SECTION 15053

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Equipment installation requirements common to equipment sections.
8. Supports and anchorages.

1.2 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.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

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.

1.3 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 PRODUCTS

1.4 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 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.

1.5 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

1.6 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

1.7 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDMor NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Plastic. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

1.8 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. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

1.9 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.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

1.10 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

1.11 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 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 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.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and 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. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. 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. 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.

P. 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 7 Section "Through-Penetration Firestop Systems" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

1.12 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 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. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. 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.

G. 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

H. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

I. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

1.13 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.
2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

1.14 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 mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

1.15 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

1.16 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 15083

HVAC INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Flexible elastomeric.
b. Mineral fiber.
c. Phenolic.
d. Polyisocyanurate.
e. Polyolefin.

2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Lagging adhesives.
7. Sealants.
8. Factory-applied jackets.
9. Field-applied fabric-reinforcing mesh.
10. Field-applied cloths.
11. Field-applied jackets.
12. Tapes.
13. Securements.
14. 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. Qualification Data: For qualified Installer.

C. 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.

D. 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.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 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 15 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

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

C. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

D. Products shall not contain asbestos, lead, mercury, or mercury compounds.

E. 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.

F. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

G. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

H. 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.

I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM V 1290, Type I, II with factory-applied vinyl jacket, III with factory-applied FSK jacket, III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, provie insulation without factory-applied jacket, with factory-applied FSK jacket.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. tested and certified to provide a [**1**] [**2**]-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, provide the following.

    a. Johns Manville; Super Firetemp M.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, providing the following.

    b. CertainTeed Corp.; FlameChek.
    c. Johns Manville; Firetemp Wrap.
    d. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
    e. Thermal Ceramics; FireMaster Duct Wrap.
    f. 3M; Fire Barrier Wrap Products.
    g. Unifrax Corporation; FyreWrap.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

2.6 SEALANTS

A. Joint Sealants:

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: 0 to plus 300 deg F.
5. Color: White or gray.

B. Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following] [provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.

5. Color: White.

6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High impact resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled: roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, [**provide the following**] [**provide one of the following**] [**available products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material].
3. Color: White Color-code jackets based on system. Color as selected by Architect.
4. Factory-fabricated fitting covers to match jacket if available; otherwise field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive: complying with ASTM C 1136.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

2.9 SECUREMENTS

A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [**0.106-inch-**] [**0.135-inch-**] diameter shank, length to suit depth of insulation indicated.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [**0.106-inch-**] diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, **galvanized-steel** sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

4. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

5. Staples: Outward-clinching insulation staples, nominal ¾ inch wide, stainless steel or Monel.

2.10 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, 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. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. 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, ducts and fittings, 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, duct system, 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- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. 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]** **[4 inches]** 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 duct and 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 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 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.

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. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

2. Pipe: Install insulation continuously through floor penetrations.

3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

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 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. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Revise first subparagraph below to allow adhesive to be omitted from top surface of horizontal rectangular ducts.

3. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

4. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps

to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

6. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
7. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
8. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for **100** percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation..
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-footintervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the

surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.8 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube 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 polyolefin 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 polyolefin 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 cut sections of polyolefin pipe and sheet insulation to valve body.
2. 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.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch 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.

3.10 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.11 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections.

1. Flat Acrylic Finish: two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and inspections:

1. Inspect ductwork, 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 two location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
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.

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

END OF SECTION

SECTION 15140

DOMESTIC WATER PIPING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.

1.2 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

C. Comply with NSF 14, "Plastic Piping Components and Related Materials" for plastic, potable domestic water piping and components.

D. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9", for potable domestic water piping and components.

PART 2 PRODUCTS

2.1 PIPING MATERIALS

E. Transition Couplings: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

F. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
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.

PART 3 EXECUTION

3.1 PIPING APPLICATION

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

B. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Domestic Water Piping: Use the following piping materials for each size range:

4. NPS 1-1/2 and Smaller: Hard copper tube, Type L; copper pressure fittings; and soldered joints.
5. NPS 2: Hard copper tube, Type L; copper pressure fittings; and soldered joints.

6. NPS 2: Hard copper tube, Type L with grooved ends; copper grooved-end fittings: copper tubing, keyed couplings; and grooved joints.
7. NPS 2-1/2 to NPS 3-1/2: Hard cooper tube, Type L copper pressure fittings; and soldered joints.

3.2 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

8. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 and larger.
9. Drain Duty: Hose-end drain valves.

3.3 PIPING INSTALLATION

A. Refer to Division 2 Section "Water Distribution" for site water distribution and service piping.

B. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

G. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.

H. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.

I. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

J. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service.

K. Install domestic water piping level without pitch and plumb.

L. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.

M. Perform the following steps before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.

N. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

O. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.4 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 ROUGHING-IN FOR WATER METERS

A. Rough-in domestic water piping and install water meters according to utility company's requirements. Water meters will be furnished by utility.

B. Rough-in domestic water piping and install water meters according to utility company's requirements.

3.6 VALVE INSTALLATION

A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

3.7 HANGER AND SUPPORT INSTALLATION

A. For pipe hanger and support devices install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.8 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 exterior water service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to service piping with shutoff valve, and extend and connect to the following:

5. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
6. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
7. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

8. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
9. 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:

   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 for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

10. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
11. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping 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 domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Cap and subject piping to static water pressure of 50 psig 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.
4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.

12. Prepare reports for tests and required corrective action.

END OF SECTION

SECTION 15150

SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes soil and waste, sanitary drainage and vent piping inside the building.

1.2 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 PIPING MATERIALS

C. Flexible Transition Couplings for Underground Nonpressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.

D. Transition Couplings for Underground Pressure Piping: AWWA C219 metal, sleeve-type coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

E. Hub-and-Spigot Cast-Iron Pipe and Fittings: ASTM A 74, [Service] class.

1. Gaskets: ASTM C 564, rubber.

F. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.

1. Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.

a. Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM A 666, Type 304, stainless-steel shield; stainless-steel bands; and sleeve.

1) NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 3-inch- (76-mm-) wide shield with 4 bands.
2) NPS 5 to NPS 10 (DN 125 to DN 250): 4-inch- (102-mm-) wide shield with 6 bands.

b. Heavy-Duty, FMG-Approved Couplings: ASTM A 666, Type 304, stainless-steel housing; stainless-steel bands; and sleeve.

1) NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 3-inch- (76-mm-) wide housing with 2 bands.
2) NPS 5 to NPS 10 (DN 125 to DN 250): 4-inch- (102-mm-) wide housing with 2 bands.

c. Heavy-Duty, Cast-Iron Couplings: ASTM A 48, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and sleeve.

d. Heavy-Duty, Type 301, Stainless-Steel Couplings: ASTM A 666, Type 301, stainless-steel shield; stainless-steel bands; and sleeve.

1) NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 3-inch- (76-mm-) wide shield with 4 bands.
2) NPS 5 to NPS 10 (DN 125 to DN 250): 4-inch- (102-mm-) wide shield with 6 bands.

e. Compact, Stainless-Steel Couplings: CISPI 310 with ASTM A 167, Type 301, or ASTM A 666, Type 301, stainless-steel corrugated shield; stainless-steel bands; and sleeve.

1) NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 2-1/8-inch- (54-mm-) wide shield with 2 bands.
2) NPS 5 and NPS 6 (DN 125 and DN 150): 3-inch- (76-mm-) wide shield with 4 bands.
3) NPS 8 and NPS 10 (DN 200 and DN 250): 4-inch- (102-mm-) wide shield with 4 bands.
4) NPS 12 and NPS 15 (DN 300 and DN 375): 5-1/2-inch- (140-mm-) wide shield with 6 bands.

G. Steel Pipe: ASTM A 53, Type E or S, Grade A or B, Schedule 40, galvanized. Include ends matching joining method.

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Cast-Iron, Threaded, Drainage Fittings: ASME B16.12, galvanized.
4. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
5. Cast-Iron Flanges: ASME B16.1, Class 125.
6. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
7. Steel-Piping, Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe section, and flanged ends.
8. Steel-Piping, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and two slip-pipe sections. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

H. Cellular-Core, Schedule 40, PVC Pipe: ASTM F 891, Schedule 40.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

I. PVC Special Fittings: ASTM F 409, drainage-pattern tube and tubular fittings with ends as required for application.

PART 3 EXECUTION

3.1 PIPING APPLICATIONS

J. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

K. Flanges may be used on aboveground pressure piping, unless otherwise indicated.

L. Aboveground, Soil, Waste, and Vent Piping: Use any of the following piping materials for each size range:

1. NPS 1-1/4 and NPS 1-1/2 (DN 32 and DN 40): Use NPS 1-1/2 (DN 40) hubless, cast-iron soil piping and one of the following:

    a. Couplings: Heavy-duty, Type 301 or 304, stainless steel.
    b. Couplings: Heavy-duty, FM approved or cast iron.
    c. Couplings: Compact, stainless steel.

2. NPS 1-1/4 and NPS 1-1/2 (DN 32 and DN 40): Steel pipe; cast-iron, threaded drainage fittings; and threaded joints.
3. NPS 2 to NPS 4 (DN 50 to DN 100): Service class, cast-iron soil piping; gaskets; and gasketed joints.
4. NPS 2 to NPS 4 (DN 50 to DN 100): Hubless, cast-iron soil piping and one of the following:

    a. Couplings: Heavy-duty, Type 301 or 304, stainless steel.
    b. Couplings: Heavy-duty, FM approved or cast iron.
    c. Couplings: Compact, stainless steel.

5. NPS 2 to NPS 4 (DN 50 to DN 100): Steel pipe; cast-iron, threaded drainage fittings; and threaded joints.
6. NPS 5 and NPS 6 (DN 125 and DN 150): Service class, cast-iron soil piping; gaskets; and gasketed joints.
7. NPS 5 and NPS 6 (DN 125 and DN 150): Hubless, cast-iron soil piping and one of the following:

    a. Couplings: Heavy-duty, Type 301 or 304, stainless steel.
    b. Couplings: Heavy-duty, FM approved or cast iron.
    c. Couplings: Compact, stainless steel.

