.
- D. Wet or Damp Interior Locations: Use only building wire Type THWN, XHHW, XHHW-2 insulation, in raceway.
- E. Exterior Locations: Use only building wire Type THWN, XHHW, XHHW-2 insulation, in raceway.
- F. Underground Installations: Use only building wire Type XHHW or XHHW-2 insulation installed in raceway..
- G. Panel Feeders: Use only building wire Type XHHW and XHHW-2 insulation, in raceway.
- H. Use other wiring methods only as specifically indicated on Drawings.

### 3.4 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Except as otherwise specifically noted, all wiring throughout the building, including each of the systems specified, shall be enclosed in raceways.
- C. In general, all wire in raceways shall be concealed above ceilings and within finished walls, securely supported in accordance with code requirements. Wiring in areas with no finished ceilings (exposed construction) shall be raceways exposed overhead, but run along structures such that raceways have minimum visibility and such that all raceways are parallel or perpendicular to joists, columns or beams and concealed in walls.
- D. Use solid conductor for feeders and branch circuits #10 AWG and smaller. At contractors option

stranded conductors for #10 AWG and smaller shall be permitted as long as vinyl insulated support crimp-on fork terminals are use for all screw head terminations. Barrel lugs and screw activated compression clamps on back wired devices shall not require crimp-on terminals.

- E. Use stranded conductor for feeders and branch circuits #8 AWG and larger.
- F. Use stranded conductors for control circuits.
- G. Minimum Size Conductors for Power and Lighting Circuits #12 AWG Except as Follows:
  - 1. Minimum #10 AWG for 120 volt circuits more than 100 feet long.
  - 2. Sizes shall be not less than indicated.
  - 3. Note: Wire sizes indicated on drawings and schedules are minimum requirements and shall be adjusted to meet the above criteria.
- H. Use conductor not smaller than #16 AWG for control circuits with fusing sized accordingly.
- I. Pull all conductors into raceway at same time.
- J. Use suitable wire pulling lubricant for building wire #4 AWG and larger.
- K. Support cables above accessible ceiling, using spring metal clips or approved cable ties to support cables from structure. Do not support from ceiling suspension system. Do not rest cable on ceiling panels. Do not drape over ductwork or between bar joists. Wiring shall not be run diagonally and shall be cabled neatly.
- L. Use approved cable fittings and connectors.
- M. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- N. Clean conductor surfaces before installing lugs and connectors.
- O. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- P. Use split bolt connectors, insulation piercing connectors or U.L. approved insulated connectors for copper conductor splices and taps, #6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- Q. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, #8 AWG and smaller.
- R. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- S. Wiring in sleeves passing through fire-rated barriers shall be sealed/filled with approved material to maintain the fire rating.
- T. **Terminations** Involving Aluminum Conductors:
  - 1. Make with solderless circumferential compression type, aluminum bodied connectors UL listed for AL/CU. Remove all surface oxides from aluminum conductors by wire brushing and immediately apply an oxide inhibiting joint compound and insert in connector. After joint is made, wipe away excess joint compound and insulate splice.

2. Terminate aluminum conductors to copper bus by utilizing a circumferential compression type, aluminum bodied terminal lug UL listed for AL/CU, and steel Belleville spring washers, flat washers, bolts, and nuts. Belleville spring washers shall be of cadmium-plated hardened steel. Take care to install the Belleville spring washers with the crown up toward the nut or bolt head, with the concave side of the Belleville bearing on a heavy-duty, wide series flat washer of larger diameter than the Belleville. Tighten nuts sufficiently to flatten Belleville and leave in that position. Lubricate all hardware with joint compound prior to making connection. Wire brush and apply joint compound to conductor prior to inserting in lug.
3. Terminate aluminum conductors to aluminum bus by utilizing all aluminum nuts, bolts, washers, and compression lugs. Wire brush and apply joint compound to conductor prior to inserting in lug. Lubricate all hardware with joint compound prior to making connection; if bus contact surface is unplated, scratch-brush and coat with joint compound (without grit).

### 3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Division 26 Section 260195 "Electrical Identification".
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

### 3.6 FIELD QUALITY CONTROL

- A. Inspect wire and cable for physical damage and proper connection.
- B. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- C. Verify continuity of each branch circuit conductor.
- D. Verify proper operation of each circuit.

### 3.7 TESTING

- A. For conductors larger than #8AWG, perform Insulation-Resistance Test on each field-installed conductor with respect to ground and adjacent conductors.
  1. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable.
  2. Take readings after 1 minute and until the reading is constant for 15 seconds.
  3. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable.

END OF SECTION 260123

## SECTION 260130 - BOXES

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Wall and Ceiling Outlet Boxes.
- B. Pull and Junction Boxes.
- C. Hinged Cover Cabinet Enclosures.
- D. Terminal Blocks and Accessories.
- E. RELATED SECTIONS
- F. Division 07 Section "Through Penetration Firestop Systems"
- G. Division 08 Section "Access Doors and Frames"
- H. Division 26 Section 260010 "Basic Electrical Requirements."
- I. Division 26 Section 260111 "Conduit."
- J. Division 26 Section 260141 "Wiring Devices."
- K. Division 26 Section 260170 "Grounding and Bonding."
- L. Division 26 Section 260180 "Equipment Wiring."

#### 1.2 REFERENCES

- A. NEMA Standards.
- B. NFPA 70 N.E.C. Latest Edition.
- C. U.L. Standards.

#### 1.3 SUBMITTALS

- A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures".
- B. Include product data for boxes larger than 12x12x6 inches

#### 1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01 Section "Project Record Documents"
- B. Accurately record actual locations and mounting heights of outlets if not as shown on Drawings, plus pull and junction boxes larger than 12x12x6 inches and boxes used for panel feeders.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)
- B. Furnish products listed and classified by Underwriters' Laboratories, Inc. as suitable for purpose specified and shown.
- C. Size per N.E.C. Art. 314.

## 1.6 PROJECT CONDITIONS

- A. Verify field measurements are as shown on Drawings.
- B. Verify locations of wall boxes and outlets in offices,,and work areas prior to rough-in.
- C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose.
- D. Generally pull boxes are not shown on Drawings. Provide as required.

## 1.7 COORDINATION

- A. Locate such that outlets are readily accessible and does not interference with other work.
- B. Provide for access panel where required.

## PART 2 - PRODUCTS

### 2.1 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: Standard type galvanized steel, minimum four inch square or octagon by 2-1/8 inch deep.
  - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
  - 2. Concrete Ceiling Boxes: Concrete type, three and four inch deep or depth as to coordinate with concrete slab.
  - 3. Single Wall Type: Minimum size, four inch square by 1-1/2 inch deep, except as noted. Provide dry wall plaster rings raised as required to insure flush finish mounting.
  - 4. Ganged Wall Type: Minimum depth 3 inches except as noted, ganged as required under common plate to contain device shown.
- B. Cast Boxes: Type FS shallow type FD deep , aluminum or , cast fer alloy.
  - 1. Provide number of threaded hubs as required.
  - 2. Use in all exterior, damp or exposed in mechanical space.
  - 3. Provide gasketed cover and accessories by box manufacturer for complete weatherproofing.

### 2.2 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: Standard type galvanized steel, minimum four inch square or octagon by 2-1/8 inch deep.



1. Sizes up to 12x12x6 inch: Provide screw-type or hinged covers.
2. Sizes greater than 12x12x6 inch: Provide hinged covers.

- B. Exterior Surface-Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface-mounted junction box.
1. Material: Galvanized cast iron or Cast aluminum.
  2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

## 2.3 CABINET ENCLOSURES

- A. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.; finish in gray baked enamel..
- B. Boxes: Galvanized steel minimum 12"x12"x6" deep or as noted. Provide 3/4 inch (19 mm) thick plywood backboard painted matte white, for mounting terminal blocks.
- C. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.
- D. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
1. Except where specifically noted, boxes on finished surfaces shall be flush mounted with finished cover plate.
  2. Consult Architect prior to installing in finished areas.
- B. Install electrical boxes to maintain headroom and to present neat mechanical appearance.
- C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- D. In Non-accessible Ceiling Areas: Install outlet and junction boxes no more than 12 inches from ceiling access panels or from removable recessed luminaires such that they are accessible.
- E. In accessible Ceiling Areas: Install outlet and junction boxes such that they are accessible from ceiling access panels or from removable recessed luminaires.
- F. Install boxes to preserve fire-resistance rating of partitions and other elements, using materials and methods under the provisions of Division 07 Section "Through Penetration Firestop Systems"
- G. Align Wall Boxes for Switches, Receptacles, Thermostats, Telephone, and Similar Devices with Each Other as Follows:
1. Horizontally for outlets with same mounting height.
  2. Vertically for outlets shown in similar locations with different mounting heights.

- H. Do not install flush mounted boxes back-to-back in walls; provide minimum 6 inch separation. Provide minimum 24 inches separation in acoustic and fire rated walls.
- I. Accurately position flush mounted wall boxes to allow for surface finish thickness.
  - 1. Box shall be flush with finished surface.
  - 2. Use wall box support brackets that span two studs.
  - 3. Single stud support will be allowed only if used with Caddy H series E-Z Mount Brackets or equal product to support side opposite the stud.
- J. Install flush mounting box without damaging wall insulation and vapor barrier or reducing its effectiveness.
- K. Use adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires.
- M. Support boxes independently of conduit.
- N. Use gang box where more than one device is mounted together. Do not use sectional box.
- O. Use 4" square box with plaster ring for single device outlets.
- P. Use cast outlet box in exterior locations and wet locations.
- Q. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.
  - 1. Interior Dry Locations: Use hinged covers.
  - 2. Other Locations: Use surface-mounted cast metal box.

### 3.2 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations and sizes of required access doors with Division 08 Section "Access Doors and Frames".
- B. Locate flush mounting box in masonry wall to require cutting of only one masonry unit. Coordinate masonry cutting to achieve neat opening.
- C. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.
- D. Position outlet boxes to locate luminaires as shown on reflected ceiling plan.

### 3.3 ADJUSTING

- A. Adjust floor box flush with finish flooring material.

END OF SECTION 260130

## SECTION 260141 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Wall Switches.
- B. Wall Dimmers.
- C. Receptacles.
- D. Device Plates.

#### 1.2 RELATED SECTIONS

- A. Division 07 Section "Through-Penetration Firestop Systems."
- B. Division 26 Section 260010 "Basic Electrical Requirements."
- C. Division 26 Section 260130 "Boxes."

#### 1.3 REFERENCES

- A. NEMA Standards.
- B. NFPA 70 N.E.C. Latest Edition.
- C. U.L. Standards.

#### 1.4 SUBMITTALS

- A. Submit Shop Drawings for equipment and component devices in accordance with Division 01 Section "Submittal Procedures".
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Include documentation showing compliance with UL, Fed. Spec. and NEMA references.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters' Laboratories, Inc. as suitable for purpose specified and shown.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).
  - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

## 2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  - 1. Cooper; 5351 (single), 5352 (duplex).
  - 2. Hubbell; HBL5361 (single), CR5352 (duplex).
  - 3. Leviton; 5891 (single), 5352 (duplex).
  - 4. Pass & Seymour; 5381 (single), 5352 (duplex)
- B. Device Body:
  - 1. Wall mounted devices shall be Brown.
  - 2. Ceiling mounted devices shall be Brown.

## 2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed -through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped. Will not energize if line and load wiring are reversed.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
  - 1. Cooper; GF20.
  - 2. Hubbell; GFR5352
  - 3. Pass & Seymour; 2095

## 2.4 RECEPTACLES

- A. Receptacles shall represent manufacturer's highest quality receptacles other than hospital grade. Receptacles shall be back and side wired, provide green ground screw terminal, automatic ground clamp, fully enclosed in composition case, nylon face, and have all brass wrap around bridge for installation strength. Receptacles shall be UL 498 listed, Fed. Spec. WC596 and NEMA WD-6compliant. Duplex Convenience Receptacle, NEMA 5-20R, Rated 20 Amp:
  - 1. Hubbell, Model HBL5362 or HBL5352.
  - 2. P&S, Model 5362A
  - 3. Leviton, Model 5362A.
- B. GFCI Duplex Receptacle, Rated 20 Amp:
  - 1. Same construction as specified above except with integral GFCI.
- C. Device Body: Nylon type, color: Brown, except as noted.
- D. GFCI Receptacle: U.L. Class A integral ground fault circuit interrupter.

## 2.5 WALL SWITCHES

- A. Comply with NEMA WD 1 and UL 20.

- B. Switches, 120/277 V, 20 A:
  1. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
  2. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
  3. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
  4. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way)
- C. Provide key switches, three-way, four-way switches, etc., as indicated matching the Series listed above. For keyed switches, provide minimum 2 keys per keyed device.
- D. Device Body: Toggle handle type, color: Brown.
- E. Pilot Light: Neon type #1720-120v red. Separate gang position combined under same plate as switch or separately mounted.

## 2.6 STANDARD WALL DIMMERS

- A. Manufacturers:
  1. Lutron. Model NOVA-T Series except as indicated.
  2. Lightolier
  3. Or equal
- B. Plastic with linear slide.
- C. Voltage: 120 volts.
- D. Power Rating: No less than 125% of load shown on Drawings. Minimum rating: 1000 watts.
- E. Device Body & Plate: Brown.
- F. Note that dimmers shall be compatible with loads indicated. Where dimmers are shown serving electronic solid state low voltage transformers such as for MR16 Lamps, then provide appropriate amplifier modules for proper operation. Locate as indicated or above accessible ceiling. Wire as required by the manufacturer's installation instructions.

