Division 232100
Hydronic Piping and Pumps
DESIGN GUIDE

1 General

1.1 General

A. CWU has a campus chilled water distribution system. See Section 230500.

B. CWU has a district with a low temperature heating water system. See Section 230500.

C. All heating systems shall be designed for 120 degree supply water (or lower) regardless of heating source so in the future, the campus can convert heating sources to less carbon intensive heating processes such as heat pumps. This includes coils, pipes and pumping system.

D. Heating coils subject to freezing from required ventilation air, shall use propylene glycol heating fluid supplied from a separate heat exchanger and pump circulation system. CWU prefers to glycol only the coils that require it and not the entire terminal reheat system that is not exposed to freezing conditions. Refer to 232500 for supplemental requirements and sections.

E. At the end of design development, review major pipe routing and branch pipe isolation with the Mechanical Plumbing Manager (MPM).

F. Show isolation valves and branch piping in the construction documents on the floor plans.

G. All installations shall conform to the International Mechanical Code and Uniform Plumbing Code.

H. Pumps

1. Pump operation and controls shall conform to the Washington State Energy Codes and system pumps shall be variable flow.
   Exceptions

   a. Unless dictated by equipment to have constant flow.

   b. CWU prefers constant flow through the central plant chillers

2. Heating water pumps serving building distribution system shall be sized for 100% redundancy. Examples: 2 pumps at 100% or 3 sized at 50% each.

3. Tertiary chilled water building pumps shall be a minimum of two pumps sized for 67-100% redundancy. Designer shall take building size, building type, application, cooling loads, critical loads, etc. into consideration to determine pump redundancy.

1.2 Maintenance Materials

A. For piping systems that require special tools for installation of joints and fittings, review tooling requirements with CWU Mechanical Piping Manager to determine if CWU has tools for repairs in their stock. If not, specialty tools will be required to be provided with the contract and incorporated in the project documents.

1.3 Campus Chilled Water Utility

A. The campus chilled water plant is located adjacent to the Jongeward building in the west area of campus and distributed underground throughout the majority of the campus with direct buried pipe.

B. The chilled water plant consists of a series of water-cooled chillers and pumps. The following chiller information is provided for the purposes of documentation of LEED credits associated with refrigeration and to provide information for energy modeling of plant efficiencies for LEED energy savings credits.

   1. CH-1

      a. Manufacturer: Carrier

      b. Installed 2010+/-

      c. Model: 19XR-8181594ELH68

d. Nominal tonnage: 1200

e. Refrigerant: 134A

f. Refrigerant charge: 2340 lbs.

2. CH-2

a. Manufacturer: York

b. Model: YKM7MSK1-DAG

c. Nominal tonnage: 1200

d. Refrigerant: 134A

e. Refrigerant charge: 2156 lbs.

3. CH-3

a. Manufacturer: McQuay

b. Model: PEH126-BCBBP

c. Nominal tonnage: 1200

d. Refrigerant: 134A

e. Refrigerant charge: 3670 lbs.

4. CH-4

a. Manufacturer: York

b. Installed 2022

c. Model:YK030Gk1-DAH

d. Nominal Tonnage: 1200

e. EWT 54 deg. F, 42 deg LWT

f. GPM: 2400

g. Pressure Drop: 16.2 feet

h. Refrigerant: 134a

i. Total Refrigerant Charge: 2087 lbs.

j. Refrigerant charge of largest circuit: 2087 lbs.

k. Peak Kw/Ton: 0.5826

l. NPLV: 0.481

1) 100% 0.5826 kw/ton

2) 75% 0.4855 kw/ton

3) 50%: 0.4564 kw/ton

4) 25%: 0.5725 kw/ton

C. Each chiller is pumped with a primary pump and chilled water is distributed through campus with variable flow secondary pumps. Each building is provided with a variable flow tertiary pump. Individual coils are typically not pumped and flow is controlled at individual coils with control valves.