8. NPS 5 and NPS 6 (DN 125 and DN 150): Steel pipe; cast-iron, threaded drainage fittings; and threaded joints.

M. Underground, Soil, Waste, and Vent Piping: Use any of the following piping materials for each size range:

1. NPS 2 to NPS 4 (DN 50 to DN 100): Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. NPS 2 to NPS 4 (DN 50 to DN 100): Extra-Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
3. NPS 2 to NPS 4 (DN 50 to DN 100): Hubless, cast-iron soil piping and one of the following:

    a. Couplings: Heavy-duty, Type 301 or 304, stainless steel.
    b. Couplings: Heavy-duty, FM approved or cast iron.
    c. Couplings: Compact, stainless steel.

4. NPS 2 to NPS 4 (DN 50 to DN 100): Cellular-core, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.
5. NPS 5 and NPS 6 (DN 125 and DN 150): Service class, cast-iron soil piping; gaskets; and gasketed joints.
6. NPS 5 and NPS 6 (DN 125 and DN 150): Extra-Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
7. NPS 5 and NPS 6 (DN 125 and DN 150): Hubless, cast-iron soil piping and one of the following:

    a. Couplings: Heavy-duty, Type 301 or 304, stainless steel.
    b. Couplings: Heavy-duty, FM approved or cast iron.
    c. Couplings: Compact, stainless steel.
8. NPS 5 and NPS 6 (DN 125 and DN 150): Cellular-core, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.

3.2 PIPING INSTALLATION

A. Refer to Division 2 Section "Sanitary Sewerage" for Project-site sanitary sewer piping.

B. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.

N. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

O. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Encase underground piping with PE film according to ASTM A 674 or AWWA C105.

P. 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 deg rees. 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.

Q. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

R. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

S. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

T. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

U. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

V. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 HANGER AND SUPPORT INSTALLATION

A. For pipe hanger and support devices install the following:

3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Individual, Straight, Horizontal Piping Runs: According to the following:

   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

D. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.

3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

E. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
7. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
8. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
9. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.

G. Install supports for vertical steel piping every 15 feet (4.5 m).

3.5 CONNECTIONS

A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

B. Connect drainage and vent piping to the following:

10. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
11. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
12. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Specialties."

3.6 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.

13. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
14. 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.

1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

2. Prepare reports for tests and required corrective action.

3.7 CLEANING

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

B. and Protect drains during remainder of construction period to avoid clogging with dirt and debris to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.8 PROTECTION

A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION

SECTION 15300

FIRE PROTECTION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire protection system.

1.2 RELATED SECTIONS

A. Division 2 – Site Construction.

B. Division 16 – Electrical

1.3 REFERENCES

A. NFPA 13 – Installation of Sprinkler Systems.

B. NFPA 14 – Standpipe for Hose Systems.

C. NFPA 70 – National Electric Code.

D. UL – Fire Resistance Directory

E. Valves: Bear UL and FM label marking. Provide manufacturer's name and pressure rating marked on valve body.

F. State Fire Marshall.

G. Fire Insurance Rating Bureau.

H. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.4 QUALITY ASSURANCE

A. Applicator: Company specializing in fire sprinkler installation with three years minimum experience.

B. Materials: UL listed; flame spread/fuel contributed/smoke developed rating of 25/50 in accordance with ASTM E84.

1.5 DESIGN CRITERIA

A. The municipal water supply is to be used to supply the facility. Hydraulic calculations shall be based on a maximum of 50 PSI domestic water pressure.

B. In fire sprinklered buildings only, all areas with the exception of electrical rooms are to be provided with a wet pipe sprinkler system. The electrical rooms shall be two-hour fire rated.

C. The general sprinkler system design parameters are as follows:

1. Classrooms, Dining/Multipurpose Rooms, Gymnasium, Locker Rooms: Light Hazard Occupancy, minimum application density of 0.10 GPM/SQ. FT. over 1500 square feet.

2. Kitchen: Ordinary Hazard Occupancy, Group 1, minimum application density of 0.15

GPM/SQ. FT. over 1500 square feet.

3. Stage (Platform): Ordinary Hazard Occupancy, Group 2, minimum application density of 0.20 GPM/SQ. FT. over 1500 square feet.

4. Hose: 100 GPM for light hazard, 250 GPM for ordinary hazard.

5. Coverage: 324 square feet per head maximum for light hazard and ordinary hazard areas.

D. The use of quick response sprinkler heads and extended coverage sprinklers are approved.

1.6 SUBMITTALS

A. Submit product data under provisions of Section 01330, "Submittal Procedures".

B. Include product description, list of materials and thickness for each service.

C. Submit manufacturer's installation instructions under provisions of Section 01330, "Submittal Procedures".

D. Submit a complete set of detailed plans showing hydraulic calculations, equipment, underground fire service mains, risers, piping and heads. Engineered wet sprinkler plans and calculations shall be signed and sealed by an accredited Florida registered professional engineer.

E. Installation shall be performed by state certified personnel in accordance with Florida Statute Chapter 33.

F. Wet sprinkler plans shall be coordinated with the reflected ceiling, mechanical and electrical plans. Mechanical and electrical installations shall have priority over sprinkler piping and head locations. The Contractor shall locate all sprinkler heads so as to avoid interference with such items.

G. Where sprinkler heads are to be installed on ceiling panels, heads are to be carefully planned, symmetrically laid out on ceiling tile, fully coordinated with partitions, columns and beams, lighting fixtures, ceiling grilles, etc. Heads to be spaced and positioned in accordance with NFPA 13 and approved by the Project Consultant.

H. Furnish guard on sprinkler heads located in stair enclosures and under air conditioning ducts or building obstructions below 8 feet above finished floor.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – SPRINKLER HEADS

A. Grinnell.

B. Viking.

C. Victaulic.

D. Central.

E. Reliable.

2.2 ACCEPTABLE MANUFACTURERS – VALVES

A. Crane.

B. Stockham.

C. Victaulic

2.3 EQUIPMENT

A. Automatic water alarm valve, motor and bell or flow switch and 120 Volt alarm bell.

B. Automatic ball drips.

C. Pressure gauge.

D. Valved drains and test connection.

E. Zone shutoff valves, OS&Y pattern gate views.

F. Indicator valve and Fire Department siamese connection.

G. Hose cabinet with 2-1/2 inch Fire Department connection and 1-1/2 inch mildew and rot-resistant fire hose.

2.4 FIRE PROTECTION PIPING

A. Fire Protection Piping: Refer to Section 15105 - Plumbing Piping.

2.5 SPRINKLER HEADS

A. Spinkler heads shall be of the following types:

1. In areas with finished plastered ceilings such as in group toilets or kitchens, provide recessed type sprinkler heads.
2. Where recessed sprinkler heads are indicated in areas with suspended ceiling panels, provide semi-recessed chrome pendant type sprinkler heads with recessed escutcheons. Heads shall carry UL, FM, LPC and SSL approval.
3. In mechanical rooms, provide sprinkler heads with cages to prevent damage to the heads.
4. In other areas without finished suspended ceiling panels, provide upright or pendant sprinkler heads of the appropriate orifice and finish for the hazard requirement.
5. In areas without finished ceilings and in concealed spaces, provide brass finish upright sprinkler heads for exposed piping.
6. All sprinkler heads shall be of the same manufacturer.

B. Provide glass bulb type sprinkler heads with the ordinary temperature range (155 Degree F) except where subject to high temperatures caused by heaters, hot pipes, radiant ceilings or other heat source in which case they shall be of the high temperature type.

2.6 GATE VALVE

A. Up to 2 Inches: UL listed, FM approved 175 PSIG WWP, O.S.&Y., threaded bronze body, rising stem, flanged ends.

B. Over 2 Inches: UL listed, FM approved 175 PSIG WWP, O.S.&Y., ferrous-steel body, bronze trim, flanged ends.

2.7 GLOBE VALVE

A. 175 PSIG W.O.G., bronze body, threaded bonnet, disc, threaded ends.

2.8 SWING CHECK VALVE

A. Up to 2 Inches: 175 PSIG WWP, bronze body, bronze trim, threaded ends.

B. Over 2 Inches: UL listed, FM approved, 175 PSIG WWP, ferrous-steel body, bronze or iron disc and seat, flanged ends.

2.9 SILENT CHECK VALVE

A. Up to 2 Inches: UL listed, FM approved, 175 PSIG WWP, cast iron or steel body, bronze trim, double center guided spring, threaded ends.

B. Over 2 Inches: UL listed, FM approved, 175 PSIG WWP, cast iron or steel body, bronze trim, double center guided spring, flanged ends.

2.10 HANGERS AND SUPPORTS

A. Hangers: UL listed and FM approved for fire protection service, plated or galvanized finish as manufactured by Grinnell, B-line or Michigan Hanger.

2.11 ESCUTHEONS

A. Escutheons: One piece chromium plated steel or chromium plated brass.

2.12 JOINT COMPOUND

A. Joint Compound: White Tile Seal.

2.13 SPRINKLER HEAD CABINET

A. Provide one wall-mounted sprinkler head cabinet containing six of each type of sprinkler head used in addition to the required wrenches for replacing the heads.

2.14 ALARM SYSTEM

A. In each zone, install a water flow indicator of the vane type with automatic reset, instant recycling retard and circuit closer for connection by the fire alarm specialist.

B. In each zone, install a shutoff valve and a tamper switch to indicate whether the valve is open or closed for connection by the fire alarm specialist.

PART 3 EXECUTION

3.1 INSTALLATION

A. Piping installed under the building concrete slab is **PROHIBITED**.

B. All areas with the exception of electrical rooms are to be provided with a wet pipe sprinkler system. Electrical rooms shall be provided with two-hour fire rated walls in lieu of sprinkler heads.