## 2.7 WALL PLATES

- A. Decorative Cover Plate: Brown, smooth face nylon.
- B. Weatherproof Cover Plate: Gasketed heavy-duty die-cast zinc with self-closing hinged lid, Leviton 4926 Series.
- C. Utility Area Cover Plates for Surface Mounting: Cadmium plated steel with rounded edges.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install devices and plates vertical and plumb. Boxes shall be flush with finished surface.

- C. Provide matching blank face plate for all unused wall boxes.
- D. Install switches with Off position down.
  - 1. Locate close to door frame on latch side of door, or beyond swing of door where appropriate.
  - 2. Where door frames have side lights, switch shall be either located below side light where a 3'-0" mounting height is possible, or beyond the side light. Coordinate with door frame schedule.
  - 3. Switches indicated in the same area at the same mounting heights shall be ganged together under a common plate.
- E. Install wall dimmers to achieve full rating specified. Do not break off cooling fins. Mount in separate gangs as required.
- F. Do not share neutral conductor on load side of dimmers.
- G. Install receptacles with grounding pole on top.
- H. Where devices such as duplex receptacles, telephone/data outlets, and TV outlets are shown adjacent to each other, then group all under a common face plate.

END OF SECTION 260141

## SECTION 260170 - GROUNDING AND BONDING

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.

#### 1.2 RELATED SECTIONS

- A. Division 26 Section 260010 "Basic Electrical Requirements."

#### 1.3 REFERENCES

- A. NEMA Standards.
- B. NFPA 70 (N.E.C.) Latest Edition.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: Conform to requirements of ANSI/NFPA 70. (N.E.C.), except that the Minimum System Resistance shall be 10 ohms.

#### 1.5 SUBMITTALS

- A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures".
- B. Product Data: Provide data for grounding electrodes and connections.
- C. Manufacturer's Instructions: Include instructions for protection, examination, preparation and installation of exothermic connectors.

#### 1.6 GROUNDING ELECTRODE SYSTEM

- A. Metal underground water pipe.
- B. Rod electrode.

#### 1.7 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01 Section "Project Management and Coordination".
- B. Accurately record actual locations of grounding electrodes.

### PART 2 - PRODUCTS

## 2.1 ROD ELECTRODE

- A. Manufacturers:
  - 1. ITT Blackburn
  - 2. Substitutions: Under provisions of Division 01 Section "Substitutions and Product Options".
- B. Material: Copper, Copper-clad carbon steel.
- C. Diameter: 3/4 inch.
- D. Length: Sectional 10 feet.
- E. Use only "Acorn" style ground clamps for connections to rods.

## 2.2 MECHANICAL CONNECTORS

- A. Material: Bronze.

## 2.3 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
  - 1. Cadweld.
  - 2. Thermoweld .
  - 3. Substitutions: Under provisions of Division 01 Section "Substitutions and Product Options".

## 2.4 WIRE

- A. Material: Copper.
- B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements, but not smaller than indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.

### 3.2 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install rod electrodes at locations indicated and as required. Install additional rod electrodes as required to achieve specified resistance to ground.
- C. Install ground wire from water entrance to main service entrance.
- D. Equipment Grounding Conductor: Provide separate, 600 volt insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.



- E. Provide and install bonding conductor to each item of electrical equipment.
- F. Bonding conductors shall be continuous where possible. Where splices are required, provide T & B, or approved equal, compression connectors of approved pattern. Insulate connectors to equivalent thickness of conductors.

END OF SECTION 260170

**This Page Intentionally Left Blank**

## SECTION 260180 - EQUIPMENT WIRING

### PART 1 - GENERAL

#### 1.1 WORK INCLUDES

- A. Electrical Connections to Equipment Specified under Other Sections Or Furnished by Owner, Including but Not Limited to: Exhaust fans, air handling units, air-conditioning units, circulators, heating system pumps, burner.
- B. All line voltage wiring including final branch circuit connections to disconnects, motor controllers, Variable Frequency Drives (VFD), Isolation transformers, and motors. See Drawings for wiring and equipment locations.
- C. Fused and non-fused disconnect switches for the equipment, except disconnect switches specifically provided with the equipment.
- D. Except as specifically noted, motors, variable frequency drives (VFD), isolation transformers for VFD, magnetic or manual starters and thermal overload protection will be furnished with the equipment for installation under Division 26 Section 260180.
  - 1. Single pole switches, switch and pilots, and light/fan switches shall be provided and installed under Division 26 Section 260180. Coordinate with equipment schedules on H&V Drawings.
- E. Temperature Control Wiring: Provided and installed under Division 23 Section "Instrumentation and Controls for HVAC Systems".
- F. Roof Top Equipment: Whether shown or not on the Drawings, provide a weather proof GFCI service receptacle at units per code requirements. For 120 volt, 15 and 20 amp equipment, connect to line side of safety switch. For larger equipment, provide home run to nearest 120 volt, 20A, 1 pole spare breaker. Label and show on as-built drawings.

#### 1.2 RELATED SECTIONS

- A. Division 01 Section "Summary".
- B. Division 08 Section "Openings".
- C. Division 11 Section "Equipment"
- D. Division 22 Section "Plumbing".
- E. Division 23 Section "Heating Ventilation and Air Conditioning".
- F. Division 26 Section "Basic Electrical Requirements".

#### 1.3 REFERENCES

- A. NEMA Standards.
- B. NFPA 70 (N.E.C.) Latest Edition.

- C. U.L. Standards.
- D. ANSI Standards.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)
- B. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.
- C. Drawings do not show all required disconnect servicing switches. Furnish and locate as required by N.E.C.
- D. Size fuses and thermal elements per N.E.C. and manufacturer's recommendations.
- E. Connect motors for correct voltage, phase and rotation.

#### 1.5 SUBMITTALS

- A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures".

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Westinghouse.
- B. I-T-E Siemens.
- C. General Electric.
- D. Square D.

#### 2.2 DISCONNECT SWITCHES

- A. Enclosed, heavy-duty type, except as noted with visible blades, Horsepower rated 600-volt and 250-volt ratings as required by the particular circuit.
- B. NEMA-1 enclosure, for dry locations; NEMA-3R raintight for exterior locations.
- C. Fuses and ampere rating and number of poles as indicated on Drawings, or as required by the specific equipment.

### PART 3 - EXECUTION

#### 3.1 INSPECTION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

### 3.2 PREPARATION

- A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

### 3.3 INSTALLATION

- A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment, but in no case less than the wire specified under Division 26 Section 260123 "Wire and Cable."
- B. Conduit Connections to Equipment: Dry locations, use flexible conduit. Damp or wet locations, use flexible liquidtight Type UA conduit with approved liquidtight fittings. Maximum length two feet (2').
- C. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
- D. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.
- E. Semiportable Machines: Use heavy-duty oil-resistant type SO cord with stranded copper conductors No. 12 AWG, minimum size and number of wires as required to include each phase conductor, white neutral conductor, and green grounding conductor. Furnish and install Kellems Series H cord grips and spring hangers for each cord connected machine with overhead supply.
- F. Make wiring connections in wiring compartment of prewired equipment in accordance with manufacturer's instructions.
- G. Install disconnect switches, controllers, control stations, temperature switches as indicated or required.
- H. Coolers and Freezers: Cut and properly seal conduit openings in freezer and cooler walls, floor, and ceilings to prevent condensate buildup. Use silicone caulking on outside of conduit penetration and listed foam in place sealant inside of conduit penetration..

END OF SECTION 260180

**This Page Intentionally Left Blank**

## SECTION 260195 - ELECTRICAL IDENTIFICATION

### PART 1 - GENERAL

#### 1.1 WORK INCLUDES

- A. Nameplates and Tape Labels.
- B. Wire and Cable Markers.
- C. Conductor Color Coding.

#### 1.2 RELATED SECTIONS

- A. Division 26 Section 260010 "Basic Electrical Requirements."

#### 1.3 REFERENCES

- A. NFPA 70 (N.E.C.) Latest Edition.

#### 1.4 REQUIREMENTS

- A. Label all panelboards, all safety switches, controls, relays, junction boxes, pull boxes, pilot lights, special switches and outlets. Label on panelboards shall include name and circuit number of source.
- B. Nameplates shall identify function of device, space controlled, voltage conditions, fuse size, panel serving switch, as indicated or required without abbreviations. Details shall be as approved.
- C. Conform to requirements of ANSI/NFPA 70. (N.E.C.) Art. 200 for grounded neutral conductor, Art. 210 for branch circuits and art. 250 for grounding (bonding) conductor.

#### 1.5 SUBMITTALS

- A. [Submit Shop Drawings, in accordance with Division 01 Section "Submittal Procedures"](#).
- B. Only include if details of nameplates, wiring markers and conductor color code are not as specified below.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.
- B. Tape Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.
- C. Junction Box Labels: Hand lettered inside box cover with indelible black marker. Indicate voltage and circuit.

- D. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install nameplates and tape labels parallel to equipment lines.
- B. Secure nameplates to equipment fronts using screws, or rivets, or adhesive. Secure nameplate to inside face of recessed panelboard doors in finished locations. Secure nameplate to outside face of surface panelboards in unfinished locations.
- C. Use embossed tape only for identification of individual wall switches and receptacles, control device stations.

#### 3.2 WIRE IDENTIFICATION

- A. Conductors throughout the building shall be color coded to identify voltage and phases.
  - 1. All metallic bonding conductors - Green.
  - 2. Phase Conductors of 120/208 Volt System: Black, red, blue. Neutral: white.
  - 3. Phase Conductors of 120/240 Volt System: Black, red. Neutral: White.
- B. All circuit conductors of the same color shall be connected to the same ungrounded feeder conductor throughout the installation.
- C. Where Conductors Are Not Available in the Colors Indicated, Due to Size, Prewired Cable, or Other Reason: Install identifying adhesive bands 3/4" wide of colors indicated above around each conductor within six inches (6") and twelve inches (12") of each end and at a maximum of five foot (5') intervals along wireways, at back of panelboards, and wherever conductors are accessible.
- D. Power and Lighting Circuits in Panelboard Gutters, Pull Boxes, Outlet and Junction Boxes, and at Load Connection: Provide wire markers on each conductor and Identify with branch circuit or feeder number.
- E. System Control Wires at Control Panel and Load Connection:
  - 1. Provide wire markers on each conductor and identify with number as indicated on equipment manufacturer's Shop Drawings.
  - 2. Fire Alarm System: Follow local Fire Department color code and labeling standards.

END OF SECTION 260195



## SECTION 260420 - SERVICE ENTRANCE

### PART 1 - GENERAL

#### 1.1 WORK INCLUDES

- A. Arrangement with Power Company for permanent electric service.
- B. Arrange with Power Company to provide for metering.
- C. Secondary wires and conduits from Power Company Tap box in basement to service entrance equipment.

#### 1.2 RELATED SECTIONS

- A. Division 26 Section 260010 "Basic Electrical Requirements."
- B. Division 26 Section 260111 "Conduit."
- C. Division 26 Section 260123 "Wire and Cable."
- D. Division 26 Section 260130 "Boxes."
- E. Division 26 Section 260170 "Grounding and Bonding."

#### 1.3 SYSTEM DESCRIPTION

- A. System Voltage: 120/208 volts, three phase, four wire, 60 Hertz.

#### 1.4 REFERENCES

- A. NEMA Standards.
- B. NFPA 70 (N.E.C.) latest edition.
- C. U.L. Standards.
- D. ANSI Standards.

#### 1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70. (N.E.C.).
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.
- C. Power Company: Central Maine Power Co.
  - 1. Contact: Paul Duperre
  - 2. Tel (207)753-3118
- D. Install in accordance with Power Company's rules and regulations.

## 1.6 SUBMITTALS

- A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures".
- B. Include modular metering equipment

## PART 2 - PRODUCTS

### 2.1 METERING EQUIPMENT

- A. Self-contained modular metering equipment:
  - 1. Section 1:
    - a. 400 Amp 3 phase 3 wire
    - b. Equal to Schneider Electric EZML331400
  - 2. Section 2:
    - a. 125Amp 1 phase 3 wire
    - b. 100Amp branch breaker
    - c. Equal to Schneider Electric EZMR313125
  - 3. Terminal box:
    - a. 600A 3 phase 3 wire
    - b. Equal to Schneider Electric EZM3600TB
  - 4. Provide additional equipment as required. Size and details as approved by the Power Company.
- B. Meter Socket: As listed and approved by the Power Company.

### 2.2 SECONDARY CONDUCTORS

- A. Specified Under Division 26 Section 260123 "Wire and Cable."

### 2.3 CONDUITS

- A. Specified Under Division 26 Section 260111 "Conduit."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Make arrangements with Power Company to obtain permanent electric service to the Project.
- B. CMP to provide secondary conductors from understreet structure through existing conduits to existing tap box in basement. Contractor to provide secondary conductors and conduits from tap box to new secondary metering equipment (see drawings). Existing metering equipment to be removed.
- C. Power Company will connect service lateral conductors to service entrance conductors.

END OF SECTION 260420

**This Page Intentionally Left Blank**

## SECTION 260440 - DISCONNECT SWITCHES

### PART 1 - GENERAL

#### 1.1 WORK INCLUDES

- A. Disconnect Switches.
- B. Fuses.
- C. Enclosures.

#### 1.2 RELATED SECTIONS

- A. Division 26 Section 260010 "Basic Electrical Requirements."
- B. Division 26 Section 260170 "Grounding and Bonding."
- C. Division 26 Section 260180 "Equipment Wiring."
- D. Division 26 Section 260195 "Electrical Identification."
- E. Division 26 Section 260470 "Panelboards."

#### 1.3 REFERENCES

- A. NEMA Standards.
- B. NFPA 70 (N.E.C.) Latest Edition.
- C. U.L. Standards.
- D. ANSI Standards.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70. (N.E.C.)
- B. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.
- C. Size per N.E.C. and Equipment Manufacturers' Recommendations.

