



DESIGN REQUIREMENTS

HYDRONIC PIPING SPECIALTIES AND PIPING GUIDELINES

GENERAL INFORMATION

- 1.1 This section applies to piping systems specialties for hot water heating, chilled water cooling, condenser water, make-up water for these systems, condensate drain piping, or any other HVAC water and/or glycol piping system.

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- 2.1 The design documents shall include a flow diagram of the hydronic system indicating all major components of the system, isolation and control valves, unions/flanges, pipe sizes, pressure and/or temperature relief devices, direction of flow, etc.
- 2.2 Connection to equipment should be made to permit ready disconnection of equipment with minimum disturbance to adjoining pipe. Screwed or flanged unions should be used at all equipment connections.
- 2.3 Provide drain valves and $\frac{3}{4}$ " hose connections with drip caps with retaining chain at low points of each hydronic line to permit complete draining of entire system, including the system side of all pump check valves. Drain lines should pitch not less than 1" in 40' in the direction of flow.
- 2.4 Provide vent valves at high points of each hydronic piping system to permit complete purging of air from the system. Automatic vents require isolation valves.
- 2.5 Miscellaneous drains and overflow from tanks, equipment, piping, water relief valves, pumps, etc. should be run to the nearest indirect drain and terminated in an elbow above the drain.
- 2.6 Minimum hydronic pipe size should be $\frac{3}{4}$ ".
- 2.7 Minimum hydronic pipe riser size should be 1".
- 2.8 In all systems operating at temperatures above 100°F., all runouts to risers and equipment should have 18" minimum spring piece offsets or 3 elbow swings to absorb expansion.
- 2.9 Unions should be provided at valves, strainers, apparatus, pumps, heat exchangers, tanks, machines and equipment to permit easy dismantling of piping and apparatus. Each piping connection to each piece of equipment should have a union or flanged connection.

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- 2.10 Provide a drain and drain-valve with hose connection and drip cap for all equipment containing water. If this equipment is within a mechanical equipment room, provide a gate valve piped to a floor drain.
- 2.11 Pipe relief and safety valves to roof vent pipes, or other approved open locations, to dispose of discharge without injury to equipment, personnel or premises.
- 2.12 Eccentric reducers shall be used to prevent trapping of air in top of pipe. Bottom of reducer should be flat.
- 2.13 All valves and piping specialties shall be located to permit easy operation and access.
- 2.14 All water coils shall be vented at the top and drained at the bottom with drain valves with hose connections and drip pans.
- 2.15 All piping connections to coils and equipment shall be made with offsets provided with screwed or welded bolted flanges so arranged that the equipment can be serviced or removed without dismantling the piping.
- 2.16 Piping carrying water shall not be installed or designed for installation over electrical switchgear, motor control centers, transformers, nor in elevator shafts and elevator equipment rooms.
- 2.17 Equipment Requirements
 - a. Diaphragm Type Expansion Tanks: Welded steel, test and stamped in accordance with ASME Section VIII, rated to suite the operating pressure with flexible butyl diaphragm sealed into the tank.
 - b. Air Separators: Steel, tested and stamped in accordance with ASME Section VIII, rated to suite the operating pressure, with integral bronze strainer, tangential inlet and outlet connections and internal stainless steel air collector tube.
 - c. Strainers
 - 1. Size 2 inches (50 mm) and Smaller:
 - a) Screwed brass, iron or steel body to suite the working pressure (minimum 175 psig), Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
 - 2. Size 2-1/2 inches (65 mm) to 4 inches (100 mm):
 - a) Flanged iron or steel body to suite the working pressure (minimum 175 psig), Y pattern with 3/64 inch (1.2 mm) stainless steel perforated screen.

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3. Size 5 inches (125 mm) and Larger:
 - a) Flanged iron or steel body to suite the working pressure (minimum 175 psig), basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.
- d. Relief Valves
 1. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.
- e. All consumption meters shall be tied into the University's data acquisition system.
- f. Thermometers and Temperature Wells
 1. Provide duct thermometers of the dial face type, minimum 4-1/2" diameter, liquid-filled with averaging bulb. Thermometers in ductwork shall be provided with suitable flanges for duct mounting, with not less than 12" stem.
 2. Thermometers shall be non-mercury, adjustable to every angle, of industrial grade, complete with double thick glass front and separable socket. Scales shall be a minimum of 9" long. Where the scale is 10' or more above the finished floor, use a 12" minimum scale length.
 3. Each thermometer to be installed in an extension neck brass separable socket. Extension neck length to be coordinated with insulation thickness. Socket and thermometer insertion length to be minimum of 75% pipe diameter.
 4. Temperature Wells are to be filled with a thermal gel to eliminate void between well wall and sensor element.
 5. Accuracy is to be factory calibrated to $\pm 1^{\circ}\text{F}$., for the average temperature of the system in which it is installed.
 6. Scale ranges shall be as follows:
 - a) Hot water, steam, condensate - 30°F to 300°F , with 2-degree scale divisions
 - b) Chilled water - 20°F to 120°F , with 2-degree scale divisions.
 - c) Condenser Water - 20°F to 150°F , with 2-degree scale divisions.

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- d) Scale ranges not indicated to be selected so that normal operating point is between 35% and 65% of full scale.
- g. Pressure Gauges
 - 1. 4½" diameter pressure and/or compound gauges with a cast aluminum case, with rim and glass over the face.
 - 2. Gauge pipe and fittings shall be brass. Piping shall be 1/4" diameter. All gauges shall be provided with shutoff cocks. Pressure gauges shall have a range of at least twice the working pressure, but in no case less than 0 to 30 pounds.
 - 3. Gauges on pumps shall be located directly at suction and discharge nozzle without any intervening valves, strainers or other specialties except for nipple and gauge petcock.
 - 4. Gauge to display operating pressure at center of scale.
 - 5. Provide a siphon and lever handle cock for each pressure gauge installed in the steam system.
 - 6. Gauges in pumped systems shall have micropose pulsation dampeners (commonly called snubbers).
- h. Air Flow Gauges
 - 1. Magnehelic Gauge: 4" dial with frictionless magnetic movements. Gauge to operate without use of fluid. Range to be compatible with service. Accuracy ±2% of scale. Die cast aluminum case with clear plastic face and "O" ring seal. Diaphragm to be silicone rubber with cobalt magnet and sapphire bearings.

CONSTRUCTION REQUIREMENTS

- 3.1 Flange joints should be faced true, packed and made up perfectly square and tight. Each flange joint should be provided with best grade steel bolts and with hexagon nuts. Bolts and nuts should be dipped in a mixture of graphite and oil or "Never Seez" just before installation.
- 3.2 Unions should be provided at valves, strainers, apparatus, pumps, heat exchangers, tanks, machines and equipment to permit easy dismantling of piping and apparatus. Each piping connection to each piece of equipment should have a union or flanged connection.
- 3.3 All piping, after erection, should be thoroughly blown and washed out. During construction, all lines should be properly capped or plugged to prevent the entrance of dirt, sand or foreign matter.

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- 3.4 Hydronic piping should be pitched upward in the direction of flow or the piping should be installed with top of pipes at the same level, using eccentric reducers.
- 3.5 Pipe relief and safety valves to roof vent pipes, or other approved open locations, to dispose of discharge without injury to equipment, personnel or premises.
- 3.6 All valves and piping specialties should be located to permit easy operation and access. All valves should be packed at the completion of the work prior to final inspection.
- 3.7 Equipment Considerations
 - a. Expansion Tank
 - 1. Provide taps for pressure gauge and air charging fitting, and drain fitting.
 - b. Suction Diffuser
 - 1. Provide a permanent magnet located within the flow stream and removable for cleaning. Equip the orifice cylinder with a start-up disposable fine mesh strainer.
 - c. Dielectric Fittings
 - 1. Provide dielectric fittings to connect piping of dissimilar metal and/or connect piping to equipment fabricated of different metal than piping. Piping should be isolated by means of a dielectric material such as teflon, micarta or thermoplastic screwed insulating unions or flange unions to provide cathodic protection currents and to stop galvanic corrosion.
 - 2. Install dielectric waterway fittings to connect piping materials of dissimilar metals.
 - 3. Bronze bodied valves and devices installed in steel piping systems do not require dielectric fittings. Iron bodied valves and devices installed in copper systems require dielectric fittings.
 - 4. All dielectric devices will be affixed with a permanent tag indicating a dielectric device.
 - d. Pipe Line Strainer
 - 1. Install strainers in the inlet connections to pumps, pressure reducing valves, automatic control valves, and where indicated on the Drawings.
 - 2. Equip strainers with ball valve type drain valves.
 - 3. On low temperature systems, connect suitable length of piping to valve to prevent spraying of adjacent piping or equipment during system drain-down. Provide at the end of the piping a male hose connection for connecting a hose to run to a drain.