C. Audible electrically operated sprinkler alarms to be provided under Division 16.

D. Extend the fire service line and sprinkler system as indicated. Piping shall not be run through

electrical rooms, communication equipment rooms or communication closets.

E. Install piping in a manner to permit freedom of movement during expansion and contraction operations without causing warping by the use of expansion joints.

F. Offset piping as necessary to avoid interference with other work or to maintain proper head room. Provide proper drain and drip where necessary.

G. O.S.&Y. and control valves on branch lines are to be provided with tamper indicators monitored at the Central Control Station.

H. Do not repair leaks by caulking. Repair defects by replacing pipe and fittings as required.

I. Pitch all horizontal lines for drainage purposes. All drain valves at all pockets.

J. Provide an inspector's test station for each individual automatic sprinkler system.

K. Provide a liquid flow switch at the sprinkler main branch. The signal from the flow switch is to be wired to the fire alarm panel. The wiring and panel to be provided under Division 16. The flow switch is to be a paddle type, tamper proof, adjustable retarding device to prevent false alarms from line surges. Double pole, double throw micro-switches are to operate separate circuits.

L. Ream and remove burrs from steel pipe before threading. Make threaded joints tight with joint compound brush-applied to the male threads only. After installation, paint exposed threads.

M. Make flanged joints with full face rubber gasket or stainless steel.

N. Use reducing fittings for changes in pipe size. Bushings are not permitted.

O. Provide sleeves large enough to accommodate the pipes passing through floors, ceilings and walls. Pack sleeves through fire rated floors or walls in accordance with UL requirements.

P. Fit and firmly secure escutcheons to pipes passing through finished floors, ceilings and walls. Escutcheons to be of sufficient outside diameter to cover the sleeved openings and to be set in a fire retardant mastic.

Q. Install hangers at branch and main line locations as required by NFPA 13. Hangers are to be securely fastened to the building structure and miscellaneous support steel is to be provided to span across structural members.

R. Paint all exposed piping red.

S. All underground piping shall be clamped in accordance with UL requirements at all changes in direction and elsewhere. In addition to clamping and after the hydrostatic test, the clamped joints shall be backed with complete thrust blocks and anchors.

T. Flush all fire mains with clean water until clean and accepted in the presence of the Project Consultant. Maintain a flow of 7 FPS for a period of time consistent with the length of main.

U. Test the system under the provisions of NFPA 13. Conduct tests in the presence of the authority having jurisdiction and the Owner's representative. The Contractor shall have a copy of the prescribed test available at the site.

V. Should any component of the prescribed test fail, replace such component of increased strength as required to withstand the test.

W. Upon completion of the test, provide the "Contractor's Material and Test Certificate" as prescribed in NFPA 13 and furnish copies of the signed certificate to the authority having jurisdiction and to the Owner.

X. Provide typed instructions relative to the sprinkler controls, alarm device operation and emergency procedures. Encase these instructions in a metal frame with a glass or lexan cover giving the number, location and function of each valve and permanently secure by chain to the sprinkler riser at each controlling alarm valve of the hydraulically designed automatic sprinkler system.

END OF SECTION

SECTION 15330

AUTOMATIC SPRINKLER PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Different sprinkler piping systems including necessary accessories to combine into one system.

1.2 RELATED SECTIONS

A. Section 07270 - Fire Stopping and Fir and Smoke Barrier Caulking.

B. Section 09900 - Painting.

C. Section 13851 - Fire Alarm System.

D. Section 15300 - Fire Protection.

E. Section 15320 - Fire Pump and Controls.

F. Section 15501 - Wet Automatic Fire Sprinkler Systems.

1.3 REFERENCES

A. American Society of Testing and Materials (ASTM).

B. American National Standards Institute (ANSI).

C. Factory Mutual (FM).

D. Federal Specification (FS) WW-H-171E.

E. National Electrical Code - 1999 (NEC).

F. NFPA 13 - Installation of Sprinkler Systems.

G. NFPA 20 - Stationary Pumps for Fire Protection

H. Underwriters Laboratories (UL).

1.4 QUALITY ASSURANCE

A. Applicator: Company specializing in fire protection system installation with three years minimum experience.

B. Fire protection equipment and devices shall be UL listed or FM approved for service intended.

1.5 DESIGN CRITERIA

A. Provide a hydraulically designed installation of automatic sprinklers with 100 percent coverage of the building except areas indicated otherwise.

B. Sprinkler head arrangement shall be installed symmetrically over the ceiling tile. Coordinate with partitions, columns, beams, lighting fixtures, ceiling grilles and other architectural elements. Sprinkler heads shall be spaced, located and positioned in accordance with NFPA 13.

C. Use maximum allowable spacing of sprinkler heads for the hazard occupancy type designed.

D. Furnish guards on sprinkler heads located near heaters, boilers, in stair enclosures and under air conditioning ducts or building obstructions installed below 8'-0" AFF.

E. Building system shall be hydraulically designed according to latest issue of NFPA 13. Calculations, drawings, referenced diagrams, performance curves and data used to layout and identify system shall be signed and sealed by an accredited Florida registered professional engineer.

F. The general sprinkler system design parameters are as follows:

PART 2 PRODUCTS

2.1 MANUFACTURERS - VALVES

A. Crane

B. Mueller

C. Victaulic

D. Stockham

2.2 GATE VALVE

A. Up to 2 Inches: UL listed, FM approved, 175 PSIG WWP, O.S.&Y., threaded bronze body, rising stem; Model #459 manufactured by Crane, Model #B133 manufactured by Stockham or Model #66 manufactured by Kennedy.

B. Over 2 Inches: UL listed, FM approved, 175 PSIG WWP, O.S.&Y., ferrous-steel body, bronze trim, flanged ends; Model #467 manufactured by Crane, Model # A2073-6 manufactured by Mueller or Model #68 manufactured by Kennedy.

2.3 CHECK VALVE

A. Up to 2 Inches: UL listed, FM approved, 175 PSIG WWP, bronze body, bronze trim, threaded ends; Model #36 manufactured by Crane, Model #B345 manufactured by Stockham or Model #144 manufactured by Kennedy.

B. Over 2 Inches: UL listed, FM approved, 175 PSIG WWP; Model #375 as manufactured by Crane, Model #A2170-6 manufactured by Mueller or Model #126 manufactured by Kennedy.

2.4 SILENT CHECK VALVE

A. Up to 2 Inches: UL listed, FM approved, 175 PSIG WWP, steel body, bronze trim, double guided spring, threaded ends; Model #203-AP manufactured by Mueller or Williams Gage Co.

B. Over 2 Inches: UL listed, FM approved, 175 PSIG WWP, steel body, bronze trim, double guided spring, flanged ends; Model #105-AP manufactured by Mueller or Williams Gage Co.

2.5 GLOBE VALVE

A. UL listed, FM approved, 175 PSIG WWP, steel body, threaded bonnet, disc, threaded ends; Model #70 manufactured by Crane, Model #B-37 manufactured by Stockham or Model #134 manufactured by Kennedy.

2.6 FLOW SWITCH

A. Flow switch shall be a tamperproof paddle type, adjustable retarding device to prevent false alarms from line surges.

B. Provide liquid flow switch at main branches. Signal from switches shall be wired to fire alarm panel.

C. Double pole, double throw micro switches to operate separate circuits, 120 VAC.

D. Wiring and panel shall be provided under division 16.

E. Flow Switch shall be Type J54 manufactured by United Electric or approved equal.

2.7 JOINT COMPOUND

A. Joint Compound manufactured by White-Tite Seal or approved equal.

2.8 PROTECTION PIPING

A. Fire Protection Piping: Refer to Section 15105 – Plumbing Piping.

2.9 SPRINKLER HEADS

A. Sprinkler Heads: Refer to Section 15300 – Fire Protection System.

2.10 HANGERS AND SUPPORTS

A. Provide UL adjustable hangers as required for proper support of pipelines according to requirements of NFPA 13, Fed. Spec. WW-H-171E. Hangers shall allow for expansion and contraction of pipelines and be wrought iron clevis type. Wire type hangers are not allowed.

B. Piping Supported from Concrete Slabs: Use hangers attached to rods suspended from concrete inserts. Powder actuated fasteners and devices are not approved. "Redhead" self-drilling concrete expansion anchors are acceptable.

C. Single Pipe Runs: Support with adjustable swivel ring hangers. Wire type hangers are not acceptable.

D. Piping Supported from Walls or Columns: Use welded steel brackets and adjustable swivel ring hanger.

E. Standpipes Supported from Walls with Wrought Strap: Model Fi.262 as manufactured by Grinnell.

PART 3 EXECUTION

3.1 INSTALLATION

A. Arrangement and locations of the fire protection system shall be as indicated on Contractor's shop drawing submittals. Any proposed departures due to actual field conditions or other causes shall be reported to the project consultant.

B. The fire protection system shall be suitable for pressures and temperatures encountered. Installation shall be as required by NFPA and as specified.

C. Investigate structure and other trades involved including finish conditions affecting work and arrange such work accordingly.

D. Furnish such fittings, valves and accessories as needed to meet such conditions at no additional cost to the Owner.

E. Excessive cutting of construction is not allowed. Damage to buildings, piping, wiring or equipment because of cutting for installation shall be repaired by mechanics skilled in the trade involved at no additional cost to the Owner.

F. Pipe openings shall be closed with caps plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury. Upon completion of work, materials and equipment shall be thoroughly cleaned, adjusted and operated.

G. Provide test and drain lines as required by NFPA 13. Pressure gauges, signs, and other standard appurtenances shall be furnished as required for a complete installation in accordance with NFPA 13.

H. Install sprinkler piping so it can be thoroughly drained and where practical, arrange to drain at the main drain valves. The main drain valves shall be capable of a full discharge test without allowing water to flow onto the floor. Drips and drains shall conform to NFPA 13.

I. Ream pipe and remove burrs from pipe after cutting and before threading. Make screw joints of lines tight with joint compound brush applied to male threads only. After installation, paint exposed threads.

