SECTION 232113

HYDRONIC PIPING

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes piping, valves, special-duty valves, and hydronic specialties for chilled-water cooling; makeup water for these systems; blowdown drain lines; and condensate drain piping.

1.2 DEFINITIONS

A. CPVC: Chlorinated polyvinyl chloride.
B. PVC: Polyvinyl chloride.
C. HDPE: High Density Polyethylene

1.3 SUBMITTALS

A. Valves: Product data for each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.
B. Specialties: Product data for expansion tanks, strainers, and air separators.

1.4 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
B. 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 the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.5 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate piping installation equipment supports.

D. Coordinate pipe fitting pressure classes with products specified in related Sections.

E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Include products intended to be used to close firestop openings created when site conditions require forming of cutting walls, partitions, or floors. This fire stop material is used to close openings and continue a fire resistance rating uninterrupted. No flammable materials shall be used. Provide foaming by one of the following:

   1. Metacauk, Meta-foam.
   4. 3-D fire caulk.

1.6 EXTRA MATERIALS

A. Water Treatment Chemicals: Furnish sufficient chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion. Turn chemicals over to district representative; obtain receipt.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

   1. Grooved Mechanical-Joint Fittings and Couplings:
      a. Central Grooved Piping Products.
      b. Grinnell Corporation.
      c. Victaulic Company of America.

   2. Valves:
      a. Nibco
      b. Apollo
c. Mueller

d. Metra Flex

e. Crane

3. Check Valves:
   a. Mueller
   b. Nibco

4. Relief Valves:
   a. Sarco
   b. Watts
   c. Wilkens

5. Calibrated Balancing Valves:
   a. Armstrong Pumps, Inc.
   b. ITT Bell & Gossett; ITT Fluid Technology Corp.
   c. Griswold Controls.

6. Pressure-Reducing Valves:
   a. Armstrong Pumps, Inc.
   b. ITT Bell & Gossett; ITT Fluid Technology Corp.
   d. Amtrol, Inc.

7. Safety Valves:
   a. Armstrong Pumps, Inc.
   b. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
   c. Amtrol, Inc.

8. Automatic Flow-Control Valves:
   b. Griswold Controls.
9. Expansion Tanks:
   a. Armstrong Pumps, Inc.
   b. ITT Bell & Gossett; ITT Fluid Technology Corp.
   c. Taco, Inc.
   d. Amtrol, Inc.

10. Air Separators and Air Purgers:
    a. Armstrong Pumps, Inc.
    b. ITT Bell & Gossett; ITT Fluid Technology Corp.
    c. Taco, Inc.
    d. Amtrol, Inc.

2.2 CHILLED AND HOT WATER PIPING, 2 INCHES AND UNDER (ABOVE GROUND)
A. Drawn-Temper Copper Tubing: ASTM B 88, Type L
B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
C. Wrought-Copper Fittings: ASME B16.22.
D. Wrought-Copper Unions: ASME B16.22.
E. Threaded Pipe Nipples and Fittings: ANSI B16.15-1985, Schedule 40, hand drawn brass or copper pipe nipples with cast brass or copper fittings.

2.3 CHILLED WATER PIPING, 2-1/2 INCHES AND LARGER (ABOVE GROUND)
A. Steel Pipe, NPS 2-1/2 through NPS 12: ASTM A 53, Type E (electric-resistance welded), Grade A, Schedule 40, black steel, plain ends.
B. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   2. End Connections: Butt welding.
   3. Facings: Raised face.
C. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47, Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM
A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.

D. Grooved Mechanical-Joint Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings. Victaulic Style 07 and 77.

E. Flexible Connectors: Stainless steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250°F maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.

F. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250°F and pressures up to 150 psig.

G. Packed, Slip, Expansion Joints: 150-psig minimum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, packing ring, packing, limit rods, flanged ends, and chrome-plated finish on slip-pipe telescoping section.

H. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

I. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures

J. Insulation: cellular glass ASTM C 552, Type II, Class 2. Refer to Section 15181 “Mechanical System Insulation” for details.

2.5 EQUIPMENT DRAINS

A. Copper Tubing: ASTM B88, Type L hard drawn.
   2. Joints: ASTM B32, lead-free solder, 95-5 tin-antimony or tin-silver with melting range of 430 to 535 Degree F; ANSI/AWS A5.8, brazed, BcuP silver/phosphorus/copper alloy with melting range of 1190 to 1480 Degree F.

B. PVC Pipe: ASTM D1785, UV inhibited, Schedule 40 PVC.
   1. Fittings: ASTM D2466 or D2467, PVC.

2.6 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.
B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:
   1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
   2. Gear Drive: For quarter-turn valves NPS 8 and larger.
   3. Handwheel: For valves other than quarter-turn types.
   4. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
   5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

G. Extended Valve Stems: On all insulated valves.


I. Valve Grooved Ends: AWWA C606.
   1. Solder Joint: With sockets according to ASME B16.18.
      a. Caution: Use solder with melting point below 840°F for angle, check, gate, and globe valves; below 421°F for ball valves.
   2. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45

2.7 HYDRONIC SPECIALTIES

A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225°F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.

B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240°F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.

C. Expansion Tanks: Welded carbon steel, rated for 125-psig working pressure and 375°F maximum operating temperature. Separate air charge from system water to maintain design
expansion capacity by a flexible bladder securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

D. Diverting Fittings: 125-psig working pressure; 250°F maximum operating temperature; cast-iron body with threaded ends, or wrought copper with soldered ends. Indicate flow direction on fitting.

E. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.

F. Flexible Connectors: Stainless steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250°F maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.

G. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250°F and pressures up to 150 psig.

H. Packed, Slip, Expansion Joints: 150-psig minimum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, packing ring, packing, limit rods, flanged ends, and chrome-plated finish on slip-pipe telescoping section.

I. Calibrated Balancing Valves, NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250°F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

J. Calibrated Balancing Valves, NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250°F maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

K. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.

L. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

2.8 GATE VALVE
A. Up to 2 Inches: Bronze body and trim, non-rising stem and handwheel, inside screw, single wedge or disc, threaded ends. Solder ends for copper pipe.

B. Over 2 Inches: Cast iron body, bronze trim, rising stem and handwheel, OS&Y, single wedge, flanged ends.

2.9 GLOBE VALVE

A. Up to 2 Inches: Bronze body and trim, non-rising stem and handwheel, inside screw, renewable composition disc, soldered or threaded ends with backseating capacity.

B. Over 2 Inches: Cast iron body, bronze trim, rising stem and handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.10 BALL VALVE

A. Up to 2 Inches: Bronze body, stainless steel ball, full port, teflon seats and stuffing box ring, lever handle, balancing stops, extended neck, soldered or threaded ends.

B. Over 2 Inches: Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged ends.

2.11 BUTTERFLY VALVE

A. Over 2 Inches: Cast iron body, bronze or stainless steel disc, resilient replaceable seat for service to 250 Degree F, lug ends, extended neck, ten position lever handle or handwheel and gear drive on valves 6 inches and larger unless otherwise noted. Extended neck shall extend beyond insulation for unobstructed operation. Gear operators shall be provided on valves at pumps and chilled water inlet and outlet.

2.12 PLUG VALVE

A. Up to 2 Inches: Bronze body, bronze tapered plug, non-lubricated, Teflon packing, threaded ends with one wrench operator for every ten plug cocks.

B. Over 2 Inches: Cast iron body and plug, pressure lubricated, Teflon packing, flanged ends with wrench operator with set screw.

2.13 CHECK VALVE

A. Silent Check Valve: Cast iron body, bronze trim, stainless steel spring, renewable composition disc, threaded or flanged ends.

B. Swing Check Valve:

1. Up to 2 Inches: Bronze body, 22 or 45 degree swing disc, threaded ends.
2.14 RELIEF VALVE
   A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities. ASME certified and labeled.

2.15 FLANGES, UNIONS AND COUPLING
   A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
   B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping.

2.16 PIPING ACCESSORIES
   A. Gage Cocks:
      1. Screwed, bronze, tee handle.
      2. Manufacturers: Crane Company or Jenkins
   B. Straight Thermometers:
      1. Mercury filled, 9-inch scale “V” shaped, adjustable angle, separable socket well thermometers.
      2. Select thermometer range with operating temperature at midpoint of range.
      4. Provide solar powered digital thermometers as an alternate.
   C. Gages:
      1. Standard depth, cast aluminum alloy case, not less than 3½ “ faces, with operating pressure at midpoint of range.
      2. Manufacturers: Trerice or Weiss
   D. Thermometer Wells: Provide thermometer wells at thermometer locations.
      1. Construction: Brass, with 2 inch insulation extension neck and with cap and chain.
      2. Provide tees in lines 3 inches or less for thermometer wells.
3.1 PIPING INSTALLATIONS

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

B. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS ¾ threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

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

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

E. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.

F. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

G. Anchor piping for proper direction of expansion and contraction.

3.2 HANGERS AND SUPPORTS

A. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.

2. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

B. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.

2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.

3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.

4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.

5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.

6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.

7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.

8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.

C. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

D. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.3 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents in mechanical equipment rooms only at high points of system piping, at heat-transfer coils, and elsewhere as required for system air venting. Pipe discharge to floor drain.

C. Install in-line air separators in pump suction lines. Install drain valve on units NPS 2 and larger.

D. Install strainer in pump suction lines. Install blowdown piping with gate valve; extend to nearest drain.

E. Install piping to compression tank with a 2 percent upward slope toward tank.

F. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above floor. Install feeder in bypass line, off main, using globe valves on each side of feeder and in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.

G. Install expansion tanks on floor on housekeeping pad. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements. Tie expansion tank into side of main to minimize air and debris from settling in tank.

H. Flexible piping connectors may be substituted with three Victaulic style, grooved mechanical joints at connections to coils, pumps, and other hydronic accessories.
3.4 VALVE APPLICATIONS

I. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
   1. Shutoff Duty: Ball and butterfly valves.
   2. Throttling Duty: Ball and butterfly valves.

J. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line.

K. Install calibrated balancing valves in the return water line of each cooling element and elsewhere as required to facilitate system balancing.

L. Install check valves at each pump discharge and elsewhere as required to control flow direction.

M. Install pressure-reducing valves as shown to regulate system pressure.

3.5 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheel operators on valves NPS 3 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor elevation.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be same as for equipment connections.

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

C. Install ports for pressure and temperature gages at coil inlet connections.

3.7 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. Flush system with clean water. Clean strainers.
3. 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.
4. 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.
2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test.
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.

3.8 ADJUSTING

A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:

1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check 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. Check operation of automatic bypass valves.
7. Check and set operating temperatures of chillers to design requirements.
8. Lubricate motors and bearings.

3.9 CLEANING

A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

3.10 PIPE JOINT CONSTRUCTION

A. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during razing to prevent scale formation.

3.11 CLEANING

A. Replace core of filter-dryer after system has been adjusted and design flow rates and pressures are established.

PART 4 - PROJECT SPECIFIC REQUIREMENTS

None required.

END OF SECTION 232113