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4. On high temperature systems extend piping from valve to a floor drain.
5. Prior to installation, disassemble strainer, coat with “Never-Seez” and reassemble.
- e. Thermometer Location and Placement Guidelines:
 1. Thermometers shall be installed at the following locations:
 - a) In inlet and outlet water connections at chilled water coil bank and hot water coils bank in each air handling unit.
 - b) In inlet and outlet of hot water side of heat exchangers.
 - c) In inlet and outlet of chilled water, hot water and condenser water pumps.
 - d) In supply air duct, return air duct and mixed air duct to each air handling unit.
 - e) In and out of each cooling tower water supply.
 - f) In and out of each chiller or boiler.
 - g) In return secondary water and in mixed water line after bleed valves on all bleed systems.
 - h) In inlet and outlet of each reheat coil.
 - i) In inlet and outlet water connections at each domestic hot water heater and where indicated on the drawings.
 - j) Intake air into air handling units.
 - k) Other locations deemed necessary by the design consultant.
 2. Thermometers in ductwork shall be installed at the following locations:
 - a) On air handling units upstream of preheat coil bank.
 - b) On supply air discharge ductwork of air handling units.
 - c) In return air duct and mixed air duct to each air handling unit.
 3. Thermometers shall be installed and adjustable so that the scale is easily readable from floor level.
 4. Thermometers in ductwork shall be provided with suitable flanges for duct mounting, with not less than a 12” stem.

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f. Pressure Gauge Location and Placement Guidelines:

1. Pressure gauges shall be installed in the following locations:
 - a) Upstream and downstream of pressure reducing stations.
 - b) In inlet and outlet of each hot water reheat coil.
 - c) In inlet and outlet of each chilled water coil bank and hot water coils.
 - d) In inlet and outlet of each chiller, boiler, heat exchanger and condenser.
 - e) In inlet and discharge side of each pump.
 - f) At each expansion tank.
 - g) At each cold water makeup to system.
 - h) In inlet side of Chilled Water and Steam stop valves for Building Supply Risers
 - i) Condensate pump discharge
2. Pressure gauges shall be installed so that the scale is easily readable from floor level. Provide extension tubing as required.

g. Air Flow Gauges

1. Install across each air handling unit's filter bank. Sensing ports shall be located on either side of the filter to provide an accurate average static pressure drop across the entire filter bank.

h. Test Plugs

1. Test plugs to be provided at inlet and outlet of each water coil (including unit heaters, cabinet heaters, fan coil units, and other terminal units) that are not provided with thermometers and pressure gauges.

i. Steam Meter

1. A steam meter for recording entire building steam consumption shall be installed at the point of connection of the campus steam main to the building's PRV station. This meter shall be either a steam vortex type or insertion style Turbine Flowmeter, as directed by the Plant Engineering department.



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j. Chilled Water Meter

1. At the connection point of the campus chilled water main, downstream of the isolation valve, an ultrasonic type meter as directed by the Plant engineering department shall be installed, for recording chilled water usage. Follow the manufacturer's recommendations for installation with respect to pipe size, straight run of piping, location, etc.
2. The meter shall be tied into the University's data acquisition system for remote recording of chilled water consumption.
3. The meter shall be of the BTU measuring type with resistance temperature devices measuring supply and return temperature, with a flow meter and math processor to calculate energy consumption (BTU's) based on temperature difference and flow.

REFERENCE

- 4.1 The applicable CSI Specification Section is 23 21 16.