J. Fit and firmly secure pipes passing through finished floors, ceilings and walls with escutcheons of sufficient outside diameter to cover sleeved openings. Set in fire retardant mastic.

K. Run piping enclosed in wall chases, partitions and ceiling where provided.

L. Use reducing fittings for changes in pipe size. Bushings are not allowed.

M. Use extra heavy pipe for nipples where unthreaded portion is less than 1-1/2 inch. Close nipples are not allowed. Use saddle nipples.

N. ASTM A135 sprinkler pipe shall be tested, either with a nondestructive electric test for continuous and uninterrupted inspection of both the welded seam and complete circumference of the pipe or by the hydrostatic method. Pipe shall be tested to a critical weld, both cone and flatten test in addition to being tested at the mill according to the applicable specification.

O. Make joints in screwed piping by acceptable compound on male threads only. Do not use lamp wick joints. Threads shall be perfect, clean cut and of proper length. Pipe shall be properly reamed and de-burred after cutting and threading.

P. Make flanged joints with full-face rubber gaskets or stainless steel.

Q. Properly support piping with approved hangers and supports. Chain, straps, perforated bar or wire hangers are not allowed.

END OF SECTION

SECTION 15400

MECHANICAL CHILLER

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes Air-Cooled Scroll type water chillers.

1.2 SUBMITTALS

A. Product Data: Include refrigerant; rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
3. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Coordination Drawings: Floor plans drawn to scale and coordinating the following:

1. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements. Determine spaces reserved for electrical equipment.
4. Access requirements around other work, including working clearances to mechanical controls and electrical equipment.

D. Product Certificates: Certification of performance according to ARI 550 and that chiller have been started and function properly.

E. Maintenance Data: For each chiller to include in maintenance manuals specified in Division 1.

1.3 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.

B. ASHRAE Compliance: Comply with ASHRAE 15 for chiller design, construction, leak testing, and installation.

C. ASME Compliance: Comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," for constructing and testing evaporator and condenser pressure vessels. Stamp with ASME label.

D. UL Compliance: Comply with UL 465.

E. Comply with NFPA 70.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver water chillers with protective crating and covering.

B. Store chillers to prevent damage and protect from weather, dirt, fumes, water, and construction debris.

C. Handle chillers according to manufacturer's written rigging and installation instructions for unloading, transporting, and setting in final location.

1.5 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer's Special Warranty on Refrigerant Compressor: Written warranty, signed by manufacturer agreeing to repair or replace compressor, including replacement of refrigerant.

C. Patent Infringement: Written warranty, signed by manufacturer agreeing to indemnify owner, engineer, general contractor and installing mechanical contractor from any patent infringements arising from the purchase and use of the chiller.

D. Warranty Period: One year parts only warranty shall be furnished and a Four-year extension of the compressor warranty – no labor, shall be included. A key parts supply shall be available locally and be backed up by the factory parts supply.

PART 2 PRODUCTS

2.1 OPERATING CONDITIONS

E. Provide air-cooled liquid chiller with the capacity as scheduled on drawings at job site elevation.

F. Chiller shall be designed to operate using R-407C Refrigerant.

G. Chiller shall be designed for parallel evaporator water flow.

H. The liquid to be chilled will be water containing corrosion inhibitors.

I. Chiller shall be designed to operate using 208 volt, 3 phase, 60 Hz electrical power supply.

2.2 AIR COOLED MODULAR CHILLER

A. Approved manufacturer is the AIRSTACK division of Multistack

B. System Description:

1. Chiller module shall incorporate single Scroll type compressors per refrigerant circuit. Each circuit shall be constructed to be independent of other circuits from a refrigeration and electrical standpoint. The multi-circuit chiller must be able to produce chilled water even in the event of a failure of one or more refrigerant circuits. Circuits shall not contain more than mass in pounds of R-407C refrigerant as listed in the table below.

	10 ton	15 ton	20 ton	30 ton
Low Ambient to 0	30	30	40	
Low Ambient to -20	60	60	70	

C. General

1. Manufacturer shall have modular chiller field experience of at least five full cooling seasons and at least four successful installations of systems of similar size and design.

2. Assembly of the chiller and start-up shall be supervised by the locally authorized and factory trained service representative.

3. The assembled chiller shall be completely capable of being serviced and repaired in place without the need for removal of a module.

4. All modules shall be ETL listed in accordance with UL Standard 465-7, CSA certified per Standard C22.2#119, and shall bear the ASME UM stamp on all heat exchangers.

5. Compressors, heat exchangers, piping and controls shall be mounted on a heavy gauge steel frame. Electrical controls, contactors, and relays for each module shall be mounted within that module.

6. All modules shall ship completely wired and fully charged with refrigerant and oil, ready for installation. All modules shall be factory run tested at full load design conditions prior to shipment. Independent verification of the performance data shall be available to confirm the efficiency of the chiller.

7. Compressors, heat exchangers, piping and controls shall be mounted on a heavy gauge steel frame. Electrical controls, contactors, and relays for each module shall be mounted within that module.

2.3 CHILLED WATER MAINS

A. Each module shall include internal 4" (5") schedule 40 steel pipe return mains and 4" (5") schedule 40 stainless steel pipe supply mains for chilled water. External headers are not acceptable. Chilled water mains shall be fully insulated. Grooved end connections shall be provided for interconnection to adjoining modules with standard victaulic type couplings. The complete chiller (regardless of number of modules) shall be capable of chilled waterside working pressures up to 450psig. Individual refrigeration system evaporators shall be supplied from the water mains via 1½" steel pipe and connected with victaulic type couplings.

Evaporator, suction lines, and all internal chilled water piping shall be fully insulated with closed cell insulation.

2.4 EVAPORATORS

B. Each evaporator shall be counterflow configured; mechanically cleanable, brazed plate heat exchangers of 316 stainless steel construction; designed, tested, and stamped in accordance with ASME code for 450 psig working pressure on the

evaporator. Evaporator, suction lines, and all internal chilled water piping shall be fully insulated with closed cell insulation.

2.5 CONDENSERS

A. Air-cooled chillers shall have finned-tube condensers with copper tubes and aluminum fins. Chillers in seacoast applications shall have heresite-coated coils and/or copper finned coils.

B. Each module shall contain dual condenser fans for each refrigerant circuit. These fans shall be multi-blade vane-axial type made of plastic composite material for quiet operation. Fans shall be direct drive at maximum RPM of 1,150. Condensers shall have a maximum sound level, at thirty feet, of 56 dBA for 15. Fan motors shall all be pressure controlled and suitable for outdoor use. Variable frequency drives shall be utilized for additional sound reduction.

2.6 COMPRESSORS

A. Each module shall contain two hermetically sealed 7.5-ton scroll compressors and shall be resiliently mounted to the module with rubber-in-shear isolation. Suction gas cooled compressor motor shall have a utilization range of ± 10% from nameplate voltage and shall be equipped with internal thermostats for direct protection against overheating and external overcurrent and single phasing protection. Each system also shall include high discharge pressure and low suction pressure cutouts manual reset safety cutouts. Each module shall be individually fused and able to be electrically isolated from the other module to allow service to each module while all other modules are operational.

2.7 ELECTRICAL POWER CONNECTIONS

A. The modular chiller shall use a wiring harness to distribute three-phase electrical power to each module. Field wired power to each module is not acceptable. More than one junction box may be required, depending on the individual chiller configuration and/or electrical supply voltage. These junction boxes shall be mounted at the end(s) of the assembled chiller modules. Modules with scroll compressors require phasing of the incoming field electrical power wiring. In addition, a phase failure and phase reversal monitor furnished by the manufacturer is to be field installed for each power feed and wired to the master controller.

2.8 UNIT CONSTRUCTION

A. All operating components for each module, including compressors, heat exchangers, piping, and controls shall be securely fastened to a unitized heavy gauge steel frame having an electrostatically applied powder, oven baked enamel finish. All electrical controls, contactors, and relays, for each module shall be mounted within that module and be of the low voltage type. The module cabinet shall be of heavy gauge steel panels provided with a powder coat paint finish suitable for outdoor use.

2.9 FILTER CARTRIDGE

A. Each module's chilled water supply main shall have a filter cartridge. This filter cartridge shall be constructed of stainless steel with a perforated support tube and 30

mesh screen all Teflon coated for easy cleaning. The cartridge shall form a continuous internal filter providing 345 square inches of filter area per module through the complete chiller. The cartridge shall be removable through the victaulic end cap at the end of the chiller water mains for routine maintenance. External Y-strainers are not acceptable unless they are double basket strainers with automatic changeovers and one per module.

2.10 SOUND ATTENUATION ULTRA QUIET UNIT

A. The module shall have variable frequency drives controlling the condenser fan motors for gradual transition from off to full airflow

B. The modules compressors shall be factory wrapped with an acoustical jacket

C. Field installed sound treatments are not acceptable.

D. Manufacturer shall provide measured sound data tested by an independent certified sound consultant.

2.11 PUMP MODULE:

A. Provide a Pump Module of size and capacity indicated on the drawings and schedules. The Pump Module shall be interconnected though the common chiller header system and require no additional water connections. Pump Module will become an integral part of the chiller system. Pump Module shall incorporate dual in-line centrifugal pumps in a Primary/Standby pumping arrangement. Pump starters and controls shall be provided to enable manual selection of lead pump. In addition, in the event of a loss-of-flow failure of the chilled water system, the Pump Module controls shall disable the lead pump and automatically start the standby pump. Module shall be completely factory assembled and tested prior to shipment.

2.12 CENTRAL CONTROL SYSTEM

A. Multiple Module Chillers:

8. Each chiller shall be equipped with a dedicated master controller specifically designed for this chiller, which shall perform the numerous functions discussed in this section. All chiller operations and features shall be accessed through a keyboard built into the face of the computer. All status and output information shall be reported through the face mounted LCD display.

9. A RS232 port shall be provided for use of an optional remote MS-DOS based PC monitoring and control software via hardwire or telephone modem.