#### 1.5 SUBMITTALS

- A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures."
- B. Include outline drawings with dimensions, and equipment ratings for voltage, capacity, horsepower, and short circuit.

## 1.6 SPARE PARTS

- A. Fuses: Furnish to Owner three (3) spare fuses for each circuit and each device requiring fuses. Maximum of six (6) spare fuses of each type and rating installed.
- B. Fuse Cabinet: Provided under Division 26 Section 260470 - Panelboards.
- C. Fuse Pullers: Furnish one fuse puller to Owner.

## PART 2 - PRODUCTS

### 2.1 DISCONNECT SWITCHES

- A. Acceptable Manufacturers:
  - 1. Cutler Hammer.
  - 2. I-T-E Siemens.
  - 3. General Electric.
  - 4. Square D.
- B. Fusible Switch Assemblies: Heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class R fuses.
- C. Nonfusible Switch Assemblies: Heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- D. Rated: Horsepower rated, 250-volt as required by the particular circuit with ampere rating and number of poles as indicated, or as required by the specific equipment.
- E. Enclosures: NEMA KS 1; Type 1 for interior dry locations, Type 3R raintight for exterior locations. Type 4 gasketed for wash down areas in kitchens.

### 2.2 FUSES

- A. Acceptable Manufacturers:
  - 1. Bussman.
  - 2. Gould Shawmut.
  - 3. Littelfuse.
- B. Fuses 600 Amperes and Less: Dual element time delay current limiting Class RK5 (Dual Element Time Delay); 250 volt.
- C. Interrupting Rating: 200,000 RMS amperes.

### 2.3 FUSE CABINET:

- A. Fuse Cabinet: Sized to contain all spare fuses required plus 25% room for future use. Provide with engraved nameplate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Section Division 26 260180 "Equipment Wiring."
- B. Install fuses in fusible disconnect switches.
- C. Mount fuse cabinet in main electrical room.

END OF SECTION 260440

**This Page Intentionally Left Blank**



## SECTION 260470 – PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Panelboards.
- B. Individually mounted circuit breakers.
- C. Metering

#### 1.2 RELATED SECTIONS

- A. Division 01 Section "Submittal Procedures."
- B. Division 06 Section "Rough Carpentry."
- C. Division 09 Section "Painting."
- D. Division 26 Section 260010: Basic Electrical Requirements.
- E. Division 26 Section 260170: Grounding and Bonding.

#### 1.3 REFERENCES

- A. NEMA Standards.
- B. NFPA 70 N.E.C. Latest Edition.
- C. U.L. Standards.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70 (N.E.C.).
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.
- C. Size per Drawings.

#### 1.5 SUBMITTALS

- A. Submit Shop Drawings, Owners' Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures."
- B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement, catalog, specification and sizes, panel dimensions, and gutter space.

#### 1.6 SPARE PARTS

- A. Keys: Furnish to Owner 1 key for each panel. All panels shall be keyed alike.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURES - PANELBOARDS

- A. General Electric.
- B. Eaton.
- C. Siemens.
- D. Schneider Electric (Square D).

### 2.2 PANELBOARDS RATED 400AMPERE AND LESS

- A. Circuit breaker type with mains and circuits as indicated on the Drawings and designed for one phase, three wire or three phase, four wire, solid neutral, 60 cycle service rated for 120/208 volt service as scheduled.
- B. Enclosure: NEMA Type 1 except as noted. Code gauge galvanized steel boxes and enameled steel fronts sized for 6" minimum side, top and bottom gutters, or greater as required by NEC.
- C. Flush or surface mounting as indicated by the panel schedule, concealed hinge and flush lock all keyed alike.
- D. Bus: Copper ratings as scheduled on Drawings. Provide subfeed and feed-through lugs as required. Lugs designed for use for both copper and aluminum conductors. Subfeed shall signify that lugs are tapped ahead of buses and feed-through shall signify that lugs are tapped on load side of the main and buses.
- E. Neutral Bar: Copper, full size insulated from the cabinet and provided with lugs for each branch circuit space in the panel.
- F. Bonding strap securely attached to the cabinet with lugs as required to receive the bonding conductors indicated and specified.
- G. Minimum Integrated Short Circuit Rating:
  - 1. As indicated on drawings
- H. Molded Case Circuit Breakers: Toggle type thermal-magnetic, quick-make, quick-break, with silver-plated contacts, bolt-in type, and with common trip for multiple circuits. Breakers shall have a nominal thickness of 1" per pole. Provide circuit breakers UL listed as Type SWD for switching lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where indicated.
- I. Bedroom Circuit Breakers: UL listed as Arc-Fault Circuit Interrupter.

### 2.3 INDIVIDUALLY MOUNTED CIRCUIT BREAKERS

- A. Molded Case Circuit Breakers: As specified above for Panelboards.
- B. Enclosure: NEMA Type 1 general purpose except as noted.
- C. Flush or surface mounted as indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install panelboards plumb and properly secured. Recessed panels shall be flush with wall finishes.
- B. Height: Per N.E.C.
- C. Provide filler plates for unused spaces in panelboards.
- D. Provide typed directory completely filled-in indicating outlets, fixtures, devices, and locations served by the circuit. Revise directory to reflect circuiting changes required to balance phase loads.
- E. Stub 4 empty one inch conduits to accessible location above ceiling and below floor, from each recessed panelboard that has accessible ceilings above and/or below the panel.
- F. Finish painting of flush panelboards and individually mounted breakers shall be as specified in Division 09 Section "Painting".
- G. Properly support backboards, and panels. At non structural walls, provide separate support system for panelboards and equipment. Use UNISTRUT P5000 channels or equal. Length and spacing to form rigid separate wall. In other areas, coordinate with Division 06 Section "Rough Carpentry", to provide blocking as required.

### 3.2 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

### 3.3 PANELBOARD SCHEDULE

- A. See Drawings.

END OF SECTION 260470

**This Page Intentionally Left Blank**

## SECTION 260510 – LUMINAIRES

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Interior and exterior luminaires and accessories.
- B. Exterior luminaires and accessories.
- C. Ballasts.
- D. Lamps.
- E. Additional wiring methods for luminaires.

#### 1.2 RELATED SECTIONS

- A. Division 26 Section 260010: Basic Electrical Requirements.
- B. Division 26 Section 260111: Conduit.
- C. Division 26 Section 260123: Wire and Cable.
- D. Division 26 Section 260130: Boxes.
- E. Division 26 Section 260170: Grounding and Bonding.
- F. Division 26 Section 260141: Wiring Devices. (for self contained local controls)

#### 1.3 REFERENCES

- A. NEMA Standards.
- B. NFPA 70 N.E.C. Latest Edition.
- C. U.L. Standards.
- D. ANSI/NFPA 101 - Life Safety Code.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70 (N.E.C.).
- B. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.

#### 1.5 SUBMITTALS

- A. [Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures".](#)

- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, performance data and total input watts.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site. Inspect for damage.
- B. Protect from moisture, corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.7 SPARES

- A. Provide two replacement lamps for each lamp type installed.

1.8 PROJECT CONDITIONS

- A. Wiring to fixtures as shown on Drawings is diagrammatic only and is intended to show circuit and switching arrangements. Fixtures shall not be used as raceways except as specifically allowed by N.E.C. Art 410.
- B. Where panel designation and circuit numbers are shown with no homerun symbol, wiring to same circuits may share same homerun to panel. See voltage drop and distance restrictions in Division 26 Section 260010.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Furnish products as specified in schedule on Drawings.
- B. All fixtures shall be approved by Underwriters' Laboratories, Inc., and bear Underwriters' labels.
- C. In addition to the manufacturers listed on the Drawings, fixtures with equivalent details and matching characteristics as provided by manufacturers listed below shall be considered for approval after review of Shop Drawings.

D. Manufacturers:

Halo	Exceline	Insight Lighting	Moldcast
Columbia	Holophane	Keystone	Peerless
Exceline	Hubble	KIM	QL
Cooper	ICE (ICON)	Lightolier	Spaulding
Daybrite	Keene	Litecontrol	SPI
Delta	Benjamin	Lithonia	Winona

- E. Ballast: Provide ballast suitable for lamp specified.
- F. Lamps: All lamps shall be furnished and installed in each fixture.

2.2 BALLASTS: Rated 120 volts or as noted.

- A. Ballast Manufacturers:
  1. Valmont.
  - (1) Osram/Sylvania.
  2. Universal Lighting Technologies.
  3. Magnetek.
  4. Jefferson.
  5. Advance.
  
- B. T8 and T5HO linear lamp Fluorescent Ballast:
  1. Fully electronic 25,000 Hz programmed start, two, three and four lamp type. Quantities to allow switching as indicated on plans. Provide only rapid start lamps which are specifically designed to operate properly on instant start electronic ballasts.
  2. Ballasts for all recessed fixtures shall be of the very low heat (VLH) design.
  3. Total harmonic distortion shall be less than 15%.
  4. Ballast Factor Shall be Normal (minimum 0.88).
  5. Where fixtures run end to end, or are within the standard 11 foot ballast whip distance, then efforts shall be made to utilize as many four lamp ballasts as possible (driving four lamps). In all cases, ballasts shall be installed to drive the exact number of lamps they are designed for, Example - one lamp ballast drives one lamp, two lamp ballast drives two lamps, etc. Installation where this criteria is not followed will not be accepted.
  6. Where fixtures can use 11 foot whips (master and satellite pairs), ballast shall be installed to drive the exact number of lamps indicated and fixture shall be provided with pre-manufactured ballast whips.

## 2.3 LAMPS

- A. Lamp Manufacturers:
  1. Sylvania/Osram.
  2. Philips.
  3. Venture Lighting International.
  4. General Electric.
  
- B. Fluorescent Lamps: T8 (2900 lumen) as scheduled, Energy saving 3500K, designed to operate properly when driven by ballasts indicated on the schedule and ballasts as specified herein.
  
- C. All Lamps shall be low mercury and non-hazardous, and shall pass the EPAs Toxicity Characteristic Leaching Procedure (TCLP) for the purpose of disposal.
  
- D. Incandescent Lamps: Rated 130 volt.
  
- E. Provide lamp types specified for luminaire.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fixtures: Complete with 660 watt sockets, wiring, ballasts, stems, hangers, fittings, end plates, pendant feeds, etc.
  
- B. Install in accordance with manufacturer's instructions.

- C. Suspended Luminaires.
    - 1. Pendants:
      - a. Provide pendant length required to suspend luminaire at indicated height. Cut or lengthened to give mounting heights as indicated and required.
  - D. Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Fixtures shall have frame and trim details to match the ceiling suspension system furnished. Coordinate details with Acoustical Treatment Section and installation with the Ceiling Installer to assure fixtures are centered on tiles or on joints as required.
  - E. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Install spacers where required to allow proper installation of rabbeted (Tegular) ceiling tiles. Secure to prevent movement.
  - F. Install clips to secure recessed luminaires in place. Install recessed luminaires to permit removal from below.
  - G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
  - H. Install wall mounted luminaires at height as indicated.
  - I. Install accessories furnished with each luminaire.
  - J. Additional Wiring Methods For Luminaires:
    - 1. Refer to Division 26 Section 260010 - Basic Electrical Requirements: Performance Requirements.
    - 2. Refer to Division 26 Section 260123 - Wire and Cable: Wiring Methods.
    - 3. Recessed and surface incandescent fixtures: Wiring rated minimum 300E F in metallic conduit where required for Underwriters' approval.
    - 4. Fluorescent Fixtures: Wiring within housings and between fixtures and junction boxes above ceilings shall be Type THHN insulated conductors rated for use at temperatures not lower than 90°C.
    - 5. Wiring From Recessed Fixtures To Junction Boxes: As described in Division 26 Section 260010 "Basic Electrical Requirements": Performance Requirements.
  - K. Bond products and metal accessories to branch circuit equipment grounding conductor.
  - L. Install specified lamps in each luminaire.
- 3.2 INTERFACE WITH OTHER PRODUCTS
- A. Locate fixtures to avoid interference with mechanical and structural features.
  - B. In finished spaces, consult the Architect prior to making adjustment to fixture locations.
- 3.3 FIELD QUALITY CONTROL
- A. All fixtures and equipment shall be in first-class condition at time of delivery of building to Owners with all scratches, mars, etc., refinished to factory standards.



- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

#### 3.4 ADJUSTING/CLEANING/RELAMPING

- A. Aim and adjust luminaires after dark as directed.
- B. Relamp luminaires whose lamps have failed at Substantial Completion and six (6) months thereafter.
- C. Clean electrical parts to remove conductive and deleterious materials.
- D. Remove dirt and debris from enclosure.
- E. Clean photometric control surfaces using procedures as recommended by manufacturer.
- F. Clean finishes and touch up damage.

#### 3.5 SCHEDULE

- A. Shown on Drawings.

END OF SECTION 260510

**This Page Intentionally Left Blank**

## SECTION 260535 – EMERGENCY LIGHTING EQUIPMENT

### PART 1 - GENERAL

#### 1.1 WORK INCLUDES

- A. Emergency lighting battery units.
- B. Exit signs.

#### 1.2 RELATED WORK

- A. Section 260010: Basic Electrical Requirements.
- B. Section 260111: Conduit.
- C. Section 260123: Wire and Cable.
- D. Section 260130: Boxes.
- E. Section 260170: Grounding and Bonding.
- F. Section 260510: Luminaires.

#### 1.3 REFERENCES

- A. NEMA Standards.
- B. NFPA 70 (N.E.C.) Latest Edition.
- C. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
- D. U.L. Standards.
- E. ANSI Standards.

#### 1.4 DESIGN REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.(N.E.C.)
- B. Conform to local building code and NFPA 101 for installation requirements.
- C. Furnish products listed and classified by Underwriters Laboratories, Inc. (U.L.) as suitable for purpose specified and shown.
- D. All components of the same manufacturer.