D. This system campus chilled water leaving the plant is 45 degrees Fahrenheit and is available seasonally (generally in the months of middle of April through middle of November).

E. All cooling coils shall be selected with entering water temperature no less than 48 degrees Fahrenheit. Coils shall be selected with maximum delta T to return chilled water temperature back to the plant at 60 degrees or higher.

F. Each building shall have diverting valves (or (2) two 2-way valves) as a means or recirculating return water back to the building in lieu of the plant to prevent water from being returned to the plant at temperatures higher than 60 degrees (or as set in the BAS by the campus operators).

G. For purposes of reduced and centralized maintenance, facilities shall receive cooling from the campus chilled water system where practical.

H. Campus chilled water is not available in the winter. Buildings shall not rely on the campus chilled water loop for winter cooling. The campus, in their preventative maintenance program, drains and winterizes building cooling coils seasonally.

I. The central chilled water system is not actively treated with chemicals, has sediment, and requires filtration at the building level as described in 232500.

J. Consult with the Mechanical HVAC Manager (MHM) at the beginning of the pre-design and design phase to review utilities in the vicinity of the facility and preferred project approach.

1.4 Campus Low Temperature Heating Water Utility

A. The campus has a district in the vicinity of the Science neighborhood that has a low temperature heating water system. This system generates 120-degree maximum supply water at the central plant using heat recovered from the steam boiler stacks. When demand exceeds recoverable heat, the system heat is supplemented with heat from a steam to hot water convertor in the central plant to consistently provide 120-degree supply water.

2 Materials

2.1 Campus Chilled Water Piping (Below Grade) and Campus Low Temperature Heating System (Below Grade)

A. High-Density Polyethylene (HDPE) with thermal butt-fusion welding.

B. Supply piping shall have minimum 1” rigid polyurethane foam insulation. Return piping insulation is not required on chilled water return

C. Protective Jacket; HDPE.

1. Field Joints

a. Thermal butt-fusion welded

2.2 Heating and Chilled Water Piping (Above Grade)

A. Copper, type L, hard drawn

B. Fittings: wrought copper and bronze

C. Joints:

1. Solder, Grade 95TA

2. Copper press fittings with a factory installed EPDM sealing element. The sealing element shall, when unpressed, shall assure leakage of liquids to provide the installer quick identification of joints that have not been pressed prior to placing system into operation. Fittings shall be rating for a maximum of 300 psi. Viega ProPress or approved equal.

D. Steel, schedule 40 black

1. Joints/fittings

a. (Up to 2”): Malleable iron, threaded joints

b. Fittings (Over 2”): Forged steel welding type fittings

c. Fittings (Over 2”): Groove locked fittings and couplings

1) Manufacturers: Victaulic, Gruv-lok

2.3 Condensate Piping

A. See 221300.

2.4 Water Flow Meters

A. See 230900.

2.5 Valves

A. Ball Valves

1. Up to and including 3 inches:

a. Class 150, 400 psi, bronze two-piece body, chrome plated brass ball, regular port.

B. Butterfly Valves

1. 2 inches and larger:

    a. 200 psi, bronze body, 316 stainless steel disc, infinite position lever handle with memory stop.

    b. Provide gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor in mechanical rooms or valves more than 3 feet above the ceiling.

C. Spring Loaded (Silent) Check Valves

1. Up to 2 inches:

    a. Class 125, cast bronze. Stainless steel stem.

2. 2½ inches and larger:

    a. 125 lb. cast iron body, renewable bronze seat and disc, stainless steel spring

D. Control Valves: provided in section 230900.

E. Buried Gate Valves

1. AWWA Gate Valves 125 psi with iron body and bronze trim, solid wedge disc, flanged ends, operating nut in a surface valve box with keyed access at grade.

2.6 Hydronic Pumps

A. Pumps with motors 5 HP or greater shall not be floor mounted. Pumps with motors less than 5 HP may be suspended. Pump casing shall have gauge tapings at the suction and discharge nozzles. All VFD controlled pumps shall be provided with shaft grounding rings.

B. In-line: Cast iron casing; cast bronze impeller keyed to shaft; alloy steel shaft; copper or bronze sleeve; internally self-flushing; mechanical seal with carbon seal ring and ceramic seat; permanently sealed, grease or oil-lubricated ball bearings

C. Floor mounted:

1. Split coupled vertical centrifugal pump. Factory installed vent/flush lines to insure removal of air and mechanical seal cooling.

Incorporate an outside balanced seal to allow for its removal without disturbing the pump and motor connections.

2. Pump Suction Fitting: Angle pattern; cast iron body; inlet vanes; cylinder strainer; disposable fine-mesh strainer over cylinder strainer; magnetic insert removable for cleaning; adjustable support foot. Do not provide on open loop systems.

2.7 Air Separators

A. Manufacturers

1. High efficiency combination air/dirt separator with blow down valve and high capacity air vent. Air separator shall be utilize coalescence to collect and merge microbubbles to remove air, sand, dirt and rust. Centrifugal style air separators are not allowed. Taco 4900 series, Spirotherm or equivalent.

2.8 Balancing Valves

A. Engineer to select type(s) appropriate for the application.

B. Flow Balancing Valves (Automatic)

1. General: Pressure compensating; factory set to control within 5 % of selected rating at selected pressure differential over 95% of the flow range.

2. Valves shall be complete with flow control, two pressure/temperature test ports and ground joint union to allow field exchange of internal components without removing from pipeline. Unit shall be all brass and stainless steel.

3. Valves shall be marked externally with size, capacity and direction of flow.

C. Flow Control Balancing Valves (Manual) – “Circuit Setters”

1. General: Precision machined orifice with memory stop; calibrated external name plate and direction arrow. Flow control balancing valves shall have tight shut-off and 2 meter taps, each with internal check valve and thread protector. Component construction and materials shall be suitable for application.

2. Circuit Setters shall be sized for a minimum of 2-foot water pressure drop and a maximum of 5-foot drop at design flow rate.

2.9 Coil Piping Packages

A. Coil piping packages are allowed for air terminal units and terminal heat transfer units based upon engineer or installer preference.

B. Packages shall be sized to match the pipe size and not the coil size, control valve size or flow control (balance valve size).

C. When provide, coil piping package shall consist of:

1. Ball valves upstream and downstream of flow control device with union connections as required to allow for isolation and removal of flow control device for service. Ball valves to be provided separately if this is not an option with the coil piping package.

2. Ball valves on both sides of coil.

3. Flow control (balancing) valve as previously specified.

4. Strainer complete with blow-down valve. Strainer shall be located upstream of flow control device and control valve.

5. Pressure/temperature test ports on either side of coil and both sides of flow control (balance) device.

6. Ground joint unions for field exchange of internal components.

7. Unit shall be all brass and stainless steel.

8. Valves, flow control devices and strainers shall be marked externally with size, capacity and direction of flow.

9. Hoses

   a. All hoses shall be equipped with swivel end connections at terminal unit. All end connections shall be crimped to meet stated pressure ratings. Serrated/slip fit connections are not acceptable.

   b. Flame Retardant Hoses. Hose materials shall be stainless steel braided over an EPDM liner.

2.10 Expansion Tanks

A. Construction:

1. Diaphragm type: Welded steel; tested and stamped in accordance with ASME SEC 8-Div. 1; 125 psi pressure rating; heavy duty butyl rubber diaphragm; air charging valve (standard tire valve); tank drain.

2. CWU will not replace a failed bladder, so expense of replaceable bladders is not desired.

3. Install with manual air vent, pressure relief valve, and water pressure gauge at system connection.

2.11 Reducing Valves

A. Brass body with integral check valve; manual fast fill feature; cleanable strainer. Adjustable discharge pressure as required for application

2.12 Safety Relief Valves

A. Construction: brass body, EPDM diaphragm and seat, brass internal wetted parts, ASME labeled, diaphragm assisted. Pressures and temperatures to suit application.