10. Each module shall have its own microprocessor based sensor panel. This panel shall communicate with the master controller via low voltage plug-in cable provided by the manufacturer. The module sensor panel shall monitor and control each refrigeration system in response to commands by the master controller. The master controller shall have a terminal strip to accept field wired low voltage system interlock such as flow switches, auxiliary contacts, remote start/stop, common alarm output, etc. (provided by mechanical contractor).

11. Safeguarding operation of refrigeration system the master controller shall continually monitor all of the following areas for each individual refrigeration system:

    a. Discharge pressure cutout

b. Suction pressure cutout
c. Solid-state compressor motor protection
d. Suction temperature
e. Evaporator leaving chilled water temperature

12. The Master Controller shall monitor and report the following system parameters:

a. Chilled Water Entering and Leaving Temperature
b. Chilled Water and Condenser Water Flow

13. A potentially unsafe (out of tolerance) condition from any of these controls or sensors shall cause a "fault" shutdown of that compressor with an automatic transfer of load requirements to another available compressor. When a fault occurs, the master controller automatically shall record the readings of all conditions at that time and shall store the data for recall by operating personnel. This information shall be capable of being recalled at any time through the keys and display on the face of the master controller. A running history of the complete fault occurrence conditions shall be automatically maintained (up to the last 20 occurrences) should it ever be required for trouble shooting.

14. Continuous individual monitoring of leaving chilled water temperature from each refrigeration system shall provide protection against freeze-up in the event of unusual, unexpected operating conditions. Internal compressor operating schedules shall be automatically sequenced every 24 hours to assure even distribution of runtime.

15. Capacity modulation and temperature control - The master controller shall continuously monitor entering and leaving chilled water temperatures to determine actual system load and shall select the quantity of compressor required to match the load. Response times and set points shall be adjustable over a wide range.

16. Monitoring and recording of chiller operation - In addition to the monitoring and safeguarding functions for each of the refrigeration systems, the master controller also shall continuously monitor the chiller entering and leaving condenser and chilled water temperatures making this information continually available to operator personnel through the built-in LCD display. The system shall provide for variable time between compressor sequencing and temperature sensing, so as to fine-tune the chiller to different existing building conditions.

17. The master controller shall also accumulate the actual operating load profile of the chiller in terms of operating hours at each 10% load increment.

18. Chiller shall have external inputs and outputs to be compatible with the building management system. Inputs/Outputs include:

a. Remote Start/Stop
b. Cooling Alarm

B. Options:

19. Customer input (Optional) - Chilled water reset or demand limit input shall accept a 4-20 ma or 0-10 vdc signal from building management system to vary the associated system variables.

2.13 SAFETIES, CONTROLS AND OPERATION

A. Chiller safety controls system shall be provided with the unit (Minimum) as follows:

20. Low evaporator refrigerant pressure
21. Loss of flow through the evaporator
22. High condenser refrigerant pressure
23. High compressor motor temperature
24. Low suction gas temperature
25. Low leaving evaporator water temperature

B. Failure of chiller to start or chiller shutdown due to any of the above safety cutouts shall be enunciated by display of the appropriate diagnostic description at the unit control panel. This annunciation will be in plain English. Alphanumeric codes shall be unacceptable.

C. The chiller shall be furnished with a Master Controller as an integral portion of the chiller control circuitry to provide the following functions:

1. Provide automatic chiller shutdown during periods when the load level decreases below the normal operating requirements of the chiller. Upon an increase in load, the chiller shall automatically restart.

2. Provisions for connection to automatically enable the chiller from a remote energy management system.

3. The control panel shall provide alphanumeric display showing all system parameters in the English language with numeric data in English units.

D. Normal Chiller Operation:

1. When chiller is enabled, the factory supplied Master Controller modulates the chiller capacity from minimum to maximum as required by building load.

2. The Chiller control system shall respond to Entering Water Temperature and will have an integral reset based on entering water temperature to provide for efficient operation at part-load conditions.

E. Power Phase Monitor:

1. Provide a Power Phase Monitor on the incoming power supply to the chiller. This device shall prevent the chiller from operating during periods when the incoming power is unsuitable for proper operation.

2. The Power Phase Monitor shall provide protection against the following conditions:

a. Low Voltage (Brown-Out)
b. Phase Rotation
c. Loss of Phase
d. Phase Imbalance

PART 3 INSTALLATIONS

3.1 PIPING SYSTEM FLUSHING PROCEDURE

J. Prior to connecting the chiller to the condenser and chilled water loop the piping loops shall be flushed with a detergent and hot water (110 - 130 deg F) mixture to remove previously accumulated dirt and other organic residue. After removal of organic residue, flushing shall

continue with a dilute phosphoric acid, sulfamic acid or citric acid and water mixture to remove inorganic scale in the pipe. (Note: Cleaning chemicals such as Calgon 798TM or equivalent suitable for both organic residue and scale removal may be substituted. Otherwise detergents and acids shall not be combined unless approved by the chemical manufacturers.) Only chemicals compatible with 316 stainless steel, copper and carbon steel shall be used. (Any concentrations of hydrochloric or sulfuric acid or chloride containing chemicals shall not be allowed to come in contact with copper brazed 316 stainless steel heat exchangers).

K. During the flushing 30 mesh (max.) Y-strainers (or acceptable equivalent) shall be in place in the system piping and examined periodically as necessary to remove collected residue. The flushing process shall take no less than 6 hours or until the strainers when examined after each flushing are clean. Old systems with heavy encrustation shall be flushed for a minimum of 24 hours and may take as long as 48 hours before the filters run clean. Detergent and acid concentrations shall be used in strict accordance with the respective chemical manufacturer's instructions. After flushing with the detergent and/or dilute acid concentrations the system loop shall be purged with clean water for at least one hour to ensure that all residual cleaning chemicals have been flushed out.

L. Prior to supplying water to the chiller the Water Treatment Specification shall be consulted for requirements regarding the water quality during chiller operation. The appropriate chiller manufacturer's service literature shall be available to the operator and/or service contractor and consulted for guidelines concerning preventative maintenance and off-season shutdown procedures.

3.2 WATER TREATMENT REQUIREMENTS

A. Supply water for the chilled water circuits shall be analyzed and treated by a professional water treatment specialist who is familiar with the operating conditions and materials of construction specified for the chiller's heat exchangers, headers and associated piping. Cycles of concentration shall be controlled such that re-circulated water quality for modular chillers using 316 stainless steel brazed plate heat exchangers and carbon steel headers is maintained within the following parameters:

1. PH Greater than 7 and less than 9
2. Total Dissolved Solids (TDS) Less than 1000 ppm
3. Hardness as CaCO3 30 to 500 ppm
4. Alkalinity as Ca CO3 30 to 500 ppm
5. Chlorides Less than 200 ppm
6. Sulfates Less than 200 ppm

3.3 ELECTRICAL POWER INSTALLATION (MULTIPLE MODULE INSTALLATION Only)

A. The main power connections: Shall be made in the junction box supplied with the chiller by the manufacturer. The installing contractor shall provide the necessary cable lugs to connect the electrical cable to the busbar connector furnished by the chiller manufacturer.

3.4 ELECTRICAL INSTALLATION RESPONSIBILITIES

A. POWER CONNECTION: The installing contractor shall be responsible for:

7. Providing the complete installation of electrical power into the junction box in compliance with all codes and standards. Use only copper conductors and provide wires, plus a ground of the size and type required to meet minimum circuit ampacity of his system.

8. Providing equipment, related accessories and wiring to meet disconnect requirements and any other electrical requirements that apply to the completed chiller installation.

9. Modules with scroll compressors require phasing of the incoming field electrical power wiring. In addition, a phase failure and phase reversal monitor furnished by the manufacturer is to be field installed for each power feed and wired to the master controller.

B. CONTROL CONNECTIONS: The installing contractor shall be responsible for:

1. Installation of the required system interlocks and the associated external wiring.
2. Install a sufficient length of wiring to permit connection to the module on which the master controller will be mounted.
3. Each wire shall be tagged with its respective terminal.

10. The master controller shall be installed and wired during the start-up procedure.

END OF SECTION

SECTION 15410

PLUMBING FIXTURE STANDARDS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes plumbing fixtures and related components.

B. See Division 15 Section "Drinking Fountains and Water Coolers."

C. See Division 15 Section "Plumbing Specialties" for backflow preventers and specialty fixtures not in this Section.

1.2 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

1.3 SUBMITTALS

A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

B. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and maintenance data.

1.4 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. 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";] about plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Plastic Lavatories: ANSI Z124.3.
3. Plastic Laundry Trays: ANSI Z124.6.
4. Plastic Mop-Service Basins: ANSI Z124.6.
5. Plastic Sinks: ANSI Z124.6.
6. Vitreous-China Fixtures: ASME A112.19.2M.

H. Comply with the following applicable standards and other requirements specified for [lavatory] [and] [sink] faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucet Hose: ASTM D 3901.
5. Faucets: ASME A112.18.1M.
6. Hose-Connection Vacuum Breakers: ASSE 1011.
7. Hose-Coupling Threads: ASME B1.20.7.
8. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
9. NSF Materials: NSF 61.
10. Pipe Threads: ASME B1.20.1.
11. Supply and Drain Fittings: ASME A112.18.1M.

I. 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 A112.18.1M.
3. Manual-Operation Flushometers: ASSE 1037.
4. Plastic Tubular Fittings and Piping: ASTM F 409.
5. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
6. Tubular Brass Drainage Fittings and Piping: ASME A112.18.1M.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Floor Drains: ASME A112.21.1M.
2. Hose-Coupling Threads: ASME B1.20.7.
3. Off-Floor Fixture Supports: ASME A112.6.1M.
4. Pipe Threads: ASME B1.20.1.
5. Plastic Shower Receptors: ANSI Z124.2.
6. Plastic Toilet Seats: ANSI Z124.5.
7. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 PRODUCTS

2.1 MANUFACTURERS

8. See drawing specifications for fixture descriptions

PART 3 EXECUTION

3.1 FIXTURE INSTALLATION

K. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.

L. For wall-hanging fixtures, install off-floor supports affixed to building substrate.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

M. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.

N. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

O. Install wall-hanging fixtures with tubular waste piping attached to supports.

P. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

Q. Install counter-mounting fixtures in and attached to casework.

R. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

S. 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.

1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture. Refer to Division 15 Section "Valves" for general-duty valves.

T. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

U. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

V. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

W. Install toilet seats on water closets.

X. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

Y. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

Z. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

AA. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.

BB. Install disposer in outlet of sinks indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

CC. 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. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.

DD. Set [service basins] in leveling bed of cement grout. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for grout.

EE. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.

3.2 CONNECTIONS

A. Connet water supplies from water distribution piping to fixtures.

B. Connect drain piping from fixtures to drainage piping.

C. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

D. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

3.3 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

END OF SECTION

SECTION 15415

DRINKING FOUNTAINS AND WATER COOLERS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Drinking fountains.
2. Pressure water coolers.
3. Fixture supports.

1.2 SUBMITTALS

A. Product Data: Include rated capacities; furnished specialties; and accessories for each type of fixture indicated.

B. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and maintenance data.

1.3 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. 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";] about fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about fixtures for people with disabilities.

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. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

PART 2 PRODUCTS

2.1 MANUFACTURERS - See drawing specifications for fixture descriptions.

PART 3 EXECUTION

3.1 APPLICATIONS

F. Use carrier off-floor supports for wall-hanging fixtures, unless otherwise indicated.

G. Use mounting frames for recessed water coolers, unless otherwise indicated.

3.2 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-hanging fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

H. Install fixtures level and plumb.

I. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation.

J. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

K. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.

L. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.

3.3 CONNECTIONS

A. Connect water supplies from water distribution piping to fixtures.

B. Connect drain piping from fixtures to drainage piping.

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water-cooler temperature settings.

END OF SECTION

SECTION 15430

PLUMBING SPECIALTIES

GENERAL

1.1 SUMMARY

A. This Section includes the following plumbing specialties:
   1. Wheel-handle wall hydrants.
   2. Trap seal primer valves.
   3. Miscellaneous piping specialties.
   4. Cleanouts.
   5. Floor drains.

1.2 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:

   1. Domestic Water Piping: [125 psig (860 kPa)].
   2. Sanitary Waste and Vent Piping: 10-foot head of water (30 kPa).
   3. Storm Drainage Piping: 10-foot head of water (30 kPa).

1.3 SUBMITTALS

A. Product Data: Include rated capacities and indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:
   1. Water hammer arresters, air vents, and trap seal primer valves and systems.
   2. Hose bibbs and hydrants.
   3. Cleanouts, and floor drains.

B. Field quality-control test reports.

C. Operation and maintenance data for the following:
   1. Trap seal primer valves and systems.

1.4 QUALITY ASSURANCE

A. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.

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. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.

D. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.
2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

PART 2 PRODUCTS

2.1 MANUFACTURERS

E. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. 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.

2.2 TRAP SEAL PRIMER VALVES

A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:

4. [Available]Manufacturers:

   a. E & S Valves.
   b. Josam Co.
   c. MIFAB Manufacturing, Inc.
   d. Precision Plumbing Products, Inc.
   e. Smith, Jay R. Mfg. Co.
   f. Tyler Pipe; Wade Div.
   g. Watts Industries, Inc.; Drainage Products Div.
   h. Watts Industries, Inc.; Water Products Div.
   i. Zurn Industries, Inc.; Jonespec Div.
   j. Zurn Industries, Inc.; Specification Drainage Operation.

5. 125-psig (860-kPa) minimum working pressure.
6. Bronze body with atmospheric-vented drain chamber.
7. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
8. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
9. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

F. Drainage-Type Trap Seal Primer Valves: ASSE 1044, fixture-trap, waste-drainage-fed type, with the following characteristics:

1. [Available]Manufacturers:

   a. Smith, Jay R. Mfg. Co.

2. Chrome-plated, cast-brass, NPS 1-1/4 (DN 32) minimum, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.

G. Trap Seal Primer System: Factory-fabricated, automatic-operation assembly for wall mounting with the following:

1. [Available]Manufacturers:

   a. Precision Plumbing Products, Inc.

2. Piping: NPS 3/4, ASTM B 88, Type L (DN 20, ASTM B 88M, Type B); copper, water tubing inlet and manifold with number of NPS 1/2 (DN 15) outlets as indicated.
3. Cabinet: Steel box with stainless-steel cover.
4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
5. Water Hammer Arrester: ASSE 1010.
6. Vacuum Breaker: ASSE 1001.

2.3 MISCELLANEOUS PIPING SPECIALTIES

A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F.

7. [Available]Manufacturers:

   a. Josam Co.
   b. Smith, Jay R. Mfg. Co.
   c. Tyler Pipe; Wade Div.
   d. Zurn Industries, Inc.; Specification Drainage Operation.

B. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compression-type faucets. Include NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig (860 kPa); integral [or field-installed,] nonremovable, drainable hose-connection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.

1. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
8. Finish for Service Areas: [Rough bronze].
9. Finish for Finished Rooms and exterior areas: Chrome or nickel plated.
10. Operation for Equipment Rooms: Wheel handle or operating key.
11. Operation for Service Areas: [Wheel handle].
12. Operation for exterior areas: [Operating key].
13. Include operating key with each operating-key hose bibb.
14. Include [integral]wall flange with each chrome- or nickel-plated hose bibb.

C. Air-Admittance Valves: Plastic housing with mechanical-operation sealing diaphragm, designed to admit air into drainage and vent piping and to prevent transmission of sewer gas into building.

1. [Available]Manufacturers:

   a. B & K Industries, Inc.
   b. Durgo, Inc.
   c. IMI Cash Valve.
   d. IPS Corporation.
   e. J & B Products.
   f. Magic Vent Co., Inc.
   g. Oatey.
   h. Sioux Chief Manufacturing Co., Inc.
   i. Studor, Inc.

2. Stack Vent Valve: ASSE 1050, designed for installation as terminal on soil, waste, and vent stacks, instead of stack vent extending through roof, in NPS 2 to NPS 4 (DN 50 to DN 100).
3. Fixture Vent Valve: ASSE 1051, designed for installation on waste piping, instead of vent connection, for single fixture, in NPS 1-1/4 to NPS 2 (DN 32 to DN 50).

H. Open Drains: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting, joined with ASTM C 564, rubber gaskets.

I. Deep-Seal Traps: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap seal primer valve connection.

1. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
2. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

J. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.

K. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.

L. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.

M. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.

N. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counter-flashing.

PART 3 EXECUTION

3.1 INSTALLATION

O. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

P. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

Q. 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 deg rees.
3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.

R. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.

S. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

T. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.

U. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.

V. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
    b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
    c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

W. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

X. Fasten recessed-type plumbing specialties to reinforcement built into walls.

Y. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.

Z. Install individual shutoff valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 15 Section "Valves" for general-duty ball, butterfly, check, gate, and globe valves.

AA. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

BB. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

B. Connect plumbing specialties and devices that require power according to Division 16 Sections.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 15440

PLUMBING FIXTURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Basic Requirements: Provisions of Section 15010, BASIC MECHANICAL REQUIREMENTS, are a part of this Section.

1.2 SUMMARY

A. General: Provide plumbing fixtures, traps, tailpieces, trim, devices and appurtenances as indicated.

1.3 ADDITIONAL REQUIREMENTS

A. Related Sections: Other Sections of Division 15 which relate to the requirements of this Section may include but are not limited to the following:

B. 15050, BASIC MECHANICAL MATERIALS AND METHODS
1. 15485, ELECTRIC, DOMESTIC WATER HEATER

1.4 SUBMITTALS

A. General: Refer to paragraph entitled "SUBMITTAL" in Section 15010. Provide shop drawings and manufacturer's data sheets for the following items:

1. Manufacturers Literature:

a. Dimensional outline drawing for each plumbing fixture including fittings and trim.

b. Outline drawings and data sheets for the following items of plumbing equipment:

(1) Each type of floor drain or floor sink including trap primer.
(2) Each type of roof drain.
(3) Each clean-out and clean-out covers including wall access cover.
(4) Water hammer arrester including capacity and pipe connection size.

2. Installation Instructions:

a. Manufacturer's printed installation instructions including copies shipped with each fixture.

b. Mounting templates for fixtures.

c. Pressure and fixture unit capacity for water hammer arresters.

3. Maintenance Instructions:

a. Exploded parts list for each item.

1.2 APPLICABLE STANDARDS

A. General: All equipment, material, accessories, methods of construction and reinforcement, finish quality, workmanship and installation shall be in compliance with the paragraph entitled "Code Compliance" in Section 15010.

B. Handicap Access: Fixtures indicated to provide handicap access shall be designed, manufactured and installed in accordance with ANSI 117.1-1986 and the "Florida Accessibility Code for Building Construction" from the Florida Board of Building Codes and Standards, Department of Community Affairs, October 1997 Revision with amendments.

C. ASSE: Fixtures and devices shall comply with the standards of the American Society of Sanitary Engineers, where required.

D. ADA: Fixtures, devices and installation clearances and heights shall comply with the requirements of the Americans with Disabilities Act (ADA).

E. PDI: Fixtures and devices shall comply with the standards of the Plumbing and Drainage Institute, where required.

PART 2 PRODUCTS

2.1 GENERAL

E. Manufacturer: Refer to paragraph entitled "MANUFACTURERS" in Section 15010.

F. Material: Fixtures shall be white vitreous china unless otherwise indicated. Where enameled iron fixtures are specified, they shall be furnished with acid resisting enamel.