#### 1.5 SUBMITTALS

- A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Section 013300.
- B. Include all components, electrical characteristics, recommended maintenance procedures and intervals, list of each battery unit and the total device count and load on each unit.
- C. Submit manufacturer's instructions.

#### 1.6 WARRANTY

- A. Fully guaranteed for a minimum of three (3) years. Except as noted, batteries shall be warranted for an additional seven (7) years minimum, on a prorated basis with a life expectancy of ten (10) years.

#### 1.7 PROJECT RECORD DRAWINGS

- A. Mark on the "AS-Built Drawings" the circuit numbers controlling the emergency lighting and exit signs next to each fixture.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Lithonia: Model numbers listed except as noted.
- B. Lightalarms.
- C. Sure-Lites.
- D. Chloride.
- E. Dual-Lite.
- F. Siltron.
- G. Prescolite.
- H. Dynaray.

#### 2.2 EMERGENCY LIGHTING BATTERY UNITS

- A. 12 volt, D.C. complete with cabinet of minimum #18 gauge steel or high-impact "NORYL" thermoplastic, sealed maintenance free lead-calcium battery, automatic solid state or two-pole type transfer relay, high and low rate charging, ampere and volt meters, lamp disconnect switch, test switch.
- B. Batteries: Sufficient capacity to supply and maintain at not less than 87-1/2 percent of system voltage the total lamp load indicated for a period of time as required by latest edition of NEC,(90 minutes minimum). Initially oversize to meet this criteria over battery's entire life.

- C. Unit Voltage: 120 volts, AC.
- D. Unit Mounted and Remote Heads: 9 watt sealed beam MR16 Halogen type in NORYL high impact thermoplastic black housing.
- E. Sure-Lites CC5 series with black housing. Lamp #029-84.

### 2.3 EXIT SIGNS

- A. Universal LED type Self powered, complete with ceiling, side wall brackets and arrows and faces as indicated. Brown out, low voltage disconnect, test switch, power indicator.
- B. Die-cast aluminum construction white Face and Red letters.
- C. Red LED=s Smooth look and no visible LED dots. Less than 3Watts input power.
- D. Nickel Cadmium Battery with 15 year pro rated warranty.
- E. Sure-Lite CX7 Series.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install units plumb and level.
- B. Aim directional lampheads to maximize light in egress paths and as directed.
- C. AC Wiring to Exit Lights: In separate conduit, or MC cable with ground.
- D. Exit Sign Mounting: Generally mount directly above and centered over the doorway opening, on the wall where possible, or mounted from the ceiling when wall mounting is not possible. End wall mounted where required, up 7'-6" AFF. The intent is to locate signs to allow for maximum visibility. Consult Architect before installation, if in question.

END OF SECTION 260535

**This Page Intentionally Left Blank**

## SECTION 260721- FIRE ALARM SYSTEMS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Complete Addressable Fire/Burglary Alarm System including but not limited to:
  - 1. Equipment, materials, labor, installation, connection, programming, testing, training and performance of all operations of the intelligent reporting fire alarm system as indicated on the drawings and as herein specified.
  - 2. Alarm initiating devices, alarm notification appliances, fire alarm control panel (FACP), auxiliary control devices, annunciators, and wiring.
  - 3. Electronic digital communicator to report Fire alarm events to the owner's central receiving station for fire department notification.

#### 1.2 RELATED SECTIONS

- A. Division 26 Section "Basic Electrical Requirements."

#### 1.3 REFERENCES

- A. NFPA 70 (N.E.C.) latest edition.
- B. U.L. Standards.
- C. FM Factory Mutual
- D. NFPA 72 National Fire Alarm Code.
- E. ADA - Americans with Disabilities Act.
- F. NFPA 101 - Life Safety Code.
- G. Local and State Codes.
- H. International Electrotechnical Commission (IEC).
- I. Fire Department - Rules & Regulations for the Installation of Fire Alarm Systems.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. All components shall be of the same manufacturer, FM approved and listed by Underwriters' Laboratories, Inc., and so labeled.
- B. Conform to requirements of NFPA 70. (N.E.C.), specifically Art 760.
- C. Conform to requirements of the National Fire Protection Association, Standards NFPA 72 NFPA 101 and also all applicable Federal, State and local codes.
- D. Conform to all requirements of the Authority Having Jurisdiction (AHJ).

- E. Furnish products listed and classified by Underwriters' Laboratories, Inc. (U.L.) as suitable for purpose specified and shown. The fire alarm control panel, network interface and all transponders shall meet the modular labeling requirements of U.L. Each subassembly, including all printed circuits, shall include U.L. modular labels.
- F. Include all necessary software, programming and the selection of the proper type and quantities of the system components to assure a complete, operational, and Code Compliant System.
- G. Where the effect of more than one strobe is visible in one location (including reflected light), then configure the system to synchronize the strobes.
- H. System shall be field programmable.
  - 1. Provide the Owner with all required components, interfaces and passwords to allow them full access to the programming features. Provide minimum on site training on programming features as specified herein under PART 3 "TRAINING".
  - 2. Provide all hardware, software, programming tools, and documentation necessary to allow modifying the fire alarm network on site. Modifications include addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices and zones.
  - 3. The system structure and software shall place no limit on the type and extent of ON-SITE software modifications. Software modification shall not require power shut down of system and shall not cause loss of system fire protection while making modifications.
- I. Special Programmable Features:
  - 1. HVAC units: Interface shall be field programmable to allow shut down activation on general alarm and/or on selective zoning of local detectors. Set initially to shut down on general alarm. For all HVAC equipment that is required to be shut down upon a fire alarm condition, ensure that fire alarm shutdown of equipment is wired through input contacts within the starter enclosure. Upon receipt of an alarm signal from the building's fire alarm system, the motor controller shall be given a command to shut down the motor. Circuitry shall be provided to ensure that the motor is shut down whether the controller is in the "AUTO", "HAND" or "BYPASS" mode. If this feature is not available from the equipment manufacturer, then Division 23 shall be responsible for providing a contactor on the line side of the starter to accomplish the same function.
  - 2. HVAC Duct Smoke Dampers: Interface shall be field programmable to allow activation on general alarm and/or on selective zoning of local detectors. Set initially to close dampers on general alarm.
- J. The drawings do not show all components, devices and details of the Fire Alarm System. It shall be the responsibility of the authorized supplier/installer to provide full documentation and to provide a fully operational code compliant system.
- K. Coordinate with and obtain approval from the local Fire Chief (AHJ), prior to the Shop Drawing submittal. See Item Submittals.

#### 1.5 SYSTEM DESCRIPTION

- A. Fire/Burglary Alarm System: Addressable automatic and manual initiating with audio visual notification, intelligent reporting, microprocessor controlled fire detection/alarm system.
- B. An active/interactive type system where each addressable device is repetitively scanned, causing a



signal to be transmitted to the local fire alarm control panel node indicating that the FACP and its associated initiating devices and notification appliance circuit wiring is functional. Loss of this signal at the local FACP shall result in a trouble indication on both the FACP display and at the network display.

C. System Performance and Supervision:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices: Encoded on NFPA Class A) signaling line circuits (SLC).
2. Initiating device circuits (IDC): Wired class A NFPA Style D as part of an addressable device connected by the SCL circuit (end of line returns to the panel using a separate path).
3. Notification appliance circuits (NAC): Wired class B.
4. Digital electronic signals: Employ check digits or multiple polling.
5. Occurrence of single ground or open condition in initiating or signaling circuit places circuit in TROUBLE mode.
6. Occurrence of single ground or open condition in the initiating circuit does not disable any device on that circuit.
7. Occurrence of single ground or open condition on alarm initiating or signaling circuits does not disable that circuit from transmitting in ALARM.
8. Component or power supply failure places system in TROUBLE mode.
9. Alarm signals arriving at the main FACP shall not be lost following a primary power failure until the alarm signal is processed and recorded.
10. Batteries: Under or over battery voltage, shorted or disconnected battery supply places system in TROUBLE mode.
11. FACP devices are to consist of low current, solid-state integrated circuits, and shall be powered locally from a primary power and standby power source.
12. Power for initiating devices and notification appliances shall be from the main fire alarm control panel, the FACP to which they are connected or to a Field Charging Power Supply (FCPS).
13. Notification appliance circuits shall have 25 percent spare capacity.

D. Alarm Sequence of Operation: Actuation of manual fire alarm station, automatic initiating device and sprinkler flow switches causes system to enter ALARM, which includes the following operations:

1. Disable local sound systems. Provide interfacing relays as required to assure that local programs will not obscure the fire alarm audible devices. Coordinate with the successful sound system vendor to assure proper operation. Provide relays with separate isolated contacts at each sound system amplifier to provide a signal to power down the sound system amplifier upon activation of a fire alarm condition. Where the sound system amplifier does not support remote shutdown of the amplifier provide a contactor (min 20 ampere rated) to interrupt the power feed to the sound system amplifier.
2. Indicate location of alarm on fire alarm control panels for all events.
3. Indicate on FACP LCD display.
4. Energize a digital electronic communicator to send a message to the Owner's central receiving station.
5. Activate all programmed events.
6. Sound and display throughout the building the fire alarm (horn/light) signaling devices.
7. See Special Programmable Features for additional requirements.

E. Alarm Silence: Configure the system such that the alarm horns/speakers may be silenced, after three (3) minutes, at the associated locked FACP control cabinet. Alarm strobes shall remain flashing

until system is reset. A subsequent alarms shall reactivate the signals.

- F. Alarm Reset: RESET function resets alarm system to NORMAL condition (out of ALARM) if alarm initiating circuits have cleared.
- G. Trouble Sequence of Operation: System trouble, including grounding or open circuit of supervised circuits, or power or system failure causes system to enter TROUBLE mode, including the following operations:
  - 1. Visual and audible trouble alarm at associated control panel.
  - 2. Manual ACKNOWLEDGE function (trouble silence switch) at control panel, silences audible trouble alarm; visual alarm is displayed until initiating trouble is cleared.
- H. The activation of any system smoke detector shall initiate an Alarm Verification operation whereby the panel resets the activated detector and waits for a second activation. If, after reset, a second alarm is reported from the same or any other smoke detector within one (1) minute the system shall process the alarm. If no second alarm occurs within one minute the system shall resume normal operations. The Alarm Verification shall operate only for smoke detectors. Other activated initiating devices shall be processed immediately.
- I. Zoning: Programmable set up and program as direct by Owner and Local Fire Department.

## 1.6 QUALIFICATIONS

- A. Fire alarm equipment Manufacturer:
  - 1. Company specializing in manufacturing the products specified in this Section with minimum five years documented experience.
  - 2. Company maintaining engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.
- B. Supplier/Installer (Vendor):
  - 1. Company authorized by the manufacturer and specializing in fire alarm systems with minimum five years' experience.
  - 2. Company shall employ NICET (minimum Level II fire alarm technology) technicians.
  - 3. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided.
  - 4. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance.
  - 5. The equipment supplier shall be authorized and trained by the manufacturer to calculate, design, install, test, and maintain the system.
  - 6. Company offering service contracts for continuing factory authorized service after the initial warranty period.

## 1.7 SUBMITTALS

- A. Submit Shop Drawings, Owner's Manuals, and Operating Instructions in accordance with Division 01 Section "Submittal Procedures".
- B. Prior to submitting Shop Drawings to the Architect, set up a meeting at the Local Fire Department with a complete submittal package. Vendor shall present the proposed system to the Fire Department and describe in detail, the operation. Once the fire department is satisfied that the proposed system

meets their requirement (including locations of ADA required Strobes), then the shop drawings may be submitted to the Architect along with a copy of the minutes of the meeting. Shop drawings will not be reviewed by the Architect without this presentation and minutes of the meeting.

- C. Include floor plan layout and system riser showing all components, devices, wiring, ID addresses and connections:
  - 1. For floor plan layout, use contract drawing.
  - 2. Electronically mark-up showing all wiring between devices, number of conductors, and labeling system.
  - 3. Shop drawings will not be reviewed by the Architect without these drawings.
- D. Include proposed wiring color code and verification that it meets local fire department standards.
- E. Include letter verifying that system has been reviewed and approved by the local Fire Department.
- F. Include narrative description of system functions and sequence of operation.
- G. Include connection diagrams and catalog cuts of all components, including all equipment, devices, annunciator layout, control panel modules, and internal terminal configurations.
- H. Include documentation showing proof of U.L. listing for all system components.
- I. Include a fire alarm system function matrix as referenced by NFPA 72. Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions.
- J. Include Power calculations and Battery capacity calculations. Provide the following supporting information:
  - 1. Total panel supervisory current.
  - 2. Total horn/strobe signal current.
  - 3. Total auxiliary power.
  - 4. Total smoke detector supervisory and alarm power.
  - 5. Total battery amp-hour calculations.
  - 6. Voltage drop on each notification appliance circuit (NAC voltage drop at each appliance).
  - 7. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25 percent spare capacity.
  - 8. NAC circuit design shall incorporate a 25 percent spare capacity for future expansion.
  - 9. Battery size shall be a minimum of 125 percent of the calculated requirement.
- K. Include all cable types.
- L. Include second year extended service contract listing services included and costs. The cost of this service contract is included under this section.
- M. Submit manufacturer's instructions.
- N. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On portable media (jump drive/compact disk), complete with data files.

3. Device address list.
4. Printout of software application and graphic screens.

O. Product Data: For each type of product:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements.

P. See additional requirement specified in PART 1 under "PERFORMANCE REQUIREMENTS"

## 1.8 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations and mounting heights of outlets if not as shown on Drawings, plus pull and junction boxes larger than 12x12x6 inches.
- B. Accurately record actual routing of conduits larger than 1 inch and main wiring trunks.

