

HYDRONIC HEATING, COOLING SYSTEMS

Hydronic System: For the purposes of this writing a *hydronic* system is defined as a water-based heat transfer system, excluding steam. It is acknowledged that steam is often included within the hydronic category.

Pumps: Centrifugal pumps that incorporate motors that are 2 HP or less may be of the close-coupled in-line type. Pumps that incorporate motors that are 3 HP or larger shall be of the base mounted type. This represents a change from previous standards. The goal is to limit the size of in-line pumps such that they can be removed and replaced by an individual working off of a ladder. Accessibility shall be such that the rotating assembly can be removed from the pump without removing the pump casing from the piping. Vertical split-coupled in-line pumps may be used in lieu of base mounted end-suction pumps as long as they are located in an accessible area near floor level. Horizontal split case pumps shall be used for applications with inlet connections greater than 4".

Vibration Isolation: See paragraph entitled *Vibration Control* in the *HVAC Systems* section within these *General Guidelines* for specific guidelines regarding vibration isolation and the installation of flexible pipe connectors at pumps, chillers, etc.

Constant vs. Variable Flow Systems: All hydronic heating/cooling systems shall be variable flow type and shall utilize two-way control valves exclusively at all central station and terminal units. Exception: A primary system serving a chiller (i.e. either a primary only system or the primary portion of a primary/secondary system) shall be configured for constant flow. Each pump motor in each variable flow system shall be served by a variable frequency drive (VFD). A three-way control valve shall not be installed within a variable flow system for any reason, not even to prevent a potential no-flow condition or to maintain continual circulation throughout the entire system.

Pressure Control: See paragraph entitled *Pressure Differential / Fill Pressure Control* within the *Energy Management, Building Automation Systems* section within these *General Guidelines*

Continuous Circulation: A measure of continuous circulation shall be maintained in variable flow hydronic heating systems. A no-flow condition shall be prevented. In the past it was deemed necessary to maintain continuous flow for at least two reasons: 1) to protect the system pump motor from overheating at low speed operation and 2) to support a perceived need for hot water to be available instantaneously upon demand at all heating units throughout the system. In regard to motor overheating: Due to the increased turn-down capability of today's VFD-approved motors (at least 10 to 1), minimal heat is generated at low flow conditions and thus it is deemed unnecessary to ensure such flow. In regard to the availability of hot water upon demand: In HVAC heating systems, loads typically change slowly and thus quick response is not required.

So why is continuous circulation needed?...to ensure adequate flow of hot water for proper sensing of temperature in the supply piping located downstream of the heat exchanger. The required circulation shall be maintained by providing a manual balance valve in bypass configuration between hot water supply and return piping at a location near the system differential pressure transmitter. The valve shall be adjusted to provide adequate flow across the temperature sensor not exceed 5% of the total system design flow rate.

Reverse vs. Direct Return: A reverse return piping configuration is desirable but not required for hydronic systems that serve multiple terminal units. Direct return configuration is also acceptable given that it is typically more cost effective and practical. When direct return systems are used it is preferred that risers, mains and main branches be "oversized" (i.e. generously sized) so as to yield a system that is somewhat self-balancing.

Terminal Zoning: As reflected in the paragraph entitled *Terminal Zoning* within the *HVAC Systems* section within these *General Guidelines*, heating systems shall be configured such that each occupied space can be controlled as a separate

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temperature zone. Further, the heating unit(s) serving each building entrance shall also be configured as a separate temperature zone.

Backup Equipment: A 100% backup or duplex unit shall be provided for each truly critical piece of hydronic heating or cooling equipment that is vulnerable to failure (e.g. chillers, boilers, heat exchangers, pumps, etc.). When a hot water heat exchanger serves only one of two heating systems (i.e. a perimeter/preheat system or a reheat system) it may be viewed as a non-critical unit that requires no backup. If it serves a single combined perimeter/preheat/reheat system it shall be viewed as critical, requiring backup.

Air Separator: A centrifugal air separator shall be installed at the warmest (first priority), lowest pressure (second priority) point in each hot water heating and each chilled water cooling system. In a hot water heating system, this will result in the air separator being installed in the hot water supply piping downstream of the boiler or heat exchanger and upstream of the distribution pump(s). In a chilled water cooling system, this will result in the air separator being installed in the chilled water return piping upstream of the chiller pump(s). See *Drawing 23 21 00-1, Flow Diagram – Hot Water Heating System*.

Expansion Tank: A replaceable bladder type expansion tank shall be connected to each hot water heating and each chilled water cooling system upstream of the distribution pump(s). See *Drawing 23 21 00-1, Flow Diagram – Hot Water Heating System*.

Fill Connection: Provision for adding fluid to each closed loop hydronic system shall be provided as shown in *Drawing 23 21 00-1, Flow Diagram – Hot Water Heating System*. A permanent fill unit shall not be provided. A portable fill unit with integral air gap shall be provided for this purpose.

Freeze Protection: Hydronic piping systems that contain no antifreeze solution (and never will) shall not be installed in locations where they could potentially

become vulnerable to freezing (e.g. outdoors without sufficient earth cover, within unheated spaces, within building exterior walls or wall cavities, within exposed overhangs, within exposed exterior walkways, etc.) Hydronic systems that incorporate components that are likely to be exposed to freezing conditions (e.g. preheat coils, outdoor chillers, etc.) shall be filled with antifreeze solution. Antifreeze solution shall never be used in any chilled water system that is served by the campus central chilled water system. The system fluid in each hydronic heating or cooling system, whether water or antifreeze solution, shall contain corrosion inhibitors appropriate for protecting components within that specific system.

Elastomers: Devices that incorporate elastomers that are vulnerable to hardening, cracking and leaking with age shall not be installed in hydronic systems. This includes certain dielectric fittings, bolt-on saddle tap type pipe connectors and specific rubber gaskets (e.g. "red rubber gaskets"). Many leaks have developed within hydronic systems across campus over the years as the elastomers within these devices hardened and cracked with age. Separation of copper and ferrous piping within a hydronic heating /cooling system shall be accomplished by the installation of a bronze body valve or other bronze fitting. It has come to our attention that brass fittings do not necessarily provide adequate galvanic separation between iron and copper.