SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:
   1. Steel pipe and fittings.
   2. Joining materials.
   3. Transition fittings.
   4. Dielectric fittings.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Pipe.
   2. Fittings.
   3. Joining materials.
   4. Bypass chemical feeder.

B. Sustainable Design Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   3. Environmental Product Declaration: For each product.

C. Delegated-Design Submittal:
   1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
   2. Locations of pipe anchors and alignment guides and expansion joints and loops.
   3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
   4. Locations of and details for penetration and firestopping for fire and smoke rated wall and floor and ceiling assemblies.

1.03 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.04 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Hot-Water Heating Piping: 100 psig at 200 deg. F.
   2. Chilled-Water Piping: 150 psig 73 deg. F.
   3. Makeup-Water Piping: 150 psig at 73 deg. F.
   4. Air-Vent Piping: 200 deg. F.
   5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.02 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
C. DWV Copper Tubing: ASTM B 306, Type DWV.
D. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International.
      b. Victaulic Company.
   2. Grooved-End Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze casting.
   3. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg. F for use with housing, and steel bolts and nuts.
E. Wrought-Copper Unions: ASME B16.22.

2.03 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   1. Material Group: 1.1.
   2. End Connections: Butt welding.
   3. Facings: Raised face.
G. Grooved Mechanical-Joint Fittings and Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International.
      b. Victaulic Company.
   2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-

end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

3. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.04 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise 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/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.05 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Charlotte Pipe and Foundry Company.
      b. IPEX USA LLC.
      c. KBI (King Bros. Industries).
      d. Viega LLC.
   2. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Charlotte Pipe and Foundry Company.
      b. IPEX USA LLC.
      c. KBI (King Bros. Industries).
      d. NIBCO INC.
   2. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.06 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A.Y. McDonald Mfg. Co.
b. Capitol Manufacturing Company.
c. Central Plastics Company.
d. HART Industrial Unions, LLC.
e. Jomar Valve.
f. Matco-Norca.
g. Watts; a Watts Water Technologies company.
h. Wilkins.
i. Zurn Industries, LLC.

2. Description:
a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg. F.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2-inch and smaller, shall be one of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe, Grade B, ASTM 53, Seamless; Class 125, cast-iron fittings; screwed fittings.

B. Hot-water heating piping, aboveground, NPS 2 ½ -inch and larger, shall be the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Hot-Water Heating Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.

D. Chilled-water piping, aboveground, NPS 2-inch and smaller, shall be one of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] [pressure-seal] joints.
2. Schedule 40 steel pipe, Grade B, ASTM 53, Seamless; Class 125, cast-iron fittings; screwed fittings.

E. Chilled-water piping, aboveground, NPS 2 ½ -inch and larger, shall be one of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and [soldered] [brazed] joints.
2. Schedule 40 steel pipe, Grade B, ASTM 53, Seamless; Class 125, cast-iron fittings; cast-iron flanges and flange fittings.

F. Chilled-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.

G. AC Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

H. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

I. Air-Vent Piping:
1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

J. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition

fittings for plastic piping systems according to piping manufacturer's written instructions.

3.02 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
E. Install piping to permit valve servicing.
F. Install piping at indicated slopes.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Install piping to allow application of insulation.
J. Select system components with pressure rating equal to or greater than system operating pressure.
K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
L. Install drains, consisting of a tee fitting, NPS 3/4-inch ball valve, and short NPS 3/4-inch threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
P. Install valves according to the following:
    1. Section 230523.12 "Ball Valves for HVAC Piping."
    2. Section 230523.13 "Butterfly Valves for HVAC Piping."
    3. Section 230523.14 "Check Valves for HVAC Piping."
Q. Install unions in piping, NPS 2-inch and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
R. Install flanges in piping, NPS 2 ½ -inch and larger, at final connections of equipment and elsewhere as indicated.
S. Install shutoff valve immediately upstream of each dielectric fitting.
T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."
Y. Piping shall not be installed over electrical panels, equipment, transformers, motor control centers, switch, gear, or substations. If absolutely necessary piping may be sleeved to prevent water from falling on electrical gear provided the installation is acceptable to the electrical inspectors and shall be approved by the engineer prior to installation.
Z. Allow clearances for expansion and contraction. Provide swing ells at connection points so as not to strain piping systems.

AA. Exposed insulated risers shall be covered with 22 gauge galvanized steel sleeves from floor to ceiling.
BB. All piping shall be installed on the interior conditioned side of the building insulation.
CC. Piping shall not be insulated until it is pressure and leak tested and until the building is closed in.

3.03 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
B. Dielectric Fittings for NPS 2-iinch and Smaller: Use dielectric unions.
C. Dielectric Fittings for NPS 2 ½ -inch to NPS 4-inch: Use dielectric flanges.
D. Dielectric Fittings for NPS 5-inchand Larger: Use dielectric flange kits.

3.04 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
C. Install the following pipe attachments:
    1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
    2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
    3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
    4. Spring hangers to support vertical runs.
    5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
    6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
    1. NPS 3/4-inch: Maximum span, 7 feet.
    2. NPS 1-inch: Maximum span, 7 feet.
    3. NPS 1 ½ -inch: Maximum span, 9 feet.
    4. NPS 2-inch: Maximum span, 10 feet.
    5. NPS 2 ½ -inch: Maximum span, 11 feet.
    6. NPS 3-inch and Larger: Maximum span, 12 feet.
E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
    1. NPS 3/4 -inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
    2. NPS 1-inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
    3. NPS 1 ¼ -inch: Maximum span, 6 feet; minimum rod size, 3/8 inch.
    4. NPS 1 ½ -inch: Maximum span, 6 feet; minimum rod size, 3/8 inch.
    5. NPS 2 -inch: Maximum span, 10 feet; minimum rod size, 3/8 inch.
    6. NPS 2 ½ -inch: Maximum span, 10 feet; minimum rod size, 3/8 inch.
    7. NPS 3-inch and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.05 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. 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.
D. 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/A5.8M.
E. 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.
F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
G. Plastic Piping Solvent-Cemented 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.
H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.06 WELDING

A. All concealed black steel piping shall be fusion welded.
B. Welding shall be performed in conformance with the ASME Boiler and Pressure Vessel Code Section IX.
C. Elbows, tees, and branch connections shall be made with welding fittings ANSI B16.9.
D. Furnish welder test certificates for review. Certificates of successful welder qualification by the following organizations shall be acceptable;
    ASME Boiler and Pressure Vessel Code
    ANSI Code for Pressure Piping
    National Certified Pipe Welding Bureau
    Military Specification MIL-STD-248.
E. Weld-o-lets and Thread-o-lets are allowed but shall be a maximum of one size smaller than line size, i.e., a maximum of a 3 inch weld-o-let on a 4 inch pipe.

3.07 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
B. Install control valves in accessible locations close to connected equipment.
C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.08 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:
1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION