

## HEATING SYSTEMS

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**Hydronic Heating:** Hydronic heating is the preferred heating system for campus buildings. Steam shall not be used as a direct source of heating for an HVAC system. It shall be used in conjunction with a heat exchanger to heat fluid within a hydronic heat transfer system. Thus, the use of steam heating coils, unit heaters, cabinet unit heaters, convectors, finned-tube elements, etc. is not allowed. Exception: In areas within existing buildings where only steam heat is available and it is impractical to provide a hydronic system, steam heating equipment may be used upon approval by FMP Engineering. When steam is used to heat a 130 Deg F loop, the steam heat exchanger shall be sized based on heating water to 180 Deg F, not 130 Deg F to provide an additional factor of safety.

**Heating Source Equipment:** Campus Steam (if available) shall typically be used to provide the heat source for campus buildings. If Campus Steam is not available, designer shall coordinate the selection of source heat equipment with FPC Engineering.

**Hydronic Heating End Use Equipment Sizing:** All end use equipment (i.e., fintubes, reheats, preheat coils, etc.) shall be sized to operate with 130 Deg F water or less.

**Terminal Zoning:** As reflected in the paragraph entitled *Terminal Zoning* within the *HVAC Systems* section within these *Design Guidelines*, heating systems shall be configured such that each occupied space can be controlled as a separate temperature zone. Furthermore, the heating unit(s) serving each building entrance shall also be configured as a separate temperature zone.

**Terminal Unit Pipe Sizing:** The minimum run out pipe size to terminal units (i.e., reheat coils, fintubes unit heaters, etc.) shall be  $\frac{3}{4}$ "

**Perimeter Heating:** Each occupied space with an exterior exposure that includes a high percentage of window area shall incorporate hydronic perimeter heating unit(s). Heating units shall be strategically located adjacent to areas of greatest heat loss. Exceptions to this requirement for perimeter heating will be considered on a case-by-case basis. Below are some general guidelines to consider during design:

If heat loss exceeds 450 Btu/hr per lineal feet of wall, heat should be provided from under the window or from the base of the wall to prevent downdrafts.

If heat loss is between 250 and 450 Btu/hr per lineal feet of wall, heat should be provided from under the window or from the base of the wall, or may be provided from overhead diffusers, located adjacent to the perimeter wall, discharging air directly downward, blanketing the exposed wall and window areas. Using overhead diffusers for perimeter heating in areas of high ceilings is discouraged.

**Public Entrances:** One or more cabinet unit heaters shall be provided at each public entrance. At larger, high traffic entrances, one heater shall be provided at each side of the entrance. These units shall be floor supported or wall mounted. Either they may be recessed or surface mounted. They shall not be installed overhead. It is important to generously size these units (For example, warm vestibule air from -20 deg to 55 deg F within 5 minutes).

**Non-Public Entrances:** The installation of cabinet unit heaters is not specifically required at low-traffic entrances. However, hydronic heating of some form (e.g. finned tube, convectors) will typically be needed.

**Loading Docks:** High capacity unit heaters and/or heated air curtains shall be provided at loading docks and other high infiltration service areas. It is important to generously size these units (For example, warm vestibule air from -20 deg to 55 deg F within 5 minutes).

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**Mechanical Equipment Room Heating:** The preferred means of cooling mechanical equipment rooms is fan coil units or unit heaters. Heating is not necessary for interior or basement mechanical spaces.

**Separate Hydronic Heating Systems:** The number of separate hydronic systems shall be coordinated with NU FPC Engineering during schematic design. Hydronic systems serving preheat equipment shall be filled with inhibited 40% propylene glycol solution. Provide a glycol feed pump (GFP) system, preferred JL Wingert 50 gal (or equivalent).

**Hydronic Heating System Connections at 100% Outdoor Air Systems:** Hydronic system connections at preheat coils in 100% dedicated outdoor air units shall be equipped with dedicated circulation pump and three-way valve. See *Design Detail 23 21 02 – 01, Pumped PreHeat Water Coil Piping Schematic* in these *Design Guidelines*. This arrangement provides constant flow through coils to reduce leaving air temperature swing at low loads, and to prevent coil hot/cold spots and freeze-ups, but still exhibits variable flow behavior to the rest of the system in order to conserve pumping energy.