G. Quality: Plumbing fixtures shall be "First Quality" as defined and set forth in Commercial Standard CS77-28 as promulgated by the U.S. Department of Commerce. Fixture fittings shall comply with ANSI/ASTM A112.18.1M - 1989. Plumbing trim for water closet bowls, tanks and urinals shall comply with ANSI/ASTM A112.19.5 - 1990.

H. Similar Character and Design: Fixtures and fittings of a similar type shall be from a single manufacturer.

I. Vitreous China Fixtures: Vitreous china fixtures shall comply with ANSI A112.19.2M - 1990.

F. Exposed Metal: Exposed metal shall be polished chromium on either brass or bronze, unless otherwise indicated. Supply valves shall have renewable seats and discs. Hot and cold water supply to fixtures shall be provided with stops. Provide P-trap with clean-out for each lavatory and sink except as indicated.

G. Concealed Carriers: Provide a cast iron or steel concealed arm, floor-mounted carrier with cast iron feet and steel uprights to support all wall mounted lavatories, sinks, urinals, and water closets. Carriers shall comply with ANSI A112.6.1.M - 1979 and shall have adjustable support plates, alignment truss, and mounting fasteners. Floor mounted carriers shall withstand an applied vertical load of 250 pounds on the front of the fixture indefinitely without breaking or permanently deforming. Supports and carriers shall have adjustments capable of permitting field alignment to allow for actual site conditions.

H. Trap Primers: Traps primers shall be water supply-fed type and shall comply with ANSI/ASSE 1018-86.

I. Vacuum Breakers: Vacuum breakers shall be full-line size, bronze with rough chrome plating, or polished chrome plating where exposed, full-line size, and shall conform to ASSE 1001-1988 or 1020-1988 as applicable.

2.3 FLOOR DRAINS

A. General: Floor drains and floor sinks shall be cast iron, shall comply with ANSI/ASME A112.21.1M - 1990, and shall be adjustable to accommodate the finished floor. Strainer size shall be as recommended by the manufacturer unless otherwise indicated. Strainers shall be polished nickel alloy or polished brass. Provide tapped boss and trap primer connection and flashing flange or clamp, unless otherwise indicated or required.

2. 4 ROOF DRAINS

A. General: Roof drains shall comply with ANSI/ASME A 112.21.2M - 1990 and shall have cast iron body, cast iron dome, gravel stop, flashing flange, and deck clamp with adjustable collar to accommodate insulation thickness, unless otherwise indicated.

2.5 CLEANOUTS AND CLEANOUT ACCESS COVERS

A. Size: Clean-outs shall be at ;east the same nominal pipe size as the pipe to which they are connected, to a maximum of 6 inch diameter, unless otherwise indicated.

B. Material: Clean-outs shall comply with ANSI A112.36.2M - 1983 and shall be water- and gas-tight cast iron construction with adjustable housing to accommodate finished floor or grade elevation. Clean-outs in waterproofed floors shall have a flashing flange and clamp device. Clean-outs shall have a countersunk internal bronze plug and scoriated nickel-bronze removable cover; wall clean-outs shall have polished stainless steel cover specifically manufactured for the wall finish at each location. Floor clean-outs for floors with finish coverings shall have the top recessed for tile or carpet, with a clean-out marker, manufactured for the finished floor material.

C. Access Cover: Access covers for concealed wall clean-outs shall be nickel-bronze with scoriated hinged cover or round stainless steel cover with countersunk machine threaded center screw, unless otherwise indicated.

2.6 WATER HAMMER ARRESTER

A. Manufactured Water Hammer Arrester: Water hammer arresters shall be designed, manufactured, tested and certified in accordance with PDI Standard WH201, 1977 Revision. Arresters shall be Type L copper tube construction, with a piston and heat sink. The piston shall have pressure lubricated O-rings separating the compressed air charge from the flowing fluid to dissipate the kinetic energy generated in the piping system. Each arrester shall be sized according the table and shall have a male sweat connection. Unless specifically indicated otherwise, calculated or field constructed air chambers are not acceptable.

B. Manufacturer:

ENGINEERED WATER HAMMER ARRESTERS						
Fixture Units	1-11	12-32	33-60	61-113	114-154	155-330
PPP, Inc.	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
Sioux Chief	652-AS	653-BS	654-CS	655-DS	656-ES	657-FS

PART 3 EXECUTION

3.1 GENERAL

J. Vacuum Breakers: Where not provided as an integral part of a device or fixture, provide vacuum breakers at each fixture to prevent back-siphonage.

K. Piping: Plumbing piping to fixtures shall be secured to the wall framing system prior to installation of the wall surface material to assure a solid installation which will not move. Fixture piping which can be moved shall be removed and re-secured to the wall structure; replacement of the wall, finishes, trim, etc. shall be included at no cost to the Owner.

L. Clearances: Install fixtures in accordance with manufacturer's data, with sufficient clearances to coordinate with accessories, specialties and equipment.

M. Mop Sinks: Unless otherwise indicated, mop sinks or basins shall be floor mounted and sealed watertight, at walls and seams.

3.2 TRAP PRIMERS

A. General: Install trap primers where indicated or required. The trap primer outlet shall extend vertically a minimum of 12 inches before a change in direction to horizontal is made. The horizontal line to the trap primer connection shall be installed sloping to the trap it serves. Provide a vacuum breaker where required. The supply to each trap primer shall be provided with an isolation valve.

B. Access Covers: Provide a minimum 12 inch by 12 inch stainless steel access cover for each trap primer.

3.3 CLEAN-OUTS AND CLEAN-OUT ACCESS COVERS

A. Exterior Clean-outs: Extend exterior clean-outs to finished grade. Provide a concrete pad 18 inches by 18 inches, 6 inches thick around clean-out; slope top down approximately 2 inches from the clean-out to edge of pad so that edge of pad is flush with finished grade.

B. Locations: Clean-outs shall be provided at not more than 50 feet apart in horizontal drainage lines of 4 inch nominal diameter or smaller, and at not more than 75 feet apart for larger diameter pipe. Clean-outs shall be provided at each change of direction of 90 degrees or more. Clean-outs shall be provided in vertical sanitary and storm water piping, with the centerline not more than 18 inches above the finished floor level, at each floor with a horizontal offset or horizontal branch connection.

3.4 WATER HAMMER ARRESTERS

A. General: Install water hammer arresters on both hot and cold water piping in accordance with manufacturer's recommendations. Water hammer arresters shall be installed at each valve-operated plumbing fixture, or at the end of piping branches serving a battery of valve-operated fixtures. In addition, water hammer arresters shall be installed at each solenoid valve, at each remotely-operated valve, or at each quick-closing valve as defined by PDI WH-201, as close to the point of quick closure as possible.

3.5 INSULATION OF HANDICAPPED LAVATORY EXPOSED PIPING

A. General: Insulate hot water supply and waste lines for handicapped lavatories with 1/2 inch thick elastomeric or fiberglass insulation. All joints shall be sealed and provided with a white finish.

3.6 DRAINS

A. General: Drains shall be located at the low point of indicated slopes, or 1/2 inch below the finished surface, Install to prevent ponding around the perimeter of the drain.

3.7 ROOF DRAINS

A. Fire Stopping: Roof drains penetrating a fire rated roof shall be proved with a fire stop. The rating of the fire stop shall be equal to the rating of the roof.

3.8 FIXTURE INSTALLATION

A. General: Obtain mounting templates and dimensions prior to roughing-in plumbing connections. Mount fixture on carrier which is bolted to the building structure with through-bolts or pre-set inserts. Floor-mounted fixtures shall have supports, blocking or a non-shrink grout setting bed to prevent movement or flexing. Floor-mounted, wall mounted and countertop fixtures shall be sealed watertight with a flexible, non-permeable caulk or mastic. Provide stainless steel escutcheons at each water supply and waste piping penetration of a wall or cabinet; caulk each escutcheon. Adjust all fixtures level and plumb at proper mounting height.

B. Rough-In: During rough-in, water and waste stub-outs shall be located to prevent gaps between the fixture and the finished wall, and to allow exposed pipe to be installed straight and plumb from the stub-out to the fixture. Continuously cover wall openings and open pipe ends to prevent construction debris from entering.

C. Fixture Connections: Provide valve cocks or stops in pressure piping to fixtures in lines 1/2 inch or smaller; provide gate valves in piping 3/4 inch and larger. Provide a water seal trap with each fixture (including floor drains and floor sinks) whether indicated or not. Drains shall be sized as indicated or required but in no case less than 1-1/2 inch pipe size.

D. Fixture Mounting Criteria: Plumbing fixtures shall comply with the following mounting criteria unless specifically dimensioned otherwise on the drawings:

1. Standard access fixtures:

   a. Wall hung water closet - 16.5 inches from finish floor elevation to top of seat.

   b. Wall hung lavatory - 31 inches from finish floor elevation to top of rim.

   c. Urinal - 24 inches from finish floor elevation to the top of the rim.

Handicap accessible fixtures:

   d. Water closet - 19 inches from finish floor elevation to top of seat, maximum 44 inches from finish floor elevation to centerline of the flush valve control on the wide side of the toilet stall. The flush valve cannot be located under the grab bar because of room required to service diaphragm. Provide offset riser tube with a minimum of 2 wall supports. Flush valve or flush lever location shall be on the access side of the water closet.

   e. Lavatory - maximum 34 inches from finish floor elevation to top of rim, minimum 29 inches from finish floor elevation to bottom of the apron, 27 inches clear knee space, 17 inches from wall to face of rim, minimum 9 inches from finish floor elevation to bottom of insulated P-trap, maximum 6 inches toe clearance between wall and insulated P-trap.

f. Urinal - maximum 17 inches from finish floor elevation to the top of the rim, 14 inches minimum from the wall to the face of the rim, maximum 44 inches from finish floor elevation to centerline of the flush valve control.

g. Drinking fountain and water cooler - maximum 36 inches from finish floor elevation to spout outlet, minimum 4 inches water flow height measured vertically above the spout outlet, minimum 27 inches of clear space between finish floor elevation to bottom of the apron.

