SECTION 23 21 00 - HYDRONIC SYSTEMS

PART 1 - GENERAL

1.1 SYSTEM DESIGN REQUIREMENTS

A. Design piping systems with drain valves at low points of piping, bases of vertical risers, and at equipment.

B. In hydronic systems subject to freezing provide Dowfrost solution or pumped coils.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Valves:
      a. Automatic Fill Valves:
         1) ITT Bell and Gossett, Model B7-12
         2) Amtrol, Model 11F

2.2 MATERIALS, GENERAL

A. Piping and Fittings:
   1. General: Working pressure and temperature maximums, 125 psi and 250 degrees F; water service.
   2. Copper Pipe: ASTM B88-96, copper tubing, hard drawn, Type K for underground lines and Type L for above ground lines.
      a. Fittings: ASME B16.22-95, wrought copper solder joint.
      b. Joining Material:
         1) Solder: ASTM B32-96, 95-5 tin-antimony solder for above ground lines.
         2) Brazing: AWS A5.8-92, Classification BAg 1 (silver) for underground lines and where copper pipe is connected to brass.
      c. Unions: ASME B16.22-95. Wrought copper solder joint, ground seat.
      d. Flanges: Class 125, cast iron or cast bronze flanges.
         1) Bolts and Nuts: ASME B18.2.1-96, carbon steel square head machine bolts with galvanized heavy hex nuts.
         2) Gaskets: ASME B16.21-92, nonmetallic, flat, 1/16-inch, full faced, for water service.
      e. Dielectric Connections: Fittings having insulating material isolating joined dissimilar metals.
         1) Dielectric Waterway Fittings: 175 psi minimum working pressure, ends to match connections.
         2) Flanges: Class 125, cast bronze, ASME Standard, with bolt insulators, dielectric gasket, bolts, and nuts.
   3. Steel Pipe: ASTM A53-96, Schedule 40, seamless black steel pipe.
      a. Fittings:
         1) Threaded: ASME B16.4-92, Class 125, cast iron, or ASME B16.3-92, Class 150, malleable-iron. Standard pattern for threaded joints. Threads shall conform to ASME B1.20.1-83.
         2) Flanged: ASME B16.1-89, Class 125, cast iron, raised ground face, bolt holes spot faced.
         3) Welded: ASTM A234-96, standard weight, butt weld, black iron.
         4) Grooved Couplings and Mechanical Fittings: ASTM A536-84 ductile or ASTM A47-90 malleable iron, with enamel finish and grooves or shoulders designed to

accept grooved couplings. Synthetic-rubber gasket, with central-cavity, pressure-responsive design, and ASTM A183-83 carbon-steel bolts and nuts.

b. Unions: ASME B16.39-86, malleable-iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

c. Dielectric Waterway Fittings : Threaded end connections. Install to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.

B. Valves:

1. Safety Relief Valves:

a. Brass or bronze body with brass and rubber, wetted, internal working parts. Valves designed, built, rated, and stamped in accordance with ASME.

2. Automatic Fill Valve: Diaphragm operated, cast brass body, fill valve designed to maintain water pressure in a closed water system. Valves shall include cleanable strainer, removable seat assembly, and built-in check valve. Valves shall have factory setting of 12 psig with field adjustment range of 10 - 25 psig. Maximum operating temperature shall be 225 degrees F, maximum working pressure of 125 psig. Valve shall have 3/4-inch inlet and outlet.

C. Piping Accessories:

1. Drain Pans: Minimum 18-gauge stainless steel, reinforced to support weight of drain pan and water.

D. Expansion Loop Guides:

1. Factory fabricated cast steel, consisting of bolted two-section outer cylinder and base. Provide two-section alignment guide spider that bolts tightly to pipe.

E. Air Separator:

1. In-Line Air Separator: Heavy duty cast iron air separator constructed for 175 psi minimum working pressure and 300 degree F. Integral weir to maximize air separation. Top outlet connection for air vent and bottom connection for expansion tank.