**Constant vs. Variable Flow Systems:** All hydronic heating systems shall be variable flow type and shall utilize two-way control valves exclusively at all central station and terminal units. Each pump motor in a variable flow system shall be served by a variable frequency drive (VFD).

**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 generously sized.

**Control Valves:** On the UNL campus, all control valves will be provided by UNL Building Systems Maintenance and installed by the contractor. See *Building Technology Coordination Schedule* of these *Design Guidelines*.

**Automatic Balancing Valves:** An automatic balancing valve shall be installed on all hydronic heating terminal units including unit heaters, cabinet unit heaters, reheat coils, fin tube radiation, fan coil units, etc. without exception.

**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 7.5 HP or larger shall be of the base mounted type. Accessibility shall be such that the rotating assembly can be removed from the pump without removing the pump casing from the piping.

Inline pumps shall always be mounted within 4'-0" of finished floor in lieu of ceiling mounting.

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".

Specify suction diffusers on the inlet of all base mounted and inline pumps (or show and note a minimum of 10 pipe diameters of straight pipe). **Do not** specify "triple-duty" type check/throttling/shut-off valves. Instead, provide separate check, venturi flow meter and shut-off valves (see Detail 23 21 00 - 02).

Pumps shall be sized on building block load or morning warm-up load. Avoid sizing based on 100% connected load. It is likely they could be sized at 2x60% or 2x70%. If the pumps are short, the hot water temperature can be increased upward from 140 Deg F to move enough heat in the building. Generally speaking, when a pump will often run backed-down (via VFD), is good to select the pump operating point to the right of the efficiency sweet spot, with the idea being the pump will operate most

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of its hours in the sweet spot. Pump efficiency becomes very poor as the operating point approaches left edge of the curve. .

**Backup Equipment:** A 100% backup or duplex unit shall be provided for each truly critical piece of hydronic heating that is vulnerable to failure (e.g. boilers, heat exchangers, pumps, etc.). When a hot water heat exchanger serves a combined perimeter/preheat/reheat system it shall be viewed as critical, requiring backup with a second heat exchanger.

**Expansion Tank:** A replaceable bladder-type expansion tank shall be provided in each hot water heating system. Expansion tanks to be sized on calculated system volume, plus 40% margin (design volume) for future additional volume (label both calculated and design volume with % margin on equipment schedule). Expansion tanks to also be sized to a minimum temperature of 55 Deg F, and maximum temperature of 190 Deg F HHW (regardless whether other HHW system components are designed and sized based on a lower temperature). Call out the initial and final system fill pressure at the expansion tank on the equipment schedule. Contractor to report actual volume based on final filling quantity of fluid, record and date this volume on expansion tank and at system heat exchanger.

**Air/Dirt Separator:** An in-line coalescing air/dirt separator shall be provided in each hydronic system. See *Drawing 23 21 00-2, Heating Hot Water System Piping Schematic*.

**Pressure Relief Valve:** Pressure Relief Valves (PRV's) shall be provided on all hydronic hot water systems as shown on *Drawing 23 21 00 – 02 “Heating Hot Water System Piping Schematic.”* PRV relief valve setting shall be noted or scheduled by the design engineer based on system operating pressure and static head. However, relief valve setting shall be no less than 50 psig. Each isolatable pressure vessel (i.e. heat exchangers) shall each have their own PRV's. Any pressure vessels (expansion tanks, buffer tanks, etc.) shall also have pressure relief valves unless said vessel isn't isolatable from the system pressure relief valve.

**Chemical Pot Feeder:** Each hydronic heating system shall incorporate a bypass pot feeder. See *Drawing 23 21 00-2, Heating Hot Water System Piping Schematic*.

**Bypass Filter:** Each hydronic heating system shall incorporate a bypass bag filter. See *Drawing 23 21 00-2, Heating Hot Water System Piping Schematic*. .

**Fill Connection:** Provision for adding fluid to each closed loop hydronic system shall be provided as shown in *Drawing 23 21 00-2, Heating Hot Water System Piping Schematic*.

**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”).