## 1.9 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
- C. Include operating instructions, and maintenance and repair procedures.
- D. Include manufacturer's representative's letter stating that system has been tested and is operational. Use NFPA 72 FIRE ALARM SYSTEM CERTIFICATION and DESCRIPTION form.

## 1.10 EXTRA MATERIALS

- A. Provide one manual pull stations.
- B. Provide two keys of each type.
- C. Provide one smoke detector of each type.
- D. Provide one duct smoke detector of each type with housing.
- E. Provide two heat detector of each type.
- F. Provide two Horn/Strobes and two adjustable Cd Strobes.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Honeywell: Addressable system. Model numbers used except as noted.

- B. The following manufactures with Systems having equivalent features and capabilities will be considered for approval:
  - 1. Edwards.
  - 2. Siemens.
  - 3. Notifier.

## 2.2 CONTROL PANELS

- A. Fire alarm control panel shall be Honeywell Vista 128FBP series. Provide all necessary modules for a complete operational system. Panel shall include a microprocessor based central processing unit (CPU). The FACP shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, control circuits, notification appliance circuits, transponders, local operator terminals, and other system controlled devices. The control panel shall be an eight (8)-partition, UL commercial fire and burglary control panel that provides 128 zones using basic hardwired, polling loop, and wireless zones. It shall also provide supervision of two (2) notification appliance output circuits (NAC), RF receivers, and relay modules. In addition, the control shall provide the ability to schedule time-driven events, and allow certain operations to be automated by pressing a single button. The system shall be capable of interfacing with an ecp long-range radio (LRR) unit that can send Contact ID messages, and alphanumeric paging devices. The control shall provide integrated access control and CCTV-switching capability with the use of a single downloader and database.
- B. FACP shall perform the following functions:
  - 1. Supervise and monitor all intelligent/addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
  - 2. Supervise all signaling and notification circuits throughout the facility.
  - 3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.
  - 4. Visually and audibly annunciate any trouble, supervisory and alarm conditions on operator's terminal, panel display, and annunciators.
- C. Capacity and General Operation:
  - 1. Listed for UL Commercial Fire and Burglary.
  - 2. Supports up to 128 zones.
  - 3. Supports up to eight (8) separate partitions.
  - 4. Supports up to 150 users.
  - 5. Supports commercial wireless devices.
  - 6. Provides integrated security, access control, and CCTV switching and commercial fire capability.
  - 7. Provides supervision of peripheral devices.
  - 8. Supports up to 96 optional relay outputs.
  - 9. Supports long-range radio (LRR) communication.
  - 10. Provides scheduling capability to allow for automated operations.
  - 11. Supports up to eight (8) alphanumeric paging devices.
  - 12. Supports panel linking.
  - 13. Supports alarm reporting via Internet.
  - 14. Interfaces with automation software.
  - 15. Monitors smoke detector maintenance signals.
- D. Polling loop (Expansion Zones):
  - 1. Polling Loop - The control shall support up to 120 additional hardwire zones using a built-in

two-wire polling (multiplex) loop interface. The polling loop shall provide power and data to remote point modules, and constantly monitor the status of all zones on the loop. Maximum current draw shall not exceed 128 mA. The polling loop zones shall have the following characteristics:

- a. Interface with RPM (Remote Point Module) devices that provide Class B, Style Y (e.g., 4208U/4208SN) or a combination of Class B, Style Y, and Class A, Style Z (e.g., 4208SNF) zones.
  - b. Individually assignable to one of eight (8) partitions.
  - c. Individually assignable to NAC outputs or auxiliary relays.
  - d. Supervised by the control panel.
  - e. A 12,000 ft (3658 m) wire run capability without using shielded cable.
  - f. Each RPM (Remote Point Module) enclosure shall be tamper protected.
2. Wireless Expansion - The control shall support up to 128 wireless zones using a 5800 series RF receiver (fewer if using hardwire and/or polling loop zones). Wireless zones shall have the following characteristics:
- a. Supervised by control panel for check-in signals (except certain non-supervised transmitters).
  - b. Tamper-protection for supervised zones.
  - c. Individually assignable to one of the partitions.
  - d. Individually assignable to bell outputs and or auxiliary relays.
  - e. Support wireless devices listed for Commercial Burglary using the 5881ENHC RF Receiver.
3. Partitions - The control shall provide the ability to operate eight (8) separate areas, each functioning as if it had its own control. Partitioning features shall include:
- a. A Common Lobby partition (1-8), which can be programmed to perform the following functions:
    - 1) Arm automatically when the last partition that shares the common lobby is armed.
    - 2) Disarm when the first partition that shares the common lobby is disarmed.
  - b. A Master partition (9), used strictly to assign keypads for the purpose of viewing the status of all eight (8) partitions at the same time (master keypads).
  - c. Assignable by zone.
  - d. Assignable by keypad/annunciator.
  - e. Assignable by relay to one or all eight (8) partitions.
  - f. Ability to display fire and/or burglary and panic and/or trouble conditions at all other partitions' keypads (selectable option).
  - g. Certain system options selectable by partition, such as entry/exit delay and subscriber account number.
4. User Codes - The control shall accommodate 150 user codes, all of which can operate any or all partitions. Certain characteristics must be assignable to each user code, as follows:
- a. Authority level (Master, Manager, or several other Operator levels). Each User Code (other than the installer code) shall be capable of being assigned the same or a different level of authority for each partition that it will operate.
  - b. Opening/Closing central station reporting option.
  - c. Specific partitions that the code can operate.
  - d. Global arming capability (ability to arm all partitions the code has access to in one command).
  - e. Use of an RF (button) to arm and disarm the system (RF key must first be enrolled into the system). Each CPU shall contain and execute all control-by-event interlock for specific local and network action to be taken if an alarm condition is detected by the system. Control-by-event programs shall be held in non-volatile programmable

memory, and shall not be lost even if system primary and secondary power failure occurs.

5. Peripheral Devices - The control shall support up to 30 addressable ECP devices, which can be any combination of keypads, RF receivers, relay modules, annunciator modules, and interactive phone modules. Peripheral devices have the following characteristics:
  - a. Each device set to an individual address according to the device's instructions.
  - b. Each device enabled in system programming.
  - c. Each device's address shall be supervisable (via a programming option).
6. Keypad/Annunciator - The control shall accommodate up to 16 keypads or six (6) touch-screen (i.e.; advanced user interface) keypads. The keypads shall be capable of the following:
  - a. Performing all system arming functions.
  - b. Being assigned to any partition.
  - c. Providing four programmable single-button function keys, which can be used for:
    - 1) Panic Functions -activated by wired and wireless keypads; reported separately by partition.
    - 2) Keypad Macros -32 keypad macro commands per system (each macro is a series of keypad commands). Assignable to the A, B, C, and D keys by partition. Consistent with UL864 standards, the CPU and associated equipment shall be protected against voltage surges and line transients.
7. Output Relays - A total of 96 relay outputs shall be accommodated using relay modules. Each relay module shall provide four (4) Form C (normally open and normally closed) relays for general-purpose use or two (2) Class-B, Style-Y supervised notification appliance circuit outputs, when using the 4204CF module. The relays shall be capable of being:
  - a. Programmed to activate in response to system events.
  - b. Programmed to activate using time intervals.
  - c. Activated manually using a relay command mode.
  - d. Assigned an alpha descriptor.
  - e. Used for Class B, Style-Y supervised bell outputs (4204CF module).
  - f. A combination of 4204 (ECP) and 4101SN (polling loop) relays.
8. Vista Interactive Phone Module - The control shall support the ADEMCO 4285/4286 VIP Modules, which permit access to the security system in order to perform the following functions:
  - a. Obtain system status information.
  - b. Arm and disarm the security system.
  - c. Control relays.
9. LED Annunciator - The control shall support the Honeywell ADEMCO FSA-8 and FSA-24 annunciators, which are capable of:
  - a. Visually identifying a zone or point that is in alarm or trouble.
  - b. Programmable for system silence/reset.
  - c. Up to 96 LEDs may be used in one system.
  - d. A total of four (4) FSA-24 or 12 FSA-8 annunciators may be used in one system.
  - e. An optional keyswitch, FSAKSM module, shall be available for UL listed Silence and Reset capability.
10. Notification Appliance Circuits (NAC) - The Control Panel shall internally provide two supervised NAC outputs for operating fire and burglar alarm notification appliances. It shall also support additional supervised bell outputs when using 4204CF relay modules. Each NAC output shall be rated at 10-14 VDC, 1.7 amp max power limited. Total alarm current draw when using two NAC outputs shall not exceed 2.3 amps for battery independent operation.
11. Auxiliary Relay - A built-in Form C relay shall be provided. The relay contacts shall be rated at 28 VAC/VDC, 2.8 amps maximum. The relay shall support:
  - a. Alarm activation.
  - b. Trouble/supervisory activation.

- c. Reset of four-wire smoke detectors.
  - d. Battery saving feature.
12. Integrated Access Control - The control shall be capable of the following:
- a. Providing a command that activates relays to allow access doors to open (e.g., lobby door), lights to be turned on or off, etc.
  - b. Becoming a fully integrated access control system by using numerous VistaKey Single-Door Access Control Modules.
  - c. Supporting up to eight (8) VistaKey Access Control Modules. The VistaKey Access Control Modules shall use the same Compass Downloader as the Vista-128FBP and shall be programmable from the Compass Downloader or the Keypad/Annunciators.
  - d. Assigning any number of access control relays to each partition (up to 96 for the system).
  - e. Supporting up to 250 access card holders using VistaKey.
  - f. Connecting to the ADEMCO PassPoint Access Control System via the Vista Gateway Module (VGM).
13. CCTV Switching - The System shall be capable of supporting the VistaView 100 CCTV Switching System. The CCTV system shall be fully integrated and be event driven by Fire, Burglary or Access events. When cameras are not event driven, they shall be driven by an automatic preset dwell time. The system shall also be capable of:
- a. Activating the CCTV system via a Form-C relay output.
  - b. Operating up to 60 camera inputs and 30 video outputs.
14. Commercial Wireless Equipment - The Control shall be compatible with UL Listed Commercial Wireless Fire & Security equipment including:
- a. Honeywell ADEMCO 5881ENHC Commercial Fire/Burg Receiver. - The receiver shall be capable of receiving as many points as the control panel is rated for. Up to two (2) receivers may be used on any system. Receivers may be remotely located anywhere on the system Keypad/Annunciator bus.
  - b. Honeywell ADEMCO 5808LST Wireless Photoelectric Smoke and Heat Detector - The device shall be UL 268 listed and shall have Maintenance Alert capability and Automatic Drift Compensation.
  - c. Honeywell ADEMCO 5809 Wireless 135D Fixed Temperature and Rate of Rise Heat Detector - The device shall be UL 521 listed for commercial applications.
  - d. Honeywell ADEMCO 5817CB Wireless Universal Contact Monitoring Transmitter - This device shall be capable of making any conventional UL listed contact device a wireless device. The device shall be UL listed for commercial fire and burglary applications as follows: UL 864, 985 for fire and UL 365, 609, 1023, 1076 and 1610 for security and nurse call.
  - e. Honeywell ADEMCO 5869 Wireless Hold Up Switch/Transmitter - This device shall be UL 636 listed for commercial burglary applications.
15. Keyswitch - The control shall support the Honeywell ADEMCO 4146 Keyswitch on any one of the system's eight (8) partitions. If used, zone 7 is no longer available as a protection zone.
16. Voltage Triggers - The system shall provide voltage triggers, which change state for different conditions. Used with long-range radio (LRR) equipment or other devices such as a remote keypad sounder, keyswitch ARMED and READY LEDs, or a printer to print the system's event log.
17. Event Log - The System shall maintain a log of different event types (enabled in programming). The event log shall provide the following characteristics:
- a. Stores up to 512 events.
  - b. Viewable at the keypad or through the use of Compass software.
  - c. Printable on a serial printer using a 4100SM Module including zone alpha descriptors.
  - d. Stores PassPoint access control events.
  - e. Sends printed events to up to eight (8) alphanumeric pagers.



18. Scheduling - Provides the following scheduling capabilities:
  - a. Open/close schedules (for control of arming/disarming and reporting).
  - b. Holiday schedules (allows different time windows for open/close schedules).
  - c. Timed events (for activation of relays, auto-bypassing and un-bypassing, auto-arming and disarming, etc.).
  - d. Access schedules (for limiting system access to users by time)
  - e. End User Output Programming Mode (provides 20 timers for relay control).
  - f. The system shall automatically adjust for daylight savings time.
19. Communication Features - Supports the following formats and features for the primary and secondary central station receivers:
  - a. Formats:
    - 1) ADEMCO Low Speed (Standard or Expanded).
    - 2) SESCOA/RADIONICS.
    - 3) ADEMCO EXPRESS.
    - 4) ADEMCO High Speed.
    - 5) ADEMCO CONTACT ID.
  - b. Backup reporting - The system shall support backup reporting via the following:
    - 1) Secondary phone number.
    - 2) ECP long-range radio (LRR) interface.
    - 3) Option to select long range radio (LRR) or dialup as the primary reporting method (dynamic signaling feature).
  - c. Internet reporting - The system shall be capable of communicating with the central station via the internet using Alarmnet-i. It shall provide the user with the ability to control the system via a browser interface (i.e., AOL, Netscape, Internet Explorer). All packet data transmitted to the monitoring station shall be encrypted with a minimum of 1024 bits of encryption.
20. Audio Alarm Verification Option - Provides a programmable Audio Alarm Verification (AAV) option that can be used in conjunction with an output relay to permit voice dialog between an operator at the central station and a person at the premises.
21. Cross-Zoning Capability - Helps prevent false alarms by preventing a zone from going into alarm unless its cross-zone is also faulted within five (5) minutes.
22. Pager Interface - The Control Panel shall be capable of sending event information to an alphanumeric pager via a VA-8201 pager interface device.
23. Power Supply - The Control Panel shall be compatible with a power supply module. The module shall supply two (2) rectified, unfiltered outputs, which power:
  - a. Alarm notification appliances, including but not limited to sirens horns, bells and strobes.
  - b. Auxiliary devices capable of operating using full-wave rectified unfiltered voltage.
24. Exit Error False Alarm Prevention Feature - The System shall be capable of differentiating between an actual alarm and an alarm caused by leaving an entry/exit door open. If not subsequently disarmed, the control panel shall:
  - a. Bypass the faulted E/E zone(s) and/or interior zones and arm the system.
  - b. Generate an Exit Error report by user and by zone so the central station knows it was an exit alarm and who caused it.
25. Enhanced Fire Walk-Test Mode - The Control Panel shall provide the installer with the following features:
  - a. Automatic test of all integrated remote point module (RPM) devices, equipped with an automatic test feature.
  - b. While automatic test is in progress all fire zones that remain untested shall be displayed.
  - c. An event log shall be capable of logging the results of tested and untested zones.
  - d. The ability to report the result of tested and untested zones to the central station.