2. Centrifugal Air Separator: Welded steel tank, ASME constructed and labeled for 125 psig minimum working pressure and 350 degree F maximum operating temperature. In-the-pipeline type air separator with tangential openings for water in and out. Inside designed to create a low velocity vortex for the separation of free air from the water stream. Internal steel strainer with perforations sized for water flow. 2-inch bottom drain and 1-1/4-inch connection located at top of air separator for expansion tank connection.

F. Diaphragm Expansion Tank:

1. Welded steel tank suitable for 125 psig working pressure and 350 degrees F maximum operating temperature. Separate air charge from system water by means of a flexible diaphragm sealed into tank. Tank shall have taps for pressure gauge, air charge fitting, and drain. Tank constructed, tested, and labeled in accordance with ASME Pressure Vessel Code-95.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Copper Pipe:

1. Install Type L copper pipe with wrought copper fittings and solder joints for 2-inch and smaller pipe, above ground, within building.

2. Install Type K copper pipe for 2 inch and smaller pipe below ground.

B. Steel Pipe:

1. Threaded Joints: Install steel pipe with threaded joints and fittings for 2-inch and smaller in exposed locations such as mechanical rooms.

2. Welded and Flanged Joints: Install welded fittings on pipe 2-1/2 inches and larger.

3. Grooved Couplings and Mechanical Fittings: Install mechanical grooved end pipe on condenser water piping.

C. Arrange piping in horizontal groups, each group to be in one plane. Maintain indicated slope. Conceal pipe installations in walls, pipe chases, utility spaces, mechanical rooms, above ceilings, below grade or floors.

D. Install piping in accordance with the stipulations in Section 01040..

E. Sloping, Air Venting, and Draining:
1. Install piping true to line and grade, and free of traps and air pockets. Slope piping up in direction of flow at 0.2 percent grade.
2. Provide eccentric reducers for changes in horizontal piping, top side flat.
3. Connect branch piping to bottom of mains, except for up-feed risers which shall have take-off out top of main.
4. Install manual air vents at high points in hydronic piping systems and at coils other than air handling units. Provide 1/4-inch copper, 180-degree bend pipe to discharge vented water into can.
5. Install automatic air vent on air separator, water coils at air handling units, and where shown. Provide valved inlet and discharge piped to floor drain.
6. Install drain valves with hose adapters at low points in mains, risers, and branch lines. Drain shall consist of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap. Provide drain valves for float type controllers.

F. Fittings: Standard manufactured fittings. Field fabricated fittings and bushings are prohibited on all piping.

G. Unions: Install unions in pipes 2-inch and smaller, adjacent to each valve, at final connections of each piece of equipment and elsewhere to permit alterations and repairs. Install dielectric waterway fittings to join dissimilar metals. Unions are not required on flanged devices.

H. Flanges: Install flanges on valves and equipment having 2-1/2-inch and larger connections.

I. Pipe Ends: Cut pipes, remove burrs and prepare ends with full inside diameter.

J. Joints:
1. Threaded Joints: Apply Teflon tape to male equipment threads. Do not use pipe with threads which are corroded or damaged.
2. Soldered Joints: Comply with procedures contained in AWS Soldering Manual-98. Clean surfaces to be joined of oil, grease, rust, and oxides. Clean socket of fitting and end of pipe with emery cloth. After cleaning and before assembly or heating, apply flux to joint surface and spread evenly.

K. Keep openings in piping closed during construction to prevent entrance of foreign matter.

L. Install stainless steel flexible connectors at inlet and discharge connections to base-mounted pumps and other vibration producing equipment.

M. Valves:
1. Field check valves for packing and lubricant. Replace leaking packing. Service valves with lubricant for smooth and proper operation before placing in service.
2. Install valves accessible from floor level, located for easy access. Install valves in horizontal piping with stem at or above center of pipe. Install valves in position to allow full stem movement. Provide operating handles for valves and cocks without integral operators.
3. Provide extended valve stems where insulation is specified.
4. Provide separate support where necessary.