END OF SECTION

SECTION 15725

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Constant-air-volume, single-zone air-handling units.

1.2 SUBMITTALS

A. Product Data: For each air-handling unit indicated.

1. Unit dimensions and weight

2. Cabinet material, metal thickness, finishes, insulation, and accessories

3. Fans:
   a. Certified fan-performance curves with system operating conditions indicated.
   b. Certified fan-sound power ratings.
   c. Fan construction and accessories.
   d. Motor ratings, electrical characteristics, and motor accessories.

4. Certified coil-performance ratings with system operating conditions indicated.
5. Dampers, including housings, linkages, and operators.
6. Filters with performance characteristics.

B. Field quality-control reports.

C. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.3 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.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. Comply with NFPA 70.

1.4 COORDINATION

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

B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

1.5 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. Filters: One set for each air-handling unit.
2. Gaskets: One set for each access door.
3. Fan Belts: One set for each air-handling unit fan.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of Design Product: Subject to compliance with requirements, provide product indicated on drawings.

2.2 AIR FILTRATION SECTION

A. General Requirements for Air Filtration Section:

1. Comply with NFPA 90A.

2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

3. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

B. Disposable Panel Filters:

1. Factory-fabricated, viscous-coated, flat-panel type.

2. Thickness: 2 inches

3. Merv (ASHRAE 52.2): 6

2.3 DAMPERS

A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating", shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper 4-inch pressure differential.

B. Dampers Operators: Comply with requirements in Division 15 Section "HVAC" Instrumentation and Controls.

2.4 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

D. Steam Coils: Factory tested to 300 psig and to 200 psig underwater according to ARI 410 and ASHRAE 33.

E. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

B. Equipment Mounting: Install air-handling units on concrete bases using elastomeric pads Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases specified in Division 3 Section. Comply with requirements for vibration isolation devices.

C. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

E. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air-handling unit to allow service and maintenance.

C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using **[NPS 1-1/4] <Insert pipe size>**, ASTM B 88, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

F. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 15 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

G. Steam and Condensate Piping: Comply with applicable requirements in Division 15 Section "Steam and Condensate Piping." Install shutoff valve at steam supply connections, float and thermostatic trap, and union or flange at each coil return connection. Install gate valve and inlet strainer at supply connection of dry steam humidifiers, and inverted bucket steam trap to condensate return connection.

H. Refrigerant Piping: Comply with applicable requirements in Division 15 Section "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.

I. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 15 Section "Duct Accessories."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

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.

C. Tests and Inspections:

1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
2. Charge refrigerant coils with refrigerant and test for leaks.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.

5. Complete installation and startup checks according to manufacturer's written instructions.
6. Verify that shipping, blocking, and bracing are removed.
7. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
8. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
9. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
10. Verify that zone dampers fully open and close for each zone.
11. Verify that face-and-bypass dampers provide full face flow.
12. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
13. Comb coil fins for parallel orientation.
14. Verify that proper thermal-overload protection is installed for electric coils.
15. Install new, clean filters.
16. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Division 15 Section "Testing, Adjusting, and Balancing" for air-handling system testing, adjusting, and balancing.

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION

SECTION 15738

SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 DEFINITIONS

A. Evaporator-Fan Unit: The part of the split-system air-conditioning unit that contains a coil for cooling (heat rejection for heating operation in heat pump units) and a fan to circulate air to conditioned space.

B. Compressor-Condenser Unit: The part of the split-system air-conditioning unit that contains a refrigerant compressor and a coil for condensing refrigerant (evaporator for heating operation in heat pump units).

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and maintenance data.

1.4 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.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fail in materials and workmanship within [five] years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

B. 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:

1. Carrier Air Conditioning; Div. of Carrier Corp.
2. Lennox Industries Inc.
3. Trane Co. (The); Unitary Products Group.
4. York International Corp.

2.2 EVAPORATOR-FAN UNIT

A. Concealed Unit Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

5. Insulation: Faced, glass-fiber duct liner.
6. Drain Pans: Galvanized steel, with connection for drain; insulated.

C. Heating Coil: Helical, nickel-chrome, electric-resistance heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

D. Evaporator Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.

E. Fan Motor: Multispeed, PSC type.

F. Disposable Filters: 1 inch (25 mm) thick, in fiberboard frames. Wiring Terminations: Connect motor to chassis wiring with plug connection.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER UNIT

A. Casing steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed [scroll] type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

D. Fan: Aluminum-propeller type, directly connected to motor.

E. Motor: Permanently lubricated, with integral thermal-overload protection.

G. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).

H. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 EXECUTION

3.1 INSTALLATION

I. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

J. Install ground-mounted, compressor-condenser components on 4-inch- (100-mm-) thick, reinforced concrete base; 4 inches (100 mm) larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

K. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

L. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 7 Section "[Roof Accessories]." Anchor units to supports with removable, cadmium-plated fasteners.

M. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch (25 mm).

3.2 CONNECTIONS

A. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

B. Install piping adjacent to unit to allow service and maintenance.

C. Unless otherwise indicated, connect piping with unions and shutoff valves to allow units to be disconnected without draining piping. Refer to piping system Sections for specific valve and specialty arrangements.

3.3 FIELD QUALITY CONTROL

A. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

B. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 15815

METAL DUCTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports..

B. Related Sections:

1. Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
2. Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 QUALITY ASSURANCE

A. NFPA Compliance

1. NFPA 904 – "Installation of Air Conditioning Systems" and ventilation.
2. NFPA QOB – "Installation of Water, Air, Heating, and Air Conditioning Systems".

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section.4.4 - "HVAC System Construction and Insulation."

PART 2 PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTIN

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1, Manufacturers: Subject to compliance with requirements, [provide products by one of the following]

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL ROUND DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.

B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct- support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
    b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

4. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (o.o39 W/m x K) at 75 deg F mean temperature.
5. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
6. Coat insulation with antimicrobial coating.
7. Cover insulation with polyester film complying with UL 181, Class 1.

E. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K)at 75 deg F mean temperature.

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180) G90 (Z275).

2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
8. Shop-Applied Coating Color: Black.
9. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.

2. Type: S.

3. Grade: NS

4. Class: 25.

5. Use: O.

6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

D. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.

2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 15 Section "Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes2-Inch wg and Lower: Seal Class C.

10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.

11. Conditioned Space, Exhaust Ducts: Seal Class B.

12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 15 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

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

D. Prepare test and inspection reports.

3.10 START UP

A. Air Balance: Comply with requirements in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 15855

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.2 SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2PRODUCTS

2.1 MANUFACTURERS

B. See drawing schedules for specification

PART 3 EXECUTION

3.1 INSTALLATION

C. Install diffusers, registers, and grilles level and plumb.

D. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

1.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 15950

TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Measuring sound and vibration.
7. Reporting results of activities and procedures specified in this Section.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. AMCA: Air Movement and Control Association.

C. NEBB: National Environmental Balancing Bureau.

D. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.3 SUBMITTALS

A. Strategies and Procedures Plan: Testing, adjusting, and balancing strategies and step-by-step procedures. Include a complete set of report forms intended for use on this Project.

B. Certified Testing, Adjusting, and Balancing Reports: Prepared on approved forms certified by the testing, adjusting, and balancing Agent.

1.4 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by AABC or NEBB.

B. Certification of Testing, Adjusting, and Balancing Reports: Certify testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
2. Certify that testing, adjusting, and balancing team complied with approved testing, adjusting, and balancing plan and procedures specified and referenced in this Specification.

C. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing." or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

D. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by the instrument manufacturer.

1.5 COORDINATION

A. Coordinate efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.6 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 EXAMINATION

B. Examine the Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

C. Examine approved submittal data of HVAC systems and equipment.

D. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

E. Examine equipment performance data, including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate

system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

L. Examine equipment for installation and for properly operating safety interlocks and controls.

M. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
4. Sequence of operation for control modes is according to the Contract Documents.
5. changes in conditions. Record default set points if different from design values.
6. Interlocked systems are operating.
7. Changeover from heating to cooling mode occurs according to design values.

N. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

7. Windows and doors can be closed so design conditions for system operations can be met.

3.3 TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to procedures contained in AABC national standards. or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." or SMACNA's "HVAC Systems--Testing, Adjusting, and Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

8. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
9. Air Outlets and Inlets: 0 to minus 10 percent.

3.5 REPORTS

A. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

B. Final Report: Typewritten, or computer printout in letter-quality font, on standard bond paper, bound in three-ring, loose-leaf binder, and tabulated and divided into sections by tested and balanced systems.

1. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing agent.

2. Include a list of instruments used for procedures, along with proof of calibration.

10. Final Report Contents: In addition to certified field report data, include the following:
    a. Fan curves.
    b. Manufacturers' test data.
    c. Field quality-control test reports prepared by system and equipment installers.
    d. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

11. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

    a. Title page.
    b. Name and address of testing, adjusting, and balancing Agent.
    c. Project name.
    d. Project location.
    e. Architect's name and address.
    f. Engineer's name and address.
    g. Contractor's name and address.
    h. Report date.
    i. Signature of testing, adjusting, and balancing Agent who certifies the report.
    j. Summary of contents, including the following:

        1) Design versus final performance.
        2) Notable characteristics of systems.
        3) Description of system operation sequence if it varies from the Contract Documents.

    k. Nomenclature sheets for each item of equipment.
    l. Data for terminal units, including manufacturer, type size, and fittings.
    m. Notes to explain why certain final data in the body of reports vary from design values.
    n. Test conditions for fans and pump performance forms, including the following:

        1) Settings for outside-, return-, and exhaust-air dampers.
        2) Conditions of filters.
        3) Cooling coil, wet- and dry-bulb conditions.
        4) Fan drive settings, including settings and percentage of maximum pitch diameter.
        5) Settings for supply-air, static-pressure controller.
        6) Other system operating conditions that affect performance.

12. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:

    a. Quantities of outside, supply, return, and exhaust airflows.
    b. Duct, outlet, and inlet sizes.

END OF SECTION