- 26. Built-in User's Manual and Descriptor Review - For end-user convenience, the control panel shall contain a built-in User's Manual. It shall include the following capabilities:
    - a. By depressing any of the function keys on the keypad for five (5) seconds, a brief explanation of that function shall scroll across the alphanumeric display.
    - b. By depressing the READY key for five (5) seconds, all programmed zone descriptors shall be displayed (one at a time). This feature shall provide a check for installers and ensure all descriptors have been entered properly.
  - 27. Programming - The Control shall be capable of being programmed locally or remotely using the Honeywell ADEMCO Compass Downloader and shall be capable of:
    - a. Uploading and downloading all programming information at 300 baud.
    - b. Uploading and displaying firmware revision levels from the control.
  - 28. Panel Linking - The Control shall be capable of being networked together with up to eight other controls and being operated by any keypad within the system. It shall provide the ability for users to:
    - a. Control multiple zones, partitions, and/or buildings from a central location.
    - b. Check status, arm and disarm any partition from any keypad in the system.
    - c. Globally arm or disarm partitions based upon user authority.
  - 29. Automation Software - The Control shall be capable of interfacing with automation software via an RS232 input on a single partition.
- E. The control panel shall be the Honeywell (ADEMCO) VISTA-128FBP Commercial Fire/Burglary Partitioned Security System or equivalent.

### 2.3 ENCLOSURE

- A. The Control Panel shall be enclosed in a metal cabinet, suitable for wall mounting. The dimensions shall not exceed 18 inches (45.7 cm) in height, 14.5 inches (36.8 cm) in width or 4.3 inches (10.9 cm) in depth.

### 2.4 ELECTRICAL POWER REQUIREMENTS

- A. System Power - The Fire and Burglary Alarm System shall operate using standard 120 volts AC, 50/60 Hz power.
- B. Control Primary Power - Transformer power shall be 18 VAC, 72 VA.
- C. Backup Battery - A rechargeable 12 VDC, gel type, lead acid backup battery shall be provided. The battery shall be rated between 12 and 34-ampere hours (AH).
- D. Alarm Power - Alarm power shall be 12 VDC, 1.7 amps for each bell output
- E. Auxiliary Standby Power - Standby power shall be 12 VDC, 1 amp maximum.
- F. Total Power - Combined auxiliary standby and alarm currents shall be 2.3 amps.
- G. Fusing - The battery input, auxiliary, and bell outputs shall be protected using PTC circuit breakers. All outputs shall be power limited.

### 2.5 SYSTEM COMPONENTS - CONVENTIONAL

- A. Horn/Strobes: Combination Audible/Visible signals.
  - 1. Electronic sounders shall produce a sound level of at least 90 dBA measured at 10 feet from the device.

2. Ability to silence the horn while leaving the visible signal active.
3. Capable of meeting the candela requirements of ADA.
4. Polarized to allow electrical supervision.
5. Candela ratings: Selectable 15, 30, 75, 110, with visual indicator.
6. Set strobe candela initially as shown on drawings and as recommended by the authorized technician.
7. Where drawings show 15/75, then use a fixed 15/75 or set selection at 75.
8. Where more than one strobe is visible in one location, synchronization shall be required.
9. Red face plate with white letters.
10. Flush mounted except in existing masonry walls. Where surface mounted, provide red matching back box.

B. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and shall meet the following criteria:

1. The maximum pulse duration shall be 2/10 of one second.
2. Strobe intensity shall meet the requirements of UL 1971.
3. The flash rate shall meet the requirements of UL 1971.
4. Where more than one strobe is visible in one location, synchronization shall be required.
5. Candela ratings: Selectable 15, 30, 75, 110, with visual indicator.
6. Set strobe candela initially as shown on drawings and as recommended by the authorized technician.
7. Where drawings show 15/75, then use a fixed 15/75 or set selection at 75.
8. Red face plate with white letters.

## 2.6 SYSTEM COMPONENTS - INTELLIGENT

A. Addressable Devices - General:

1. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the FACP signaling line circuit.
2. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LED's. Both LED's shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LED's shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
3. Smoke detector sensitivity shall be set in the fire alarm control panel and shall be adjustable in the field through the field programming of the system. Sensitivity may be automatically adjusted by the panel on a time-of-day basis.
4. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
5. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.
6. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
7. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
8. Detectors shall operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby

- allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
9. Addressable devices shall provide address-setting means using decimal switches and shall also store use to identify the type of device. LED(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
  10. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.
- B. Addressable Pull Box (Manual Station):
1. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
  2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
  3. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger.
  4. Stations shall be suitable for surface mounting or semi-flush mounting and shall be installed not less than 42 inches, nor more than 48 inches above the finished floor.
  5. Manual boxes shall be the double action type.
- C. Intelligent Photoelectric Smoke Detector: The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
- D. Intelligent Thermal Detectors: Thermal detectors shall be intelligent addressable devices rated at 135 deg F (58 deg C) And have a rate-of-rise element rated at 15 deg F (9.4 deg C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.
- E. Intelligent Duct Smoke Detector:
1. The in-duct smoke detector housing shall accommodate intelligent photoelectric detector, that provides continuous analog monitoring and alarm verification from the panel. Include sampling tube.
  2. When sufficient smoke is sensed, an alarm signal shall be initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.
  3. Whether shown on plans or not, all air handling systems operating at 2000 CFM and above shall have duct mounted smoke detection equipment in accordance with the requirements of NFPA 90A. See Mechanical drawings for quantities and locations of duct mounted smoke detectors.
  4. Provide labeled remote test and indicating stations at the fire alarm control panel and at a visible location in the vicinity of the HVAC units.
  5. Use Photoelectric type detector with duct housing and relays plus appropriate sampling tubes cut to length (width of duct).
- F. Addressable Dry Contact Monitor Module:
1. Addressable monitor modules shall be provided to connect supervised initiating device circuits (IDC) zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLC loops.
  2. The monitor module shall mount in a 4-inch square, 2-1/8 inch deep electrical box.

3. The IDC zone may be wire for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

G. Addressable Control Module:

1. Addressable control module shall be provided to supervise and control the operation of one conventional NACs of compatible, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay.
2. The control module shall mount in a standard 4-inch square, 2-1/8 inch deep electrical box, or to a surface mounted back box.
3. The control module NAC may be wired for Style Z or Style Y (Class A/B) with a current rating of 2 Amps for Style Z and 3 Amps for Style Y.
4. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply (FCPS).
5. The control module shall be suitable for pilot duty applications.

H. Addressable Relay Module:

1. Addressable Relay Modules shall be available for HVAC control and other building functions. The module shall provide two form C relays rated at up to 3 Amps resistive and up to 2.0 amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100 percent of all auxiliary devices energize at the same time on the same pair of wires.
2. For multiple relay controls a module shall be available that provides up to 6 programmable Form-C relays.

## 2.7 BATTERIES

- A. Sealed lead calcium type capable of operation of the system under supervisory conditions for a minimum of 60 hours after power failure and capable of operating the alarm devices for 15 minutes during the 60 hour period. If batteries do not fit in control panels, then remotely mount in battery cabinet in nearest storage/mech room.

## 2.8 AUXILIARY DEVICES

- A. Provide and install interface relays with number of poles as required (in no event less than three poles). Relays shall be Allen-Bradley, or approved equal, Bulletin 700, Type "BR" series, 120 volt coil in NEMA I enclosures. Paint enclosure red and mark "Fire Alarm Relay."

## 2.9 FIRE ALARM WIRE AND CABLE

- A. Fire Alarm Power Branch Circuits: Specified in Section 260123 - "Wire and Cable."
  1. Fire Alarm Control Panel: Provide 120 volt 20 amp dedicated circuit from nearest emergency electrical panel.
  2. Remote FCPS power supplies and other devices requiring line voltage are not shown on the plans. Provide 120 volt 20 amp dedicated circuits from nearest emergency electrical panel.
- B. Alarm System Wiring Within Building: Minimum size #16 AWG for initiating circuits and #14 AWG for alarm signal circuits, all copper-THWN, except as noted. Non power-limited wiring (NPLFA) and exposed wiring shall be in rigid conduit or electrical metallic tubing or flexible metal conduit in accordance with Specifications for locations used, see Section 260123 – "Wire and Cable".

1. Installation shall meet requirements of NEC Article 760 "Fire Alarm Systems."

- C. SLC Multiplex Communication Loop: Twisted shielded pair sized per manufacturer and installed in conduit.
- D. Telephone Circuits: Twisted shielded pair sized per manufacturer and installed in conduit.
- E. All wiring shall be per manufacturers recommendations for load and length required.

## 2.10 ENCLOSURES

- A. Control panels shall be housed in UL listed cabinets suitable for surface or semi-flush mounting. Cabinets shall be corrosion protected, given a rust-resistant prime coat, and the manufacturer=s standard finish. Mount flush in finished areas.

## 2.11 FIREMAN’S KEY BOXES

- A. Fireman’s Key Boxes: Knox – Surface mounted with tamper switch and high security lock to match Fire Department standards.
  - 1. Hinged-door, tamper switch and where indicated, include inside switch accessory to allow operation of electric operator.
  - 2. Holds up to 10 keys and access cards in interior compartment.
  - 3. Box and lock: UL Listed.
  - 4. Color: Dark Bronze.
  - 5. Surface Mounted
  - 6. Quantity and locations as required by the local fire department and as indicated.

## PART 3 - EXECUTION

### 3.1 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.
- B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

### 3.2 PROJECT CONDITIONS

- A. Installed products or materials shall be free from any damage including, but not limited to, physical abuse, dirt and debris, moisture, and mold damage.
- B. Environmental Limitations: Do not deliver or install products or materials until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

### 3.3 INSTALLATION

- A. Install system in accordance with manufacturer's instructions.
- B. Wiring shall be concealed in walls and above ceilings. Wiring in exposed construction shall be

enclosed in conduit and run along structural members and painted to match.

- C. Minimum size conduit: 3/4 inch. Refer to above paragraph: FIRE ALARM WIRE AND CABLE.
- D. Install manual station with operating handle 48 inches above floor. Install audible and visual signal devices 80 inches above floor, or 6 inches below ceiling, whichever is lower, except as noted.
- E. Smoke detectors shall not be installed prior to system programming and testing period. If construction is on going during this period, then protect the smoke detectors from contamination and physical damage.
- F. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, duct smoke detectors.
- G. Automatic Detector Installation: Per NFPA 72.
- H. Provide nameplates identifying all equipment, junction boxes and controls. Paint all junction boxes red.
- I. Wiring Color Code: See Division 26 Section 260195 "Electrical Identification."
- J. All devices and panels shall be flush mounted in finished areas and may be surface mounted in unfinished areas such as storage rooms. Where devices are surface mounted, the back box shall be a cast red box designed to mate with the device for a smooth appearance.
- K. Wire installation shall be inspected by the fire department. Coordinate and ask for inspections from the fire department.
- L. Fireman's Key Boxes: Key boxes shall be located surface mounted on the exterior of the building as shown on drawings and coordinated with local fire department and owner.
- M. Factory Trained, licensed authorized technical representative of the manufacturer of the equipment shall adjust taps after installation to meet requirements.

#### 3.4 SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for 2 years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
- C. Provide 30 days' notice to Owner to allow scheduling and access to system.

#### 3.5 MANUFACTURER'S FIELD SERVICES

- A. Provide the services of a Factory Trained, licensed authorized technical representative of the manufacturer of the equipment to supervise the installation and final connections, plus adjusting, programming and all testing of the system required to assure a complete and fully operative facility in accordance with the specifications; and to instruct designated personnel in the operation, adjustment, testing and maintenance of the system. Provide letter certifying results of test.

- B. Include testing at substantial completion, at 6 months after occupancy and again two weeks prior to end of first year warranty. (Total of 3 complete documented tests). Invite the Owner, Architect and Local Fire Department to witness each test.
- C. Include testing of the fire alarm system Horn/Strobe audio/visual devices to assure that the signals are operating according to the guidelines set by the NFPA 72 and the Americans with Disabilities Act (ADA).
  - 1. The limitations are as follows: NFPA – “Audible signals intended for operation in the public mode should have a sound level of not less than 75 dBA at 10 feet or more than 130 dBA at the minimum hearing distance from the audible appliance.” ADA – “Audible emergency alarms shall produce a sound that exceeds the prevailing equivalent sound level in the room or space by at least 15 dBA or exceeds any maximum sound level with a duration of 60 seconds by 5 dBA, whichever is louder. Sound levels for alarm signals shall not exceed 120 dBA.”
  - 2. Test the audio/visual units and make adjustments where required, including setting volume of horns and replacing strobes with proper intensity level. If horns are not adjustable then replace for proper dB level. Submit findings in writing, with areas marked that do not meet criteria after adjustments have been made.

