23 2113 - Hydronic Piping

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 EQUIPMENT CRITERIA

B. Equipment and Materials shall be specified to be free of silicone

C. Where there is no alternative, BAE shall review and approve all equipment containing silicone.

1.3 SUMMARY

1.3.1 Section includes pipe and fitting materials and joining methods for the following:

- Copper tube and fittings.
- Steel pipe and fittings.
- Joining materials.
- Dielectric fittings.

1.3.2 ACTION SUBMITTALS

1.3.2.1 Product Data: For each type of the following:

- Pipe.
- Fittings.
- Joining materials.

1.3.2.2 Shop Drawings

1.3.2.3 Delegated Designs

1.3.3 INFORMATIONAL SUBMITTALS

1.3.3.1 Coordination Drawings: Detail, at 1/4 (1:50) scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops. Coordinate with the following:

1.3.3.1.1 Suspended ceiling components (new and existing).

1.3.3.1.2 Other building services (new and existing).

1.3.3.1.3 Structural members (new and existing).

1.3.3.2 Welding certificates.

1.3.3.3 Certification for anchor installation.

1.3.3.4 Field quality-control reports.

1.3.4 QUALITY ASSURANCE

1.3.4.1 Installer Qualifications:

1.3.4.2 Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.3.4.3 Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

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

1.3.4.3.2 Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.3.4.4 ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.3.4.5 Installation of copper tubing for hydronic systems shall conform to the requirements of the International Codes (IMC, IPC, etc.).

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.1.1 Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

2.1.1.1 Hot-Water Heating Piping: 150 psig at 250 deg F.

2.1.1.2 Chilled-Water Piping: 150 psig at 150 deg F.

2.1.1.3 Condenser-Water Piping: 150 psig at 150 deg F.

2.1.1.4 Makeup-Water Piping: 150 psig at 100 deg F.

2.1.1.5 Condensate-Drain Piping: 150 deg F.

2.1.1.6 Air-Vent Piping: 250 deg F.

2.1.1.7 Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

2.2.1 Drawn-Temper Copper Tubing: ASTM B 88, Type L.

2.2.2 DWV Copper Tubing: ASTM B 306, Type DWV.

2.2.3 Wrought-Copper Fittings: ASME B16.22.

2.2.4 Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

2.3.1 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.

2.3.2 Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

2.3.3 Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

2.3.4 Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

2.3.5 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 Part 3 "Piping Applications" Article.

2.3.6 Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

2.3.7 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:

2.3.7.1 Material Group: 1.1.

2.3.7.2 End Connections: Butt welding.

2.3.7.3 Facings: Raised face.

2.3.7.4 Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 JOINING MATERIALS

2.4.1 Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

2.4.1.1 ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

2.4.1.2 Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

2.4.1.3 Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2.4.2 Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

2.4.3 Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813. Canfield 100% Watersafe or approved substitution.

2.4.4 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.

2.4.5 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.

2.4.6 Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures with spiral wound stainless-steel reinforcement.

2.5 DIELECTRIC FITTINGS

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

2.5.1.1 Dielectric unions are not acceptable.

2.5.1.2 Dielectric Waterways/Nipples:

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

- Perfection Corporation; a subsidiary of American Meter Company.
- Precision Plumbing Products, Inc.
- Sioux Chief Manufacturing Company, Inc.
- Elster Perfection Corporation.

2.5.1.2.2 Description:

- Standard: IAPMO PS 66.
- Electroplated steel nipple, complying with ASTM F 1545.
- Pressure Rating: 300 psig at 225 deg F. End Connections: Male threaded.
- Lining: Inert and noncorrosive, propylene.

2.5.1.3 Dielectric Flanges, where applicable:

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

- Watts Regulator Co.; a division of Watts Water Technologies, Inc
- Approved substitution

2.5.1.3.2 Description:

- Standard: ASSE 1079.
- Factory-fabricated, bolted, companion-flange assembly.
- Pressure Rating: 300 psig.
- End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.5.1.4 Dielectric-Flange Insulating Kits:

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

- Advance Products & Systems, Inc.
- Calpico, Inc.
- Central Plastics Company.
- Pipeline Seal and Insulator, Inc.

2.5.1.4.2 Description:

- Nonconducting materials for field assembly of companion flanges.
- Gasket: Garlock, Neoprene or phenolic.
- Bolt Sleeves: Phenolic or polyethylene.
- Washers: Phenolic with steel backing washers.

2.6 VALVES

2.6.1 Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 – General-Duty Valves for HVAC Piping.

2.6.2 Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 – Instrumentation and Control for HVAC.