5. Where soldered end connections are used for valves, use solder having a melting point below 840 degrees F for gate, globe, and check valves; below 421 degrees F for ball valves.
6. Provide valves same size as line size.
7. Provide gate blow-down valves and hose adapters at strainers; same size as strainer blow-off connection.
8. Provide mechanical actuators with chain operators where valves 2-1/2 inches and larger are mounted more than 6 feet above the floor. Extend chains to elevation of 5 feet above floor.
9. Check Valves: Install wafer or lift check valves on pump discharge. Install check valves for proper direction of flow as follows:
    a. Swing Check Valve: Horizontal position with hinge pin level.
    b. Wafer Check Valve: Horizontal or vertical position, between flanges.
    c. Lift Check Valves: With stem upright and plumb.

N. Equipment Piping:
1. Provide combination balancing and shutoff valves to regulate water flow through piping, coils, and at other equipment and piping where shown or required for proportioning flow.
2. Install automatic fill valve in cold water make-up to boilers and chillers. Install three-valve bypass with globe valve around automatic fill valve for quick filling system. Install backflow preventers upstream of fill valve and bypass.

O. Expansion Loops, Guides, and Anchors:
1. Install piping with provisions for expansion and contraction, using expansion loops. Provide for expansion and contraction in mains, risers, and run-outs. Install pipe expansion loops cold-sprung in tension for piping with operating temperatures higher than installed temperature and compression for piping with operating temperatures lower than installed temperatures. Install pipe to absorb 50 percent of total compression or tension produced during anticipated change in temperature. Do not bend piping without use of bending machine.
2. Install guides to properly direct pipe movement into expansion loops and offsets.
3. Install anchors to control movement in piping. Weld anchors to ferrous piping and braze anchors to nonferrous piping. Install pipe anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops.
4. Install in accordance with standards of Expansion Joint Manufacturer's Association, EJMA-93.

P. Drain Pans:
1. Provide drain pans under the entire length of any piping, including valves, joints, and fittings for any liquid-carrying piping system installed over any motor, motor starter, switch gear, transformer, or other electrical equipment. Also, under all such piping located anywhere in any transformer vault, electrical switchboard room, and telephone equipment room. Drain pans shall be not less than 2 inches deep, with a 3/4-inch drain pipe to discharge where shown or to discharge at nearest convenient drain line, floor drain, or other approved drain point.

Q. Expansion Tank and Air Separator Installation:
1. Install tanks as shown; locate appurtenances for easy servicing.
2. Install gate valve and union on air separator drain to facilitate removal of strainer. Route discharge on air separator tank to nearest drain.
3. Check expansion tank after cleaning, testing, and filling of system to ensure system is completely full.
4. Provide bracket supports, saddles, and hangers to support tanks.
5. Install air separator level in both directions, supported from structure so that all pipe can be removed without moving tank.
6. Charge expansion tank with proper air charge.

3.2 TESTING, CLEANING AND CERTIFICATION

A. Test piping systems using ambient temperature water, except where there is risk of damage due to freezing.

B. Release trapped air while filling system using vents at high points. Use drains installed at low points for complete removal of liquid.

C. Isolate equipment and parts that cannot withstand test pressures.

D. 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.

E. 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.

F. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.

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

H. Prepare written report of testing, indicating locations of leaks corrected, method used to correct leaks, number of tests required, and certification that system is leak free.

3.3 COMMISSIONING (DEMONSTRATION)

A. Provide 2 hours of instruction on hydronic systems. Include following items as a minimum:
1. Location of automatic and manual air vents.
2. Location of strainers and blow down valves.
3. Location of safety and relief valves.
4. System drain valves.
5. System fill and associated devices.
6. Expansion tank and air separator.

END OF SECTION 23 21 00