### 3.6 SYSTEM FIELD TEST

- A. Test in accordance with NFPA 72 and local fire department requirements. See PART 1 of this specification, article “SUBMITTALS” for additional requirements.
- B. Test shall include but not be limited to:
  - 1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
  - 2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
  - 3. Verify activation of all flow switches.
  - 4. Open initiating device circuits and verify that the trouble signal actuates.
  - 5. Open signaling line circuits and verify that the trouble signal actuates.
  - 6. Open and short notification appliance circuits and verify that trouble signal actuates.
  - 7. Open and short (wire only) network communications and verify that trouble signals are received at network annunciators or reporting terminals.
  - 8. Ground initiating device circuits and verify response of trouble signals.
  - 9. Ground signaling line circuits and verify response of trouble signals.
  - 10. Ground notification appliance circuits and verify response of trouble signals.
  - 11. Check alert tone and prerecorded voice message to all alarm notification devices.
  - 12. Check installation, supervision, and operation of all intelligent smoke detectors using walk test.
  - 13. Each of the alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control panel points.
  - 14. When the Vendor determines that the system must be equipped with optional features to satisfy this specification, the manufacturer’s manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.
- C. Arrange for final system test and approval by the Local Fire Department (Authority Having Jurisdiction).



3.7 FINAL INSPECTION

- A. A factory trained representative shall demonstrate that the system functions as specified.
- B. Demonstrate in the presence of the Owner, Local Fire Chief, and the contractor. Invite the Architect's representative.

3.8 INSTRUCTIONS

- A. In addition to the site training on programming features previously specified, provide minimum of two four hour periods to instruct the owner in the proper operation and maintenance requirements of the system. Provide one four hour period at substantial completion (after all testing and the system is fully operational and accepted by the fire department) and the other four hour period six months after substantial completion. Video tape both training sessions for owner's record.
- B. Provide a typewritten, bound, laminated "Sequence of Operation" to the Owner.

3.9 TRAINING

- A. Provide minimum of two on site training sessions on programming features. Each training session shall be a minimum of one hour each.

END OF SECTION 260721

**This Page Intentionally Left Blank**

## SECTION 312000 - EARTH MOVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Preparing subgrades and finish grades. Cutting, filling, and providing additional materials required.
  - 2. Excavating, filling, and backfilling to grade.
  - 3. Excavating and backfilling for buried structures, tanks, pipes, wires, and conduits.
  - 4. Subbase and base course for roadways and walks.

#### 1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
  - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and finish pavement.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Crushed Stone (Drainage Fill): Crushed stone backfill to facilitate stormwater flow; that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
  - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
  - 2. Open (bulk) Excavation: Excavation more than 6 feet (3 m) in width.
  - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 2 cu. yd. (1.5 cu. m) for bulk excavation, footing, trench, and pit

excavation, that cannot be removed by rock excavating equipment, without systematic drilling, ram hammering, or blasting, when permitted. Fragmented "weathered" rock which can be removed by excavation equipment with "ripper" teeth will be considered earth.

- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Aggregate layer placed between the subgrade and base course beneath pavement.
- K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

#### 1.4 SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each soil material proposed for fill and backfill as follows:
  - 1. Classification according to ASTM D 2487; with particle gradation test results.
  - 2. Laboratory compaction curve according to ASTM D 1557.
- C. Pre-excavation Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

#### 1.5 QUALITY ASSURANCE

- A. Blasting: Not Anticipated. If ledge is encountered and blasting is approved by Owner, comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
  - 1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
  - 2. Seismographic monitoring during blasting operations.
- B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
  - 1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
  - 2. Seismographic monitoring during blasting operations.
- C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

## 1.6 PROJECT CONDITIONS

- A. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
1. Pre-mark the boundaries of your planned excavation with white paint, flags or stakes, so utility crews know where to mark their lines.
  2. Call Dig Safe, at either 811 or 1-888-DIGSAFE, at least 72 business hours - but no more than 30 calendar days - before starting work. Don't assume someone else will make the call.
  3. If blasting, notify Dig Safe at least 24 business hours in advance.
  4. Wait 72 business hours for lines to be located and marked with color-coded paint, flags or stakes. Note the color of the marks and the type of utilities they indicate. Transfer these marks to the As-Built drawings.
  5. Contact the landowner and other non-member utilities (water, sewer, gas, etc.), for them to mark the locations of their underground facilities. Transfer these marks to the As-Built drawings.
  6. Re-notify Dig Safe and the non-member utilities if the digging, drilling or blasting does not occur within 30 calendar days, or if the marks are lost due to weather conditions, site work activity or any other reason.
  7. Hand dig within 18 inches in any direction of any underground line until the line is exposed. Mechanical methods may be used for initial site penetration, such as removal of pavement or rock.
  8. Dig Safe requirements are in addition to town, city and/or state DOT street opening permit requirements.
  9. For complete Dig Safe requirements, visit their website.
  10. If you damage, dislocate or disturb any underground utility line, immediately notify the affected utility. If damage creates safety concerns, call the fire department and take immediate steps to safeguard health and property.
  11. Any time an underground line is damaged or disturbed, or if lines are improperly marked, you must call Dig Safe.
- B. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect or Owner, and then only after arranging to provide temporary utility services according to requirements of the City and utility companies.
- D. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures are in place.

## 1.7 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction. The Contractor shall conduct his operations in conformity with all Federal and State permit requirements concerning water, air,

or noise pollution, or the disposal of contaminated or hazardous materials. Erosion control measures shown on the Plans are minimum only and are not intended to be complete. Satisfy the current requirements of the regulatory agencies.

- B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

## 1.8 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed, or abandoned in place.
  - 1. Arrange with utility companies to shut off indicated utilities.
  - 2. Owner will arrange to shut off indicated utilities within his control, when requested by Contractor.
- B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Architect and Owner not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without the utility company's and Owner's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487 or a combination of these groups, free of rock or gravel larger than 6 inches (150 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with 100 percent passing a 6-inch (150-mm) sieve, 25-70 percent passing a 1/4-inch (6-mm) sieve, 0-30 percent passing a No. 40 (0.425-mm) sieve, and not more than 7 percent passing a No. 200 (0.075-mm) sieve. Maximum size stone passes 6-inch sieve. MDOT spec. 703.06 Type D.

- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with 100 percent passing a 4-inch (100-mm) sieve, 35-75 percent passing a 1/2-inch (13-mm) sieve, 25-60 percent passing a 1/4-inch (6-mm) sieve, 0-25 percent passing a No. 40 (0.425-mm) sieve, and not more than 5 percent passing a No. 200 (0.075-mm) sieve. MDOT spec. 703.06 Type B.
- F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with 100 percent passing a 2-inch (50-mm) sieve, 25-100 percent passing 1/4-inch (6-mm) sieve, 0-30 percent passing the No. 40 (0.425-mm) sieve, and not more than 7 percent passing a No. 200 (0.075-mm) sieve.
- G. Crushed Stone (Drainage Fill): Narrowly graded mixture of washed crushed stone; ASTM C 33; grading Size 56; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.
- H. Granular Borrow: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with maximum stone size of 6" (150-mm); the portion passing a 3-inch (75-mm) sieve shall meet the following: 100 percent passing the 3-inch (75-mm) sieve, 60-100 percent passing the 1/4-inch (6-mm) sieve, 0-50 percent passing the No. 40 sieve, and not more than 7 percent passing a No. 200 (0.075-mm) sieve. MDOT spec. 703.06 Type F.
- I. Sand: ASTM C 33; fine aggregate.

## 2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
  1. Survivability: Class 2; AASHTO M 288.
  2. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
  3. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
  4. Tear Strength: 56 lbf (250 N); ASTM D 4533.
  5. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
  6. Apparent Opening Size: No. 70 (0.212-mm) sieve, maximum; ASTM D 4751.
  7. Permittivity: 0.2 per second, minimum; ASTM D 4491.
  8. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
  1. Survivability: Class 2; AASHTO M 288.
  2. Grab Tensile Strength: 247 lbf (1100 N); ASTM D 4632.
  3. Sewn Seam Strength: 222 lbf (990 N); ASTM D 4632.
  4. Tear Strength: 90 lbf (400 N); ASTM D 4533.
  5. Puncture Strength: 90 lbf (400 N); ASTM D 4833.
  6. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
  7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
  8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

## 2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:
  - 1. Portland Cement: ASTM C 150, Type I.
  - 2. Fly Ash: ASTM C 618, Class C or F.
  - 3. Normal-Weight Aggregate: ASTM C 33, 3/8-inch (10-mm) nominal maximum aggregate size.
  - 4. Water: ASTM C 94/C 94M.
  - 5. Air-Entraining Admixture: ASTM C 260.
- B. Produce conventional-weight, controlled low-strength material with 140-psi (965-kPa) compressive strength when tested according to ASTM C 495.

## 2.4 INSULATION BOARD

- A. Extruded polystyrene with a "K" factor of 0.18, with 2.2 lb./cu. ft. density, and 30 psi compressive strength, manufactured by Dow Chemical, or approved equal. ASTM C 578, Type VI.

## 2.5 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:
  - 1. Red: Electric.
  - 2. Yellow: Gas, oil, steam, and dangerous materials.
  - 3. Orange: Telephone and other communications.
  - 4. Blue: Water systems.
  - 5. Green: Sewer systems.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
  - 1. Red: Electric.
  - 2. Yellow: Gas, oil, steam, and dangerous materials.
  - 3. Orange: Telephone and other communications.
  - 4. Blue: Water systems.
  - 5. Green: Sewer systems.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.



- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

### 3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
  - 2. Water from construction dewatering operations shall be cleaned of sediment before reaching wetlands, water bodies, streams, or site boundaries. Conform to the requirements of the Department of Environmental Protection.

### 3.3 EXPLOSIVES

- A. Explosives: Not Anticipated. If explosives are needed and are approved by Owner, obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.
  - 1. Perform blasting without damaging adjacent structures, property, or site improvements.
  - 2. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.
- B. Rock excavation is not anticipated, however if encountered, ledge rock excavation cost shall be approved prior to excavation. Prior to blasting and rock excavation, provide survey grades of the top of the ledge surface, and calculations of the expected rock quantities to be excavated. Submit this data and obtain Architect's approval prior to proceeding with rock excavation. The Architect will determine the extent of rock excavation and classification.

### 3.4 EXCAVATION, GENERAL

- A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock.
  - 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
    - a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
  - 2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction.
- B. If hazardous waste or special waste as defined by the U. S. Environmental Protection Agency or State Department of Environmental Protection is encountered during excavation, the Contractor shall avoid disturbance of that material, and shall notify the Owner immediately. The State Bureau of Oil and Hazardous Waste Control must be notified and consulted prior to disturbance of the waste or contaminated soil. Removal and disposal of contaminated materials is not

included in the Contract Bid, since it must be handled as directed by the regulatory agencies on a case-by-case basis.

### 3.5 EXCAVATION FOR STRUCTURES

- A. Excavate for underground tanks, basins, and mechanical or electrical utility structures to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections. Do not disturb bottom of excavations intended as bearing surfaces.

### 3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### 3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
  - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line, unless pipe inverts are shown otherwise.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
  - 1. Clearance: As indicated.
- C. Trench Bottoms: For ductile iron pipe, excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
  - 1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
  - 2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
  - 3. Excavate trenches 8 inches (200 mm) deeper than bottom of pipe elevation in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: For pipe materials other than ductile iron, excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
  - 1. Excavate trenches 8 inches (200 mm) deeper than bottom of pipe elevation in rock or other unyielding bearing material to allow for bedding course.

### 3.8 SUBGRADE INSPECTION

- A. Notify Architect and Geotechnical Engineer when excavations have reached required subgrade.
- B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Geotechnical Engineer, without additional compensation.

### 3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.
  - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

### 3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of trees.

### 3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
  - 2. Surveying locations of underground utilities for Record Documents.
  - 3. Testing and inspecting underground utilities.
  - 4. Removing concrete formwork.
  - 5. Removing trash and debris.
  - 6. Removing temporary shoring and bracing, and sheeting.
  - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

### 3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Place and compact initial backfill of bedding course material, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.
  - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- D. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- E. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

### 3.13 INSULATION BOARD

- A. Place a leveling course of sand, 2 inches (50 mm) thick, over subgrade. Finish leveling course to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.
  - 1. Place leveling course on subgrades free of mud, frost, snow, or ice.
- B. Install insulation board in layers with abutting edges and ends along pipelines or other objects to be insulated.

### 3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
  - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### 3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 12 inches (300 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches (150 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
  - 1. Under structures, building slabs, steps, walkways, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
  - 2. Under lawns, turf, or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 90 percent.
  - 3. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.
  - 4. Compact crush stone to 100 percent of its dry rodded weight.

### 3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  - 1. Provide a smooth transition between adjacent existing grades and new grades.
  - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  - 1. Lawn, turf, or unpaved Areas: Plus or minus 1 inch (25 mm).
  - 2. Pavements and walks: Plus or minus 1/2 inch (13 mm).

### 3.17 SUBBASE AND BASE COURSES

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade or granular fill layer, place subbase course and base course under pavements and walks as follows:
  - 1. Where fill is required, place satisfactory soil or granular borrow fill on prepared subgrade.
  - 2. Place base course material over subbase course under hot-mix asphalt pavement, concrete pavement, and unit pavers.
  - 3. Shape subbase course and base course to required crown elevations and cross-slope grades.
  - 4. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
  - 5. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
  - 6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

### 3.18 FIELD QUALITY CONTROL

- A. Testing Agency: If deemed necessary, the Owner will engage a qualified Geotechnical Engineering testing agency to perform field quality control testing and inspections.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
  - 1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
  - 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 100 feet (30 m) or less of trench length, but no fewer than two tests.
- D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

### 3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property. Comply with the requirements of Division 01 "Construction Waste Management".