2.7 AIR CONTROL DEVICES

2.7.1 Manual Air Vents: Provide 3/4" hose end ball valve or larger. Refer to specification section 230523 for valve specifications.

PART 3 – EXECUTION

3.1 PIPING APPLICATIONS

3.1.1 Hot-water heating piping/Glycol Heating Water Piping, aboveground, NPS 2 and smaller, shall be the following:
3.1.1.1 Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.

3.1.2 Hot-water heating piping/Glycol Heating Water Piping, aboveground, NPS 2-1/2 and larger, shall be the following:
3.1.2.1 Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints. Keep flanges to a minimum.

3.1.3 Chilled-water piping/Process Chilled Water, aboveground, NPS 2 and smaller, shall be the following:
3.1.3.1 Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.

3.1.4 Chilled-water piping/Process Chilled Water, aboveground, NPS 2-1/2 and larger, shall be the following:
3.1.4.1 Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints. Keep flanges to a minimum.

3.1.5 Condenser-water piping, aboveground, NPS 2 and smaller, shall be the following:
3.1.5.1 Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.

3.1.6 Condenser-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
3.1.6.1 Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints. Keep flanges to a minimum.

3.1.7 Makeup-water piping installed aboveground shall be the following:
3.1.7.1 Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.

3.1.8 Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

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

3.1.9 Air-Vent Piping:
3.1.9.1 Inlet: Same as service where installed.
3.1.9.2 Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

3.2 VALVE APPLICATIONS

3.2.1 Install shut-off-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

3.2.2 Install calibrated-orifice, balancing valves at each branch connection to return main.

3.2.3 Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

3.3 PIPING INSTALLATIONS

3.3.1 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. Coordination drawings are listed as an information submittal. All deviations from the contract drawings must be reviewed and accepted by the engineer of record and BAE.

3.3.2 Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

3.3.3 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.

3.3.4 Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

3.3.5 Install piping to permit valve servicing for maintenance and access.

3.3.6 Install piping at indicated slopes.

3.3.7 Install piping free of sags and bends.

3.3.8 Install fittings for changes in direction and branch connections.

3.3.9 Install piping to allow application of insulation.

3.3.10 Select system components with pressure rating equal to or greater than system operating pressure.

3.3.11 Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

3.3.12 Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

3.3.13 Install piping at a uniform grade of 0.2 percent upward in direction of flow.

3.3.14 Reduce pipe sizes using eccentric reducer fitting installed with level side up.

3.3.15 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.

3.3.16 Install shut off valves in supply and return branch takeoffs from mains.

3.3.17 Install valves in accordance with Ball Valves, Check Valves, and Butterfly Valves for HVAC piping.

3.3.18 Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated. At these sizes, soldered or brazed connections are acceptable.

3.3.19 Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated. For these sizes, use welded connections.

3.3.20 Install shutoff valve immediately upstream of each dielectric fitting.

3.3.21 Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

3.3.22 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."

3.4.1 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."

3.4.2 Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.5 DIELECTRIC FITTING INSTALLATION

3.5.1 Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.5.2 Dielectric Fittings for NPS 2 and Smaller: Use dielectric waterways.

3.5.3 Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or nipples.

3.5.4 Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGERS AND SUPPORTS

3.6.1 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.

3.7 PIPE JOINT CONSTRUCTION

3.7.1 Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

3.7.2 Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

3.7.3 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.

3.7.4 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.

3.7.5 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:

3.7.5.1 Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

3.7.5.2 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.

3.7.6 Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

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

3.8 TERMINAL EQUIPMENT CONNECTIONS

3.8.1 Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

3.8.2 Install control valves in accessible locations close to connected equipment.

3.8.3 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."

3.9 FIELD QUALITY CONTROL

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

3.9.1.1 Leave joints, including welds, uninsulated and exposed for examination during test.

3.9.1.2 Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3.9.1.3 Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.

3.9.1.4 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.

3.9.1.5 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.

3.9.2 Perform the following tests on hydronic piping:

3.9.2.1 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.

3.9.2.2 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.

3.9.2.3 Isolate expansion tanks and determine that hydronic system is full of water.

3.9.2.4 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."

3.9.2.5 After hydrostatic test pressure has been applied for at least two hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

3.9.2.6 Prepare written report of testing.

3.9.3 Perform the following before operating the system:

3.9.3.1 Open manual valves fully.

3.9.3.2 Inspect pumps for proper rotation.

3.9.3.3 Set makeup pressure-reducing valves for required system pressure.

3.9.3.4 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).

3.9.3.5 Set temperature controls so all coils are calling for full flow.

3.9.3.6 Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.

3.9.3.7 Verify lubrication of motors and bearings.

END OF SECTION