END OF SECTION 312000

**This Page Intentionally Left Blank**

## SECTION 321216 - ASPHALT PAVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Saw-cutting or cold milling of existing asphalt pavement.
  - 2. Hot-mix asphalt patching.
  - 3. Hot-mix asphalt paving.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include technical data and tested physical and performance properties.
  - 2. Job-Mix Designs: For each job mix proposed for the Work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and installer.
- B. Material Certificates: For each paving material.
- C. Material Test Reports: For each paving material, by a qualified testing agency.
- D. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the latest revision of "Standard Specifications for Highways and Bridges" of the State of Maine Department of Transportation (MDOT), for asphalt paving work.
  - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

## 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
  - 1. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
  - 2. Slurry Coat: Comply with weather limitations in ASTM D 3910.
  - 3. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
  - 4. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

## PART 2 - PRODUCTS

### 2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
  - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

### 2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320, conform to MDOT specification Sec. 702.
- B. Tack Coat: AASHTO M 140 emulsified asphalt, or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application. Emulsified asphalt conforming to MDOT 702.04.
- C. Water: Potable.

### 2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled asphalt shingles from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
- B. Joint Sealant: ASTM D 6690 hot-applied, single-component, polymer-modified bituminous sealant.



- C. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.
  - 1. Color: White.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Sherwin-Williams Waterborne Traffic Paint, or equal.

## 2.4 MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
  - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
  - 2. Roads and Walks:
    - a. Surface Course: Conforming to HMA 12.5mm. MDOT, Section 703.09.
    - b. Binder Course: Conforming to HMA 19mm. MDOT, Section 703.09.

Sieve Size	Percent by Weight Passing – Combined Aggregate		
	Type 19 mm (B)	Type 12.5 mm (C)	Type 9.5 mm (D)
25 mm (1 in)	100		
19 mm (3/4 in)	90-100	100	
12.5 mm (1/2 in)	-90	90-100	100
9.5 mm (3/8 in)	-	-90	90-100
4.75 mm (No. 4)	-	-	-90
2.36 mm (No. 8)	23-49	28-58	32-67
75 µm (No. 200)	2-8	2-10	2-10

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph (5 km/h).
  - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
  - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected, and underground conduits and utilities have been completed.

### 3.2 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

### 3.3 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.
  - 1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm).
  - 1. Clean cracks and joints in existing hot-mix asphalt pavement.
  - 2. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.

### 3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
  - 3. Treat exposed existing horizontal and vertical pavement surfaces with sprayed bituminous tack coat prior to placing new adjacent or overlaying bituminous pavement. Pavement which has been in place longer than 30 days shall be considered existing.

### 3.5 PLACING HOT-MIX ASPHALT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
  2. Spread mix at a minimum temperature of 250 deg F (121 deg C).
  3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
  4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches (25 to 38 mm) from strip to strip to ensure proper compaction of mix along longitudinal joints.
  2. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
  2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
  3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
  4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
  5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
  6. Compact asphalt at joints to a density within 2 percent of specified course density.

### 3.7 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 95 percent of reference laboratory density according to MDOT, but not less than 92.5 percent or greater than 97.5 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.8 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for at least 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm). Apply sufficient thickness to completely cover the underlying pavement with solid white (or yellow) lines, such that no pavement color shows through.

### 3.9 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  1. Base Course: Plus or minus 1/2 inch (13 mm).
  2. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
  1. Base Course: 3/8 inch (9 mm).
  2. Surface Course: 1/4 inch (6 mm).
  3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. This will not relieve the Contractor of his quality control responsibilities
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Alignment: Pavement edges shall be in conformance to alignment with straight edges or smooth curved edges, without irregularities or ragged edges.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to MDOT specifications.
  - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
  - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
    - a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than three cores taken.
    - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- F. Replace and compact hot-mix asphalt where core tests were taken.
- G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

### 3.11 WASTE HANDLING

- A. General: Handle asphalt-paving waste according to approved waste management plan required in Division 01 Section "Construction Waste Management and Disposal."

END OF SECTION 321216

**This Page Intentionally Left Blank**

## SECTION 331000 - WATER DISTRIBUTION PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes water-distribution piping, connections, and related components outside the building for complete operational domestic water service and fire-service lines.

- 1.3 Utility companies usually provide water meters and bill charges directly or through Contractor to Owner. Contact utility company serving the site for information. Delete paragraph below if water meters are provided by utility company or Contractor. If utility company furnishes water meters, identify the company here and specify what it will do; then edit text to suit Project.

#### 1.4 DEFINITIONS

- A. EPDM: Ethylene propylene diene terpolymer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. PA: Polyamide (nylon) plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- H. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
  - 1. Wiring Diagrams: Power, signal, and control wiring for alarms.

- C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

## 1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
  - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
  - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. 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.
- D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- G. NSF Compliance:
  - 1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
  - 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
  - 1. Ensure that valves are dry and internally protected against rust and corrosion.
  - 2. Protect valves against damage to threaded ends and flange faces.
  - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
  - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.



2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

## 1.8 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
  1. Notify Architect, Owner, and utility company no fewer than two days in advance of proposed interruption of service.
  2. Do not proceed with interruption of water-distribution service without utility company's written permission.

## 1.9 COORDINATION

- A. Coordinate installation within street right-of-way, including connection to water main with utility company.

## PART 2 - PRODUCTS

2.1 First five articles below include examples of materials used for water-distribution piping. See "Writing Guide" Article in the Evaluations.

### 2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Push-on-Joint, Ductile-Iron Pipe: Class 52, AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated. Cement lined and seal coated to meet AWWA C104. Joints meet AWWA C111.
  1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  2. Pipe: Bituminous interior and exterior coatings of 2 mils dry film thickness minimum.

3. Fittings: Class 350 pressure rating in accordance with AWWA C153. Bituminous interior and exterior coatings of 4 mils dry film thickness minimum. Gland with Cor-Ten bolts and nuts.
4. Gaskets: AWWA C111, rubber.
5. Polyethylene tube-type encasement: Wrap pipe and fittings with 8-mil LLDPE or 4-mil HDCLPE to prevent contact of pipe and soil backfill, but not necessarily air-or water-tight.

## 2.3 HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

- A. High-density polyethylene PE 3408 tubing conforming to AWWA C906, SDR-11, rated for water service at 160 psi sustained pressure. For diameters 2 inches or smaller, use compression type fittings with pipe stiffeners. For diameters larger than 2 inches, use heat-fusion welded joints.
  1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and Cor-Ten steel bolts.

## 2.4 PVC WATER SERVICE PIPE AND FITTINGS

- A. PVC piping for services smaller than 4 inches diameter shall conform to ASTM 2241, SDR-21, rated for water service at 200 psi sustained pressure. Push-on rubber gasket joints meeting ASTM F 477.
  1. Fittings: Schedule 40 or 80 PVC meeting ASTM D 3139.

## 2.5 JOINING MATERIALS

- A. Type and material recommended by piping system manufacturer, unless otherwise indicated.

## 2.6 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Clow gate valves, meeting Water District standards.
  2. Nonrising-Stem, Resilient-Seated Gate Valves:
    - a. Description: Gray- or ductile-iron body and bonnet, meeting AWWA C153; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      - 1) Standard: AWWA C509.
      - 2) Minimum Working Pressure Rating: 200 psig (1380 kPa).
      - 3) End Connections: Mechanical joint, with 'Cor-ten' or equal bolts and nuts.
      - 4) Interior Coating: Complying with AWWA C550.
      - 5) Direction of Opening: Right, coordinated with the Water District standard.

## 2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies:
  - 1. Description: Sleeve and valve compatible with drilling machine.
    - a. Standard: MSS SP-60.
    - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve. AWWA C207, Class D, 200 psi. working pressure rating.
    - c. Mechanical joint, with 'Cor-ten' or equal bolts and nuts. Bituminous interior and exterior coatings of 4 mils dry film thickness minimum.
    - d. Valve: AWWA C509, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.
  - 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

### 3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground Water-Service and Fire-Service-Main Piping within City Right-Of-Way, NPS 4 to NPS 8 (DN 100 to DN 200), shall be Ductile-iron, push-on-joint pipe; ductile-iron, mechanical-joint fittings.
- F. Wrap pipe and fittings with polyethylene tube-type encasement to prevent contact of pipe and soil backfill, but not necessarily air-or water-tight.

### 3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for underground installation. Use threaded- or flanged-end valves for installation in vaults.

### 3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Division 22 Section "Common Work Results for Plumbing" for piping-system common requirements.

### 3.5 PIPING INSTALLATION

- A. Water-Main Connection: Coordinate with the utility company for tap of size and in location indicated in water main.
- B. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:
  - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
  - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
  - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
  - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- C. Make connections NPS 2 (DN 50) and smaller with drilling machine according to the following:
  - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
  - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
  - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
  - 4. Install corporation valves into service-saddle assemblies.
  - 5. Install manifold for multiple taps in water main.
  - 6. Install curb valve in water-service piping with head pointing up and with service box.
- D. Comply with NFPA 24 for fire-service-main piping materials and installation.
  - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
  - 2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- E. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
  - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- F. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- G. Bury piping with depth of cover over top at least 5 ft., for frost protection.
- H. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- I. Sleeves are specified in Division 22 Section "Common Work Results for Plumbing."
- J. Mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- K. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

### 3.6 JOINT CONSTRUCTION

- A. See Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Make pipe joints according to the following:
  1. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure. Refer to Division 22 Section "Common Work Results for Plumbing" for joining piping of dissimilar metals.

### 3.7 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
  1. Concrete thrust blocks.
  2. Locking mechanical joints.
  3. Set-screw mechanical retainer glands.
  4. Bolted flanged joints.
  5. Heat-fused joints.
  6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
  1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
  2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
  3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
  4. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

### 3.8 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

### 3.9 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
  - 1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

### 3.10 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Division 22 Section "Common Work Results for Plumbing" for identifying devices.

### 3.11 CLEANING

- A. Coordinate flushing and chlorination with the Water District. Clean and disinfect water-distribution piping to meet Water District standards, generally as follows:
  - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
  - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

- a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
- b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
- c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
- d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities, and submit to Water District and Architect.

END OF SECTION 331000

**This Page Intentionally Left Blank**



## SECTION 333000 - SANITARY SEWERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes gravity-flow non-pressure sanitary sewerage outside the building, with the following components:
  - 1. Pipe and fittings.
  - 2. Precast concrete manhole components.
  - 3. Precast concrete grease trap.

#### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene-monomer rubber.
- C. FRP: Fiberglass-reinforced plastic.
- D. LLDPE: Linear low-density, polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. RTRF: Glass-fiber-reinforced, thermosetting-resin fitting.
- I. RTRP: Glass-fiber-reinforced, thermosetting-resin pipe.
- J. TPE: Thermoplastic elastomer.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water (30 kPa).

## 1.5 SUBMITTALS

- A. Product Data: For materials including the following:
  - 1. Pipe materials.
  - 2. Fittings and joints.
  - 3. Manholes, frames & covers, pipe sleeves.
  - 4. Precast concrete tanks.
  
- B. Field quality-control test reports.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic pipe and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

## 1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Architect, Owner, and utility company no fewer than two days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of service without Owner's or utility company's written permission.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Use the following materials for sanitary sewer lines:

### 2.2 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe (non-pressure) and Fittings, NPS 15 (DN 375) and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

### 2.3 MANHOLE COMPONENTS

- A. Standard Precast Concrete Manholes:
  - 1. Top Section: Eccentric-cone type of size that matches grade rings.
  - 2. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
  - 3. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.

4. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
6. Protective Coating: Plant-applied, SSPC-Paint 16, coal-tar, or epoxy-polyamide paint applied to exterior surfaces.
7. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SEWER."
  - a. Material: ASTM A 48/A 48M, Class 35 gray iron, unless otherwise indicated.

#### 2.4 PRECAST REINFORCED CONCRETE GREASE TRAP

- A. Constructed of 4000 psi concrete, designed to support an H-20 wheel loading. The 1000-gallon capacity tank shall have two 24 inch diameter cleanout manhole covers with precast concrete manhole sections, frames, and covers raised to finish grade, at the tank ends.
- B. For vent piping, use PVC SDR 35 pipe.

#### 2.5 MISCELLANEOUS MATERIALS

- A. Paint: SSPC-Paint 16.
- B. PE Sheeting: ASTM D 4397, with at least 8-mil (0.2-mm) thickness or other equivalent, impervious material.

### PART 3 - EXECUTION

#### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

#### 3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

- D. Install gravity-flow, non-pressure, drainage piping according to the following:
  - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
  - 2. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
  - 3. Install piping with 4.5 ft. minimum cover.
- E. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

### 3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
  - 1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
  - 2. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

### 3.4 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."
- B. Make connections to existing piping and underground manholes.
  - 1. Use commercially manufactured wye fittings or saddles for piping branch connections. Cut existing pipe; install wye fitting or saddle into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
  - 2. Make connections to underground manholes by cutting opening into existing wall large enough to allow installation of water-tight flexible boot connector; Cor-N-Seal ring, or equal.
  - 3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

### 3.5 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
  - 1. Close open ends of piping with concrete mortar, and if opening is large use at least 8-inch (200-mm) thick, brick masonry bulkheads.
  - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Backfill to grade according to Division 31 Section "Earth Moving."

### 3.6 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
  - 1. Use warning tape or detectable warning tape over ferrous piping.
  - 2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

### 3.7 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.
  - 1. Submit separate report for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Reinspect and repeat procedure until results are satisfactory.

### 3.8 CLEANING

- A. Clean interior of piping and structures of dirt and superfluous material.

END OF SECTION 333000

**This Page Intentionally Left Blank**