2.13 Strainers

A. Size 2 inch and under:

1. Screwed brass or iron body for 250 psig working pressure Y pattern with 1/32-inch stainless steel perforated screen with ¾ inch blow-off valve and cap

B. Size 2½ inch to 8 inch:

1. Flanged iron body for 147 psig working pressure; Y pattern with 3/64-inch stainless steel perforated screen with ¾ inch blow-off valve and cap

C. Adjust screen mesh as required by equipment manufacturer that strainer serves if recommended or required by the equipment manufacturer.

2.14Venturis

A. Precision machined orifice with tag indicating size and flow ratings. Fittings shall have two-meter taps, each with shut-off cock and thread protector.

2.15Thermometers

A. Adjustable angle, brass stem with 2 ½" insertion length, brass sockets with or without extensions, scale appropriate for intended use. Spirit filled. Mercury not allowed.

2.16Pressure Gauges

A. 4½ inch dial; dry filled, cast aluminum case with glass window; brass tube and socket; brass movement; painted aluminum dial with black graduations on white background; suitable for outdoor use; psi scale as appropriate for intended use; full scale accuracy of plus or minus 1 %.

B. Provide with ¼" NPT brass ball valve and brass pressure snubbers with ¼" NPT connection.

2.17Water Make Up

A. For systems with glycol, premixed chemical treatment is introduced through the glycol feeder. Refer to 232500.

B. For systems without glycol, provide water make up with automatic fill to a preset pressure at the PRV. Water supply shall be protected with RP style backflow preventor provided in Division 22. Division 22 shall additionally provide a meter with contacts for monitoring by the BAS (230900) to alert the campus to a system water leak.

3 Execution

3.1 General

A. Hydrostatically pressure test and clean and flush and disinfect piping prior to connection to campus utility (or existing connections in buildings).

B. Hydrostatically test HDPE piping to 150 psi or 1.5 times the service pressure (whichever is greater).

C. Test in the presence of the Owner's representative. Provide copies of test to the Owner's representative and include in the O&M manual.

D. After completion, fill, clean, and treat systems. Refer to Section 232500.

E. Install piping, valves and equipment in accordance with the manufacturer's requirements.

F. Provide water taps for water treatment testing on all closed circulating pipe systems.

3.2 Campus Chilled Water Piping (Below Grade)

A. The Architect/Engineer must identify and/or verify critical utilities location on a project-by-project basis.

B. Provide plastic ribbon pipe makers above direct buried pipe in accordance with Section 230700.

C. Provide pea gravel or sand bedding and cover around all utility lines. Provide excavation, backfill and compaction in accordance with Division 31. Compaction shall be no less than 90% under paved for cohesive soils and 95% for cohesionless soils. Other areas shall be compacted to no less than 85% maximum density for cohesive coils and 90% relative density for cohesionless soils. During construction all pipe ends must be closed when left unattended.

D. All water lines must be buried at a minimum depth of forty-eight inches (48").

E. Utilities Easement. All underground utilities design must be conceived and designed with an "easement approach" in mind, thus facilitating their maintenance and accessibility. The Schematic Design utility site plan and all other utilities site plan(s) thereafter, must clearly indicate the outline of this utility easement.

F. All field joints shall be thermal butt-fusion welded. The service pipe and jacket shall be simultaneously welded to maintain the pressure rating of both the service pipe and jacket. Weld pressures, temperatures and time shall be in accordance with the manufacturer's recommendations.

G. System does not require thrust blocks but provide restraint of the piping system where the pipe penetrates the building foundation wall and where the pipe drops from above grade to below grade.

H. Insulation shall be poured in place into the field joint area. The field joint area shall then be sealed with a heat shrinkable adhesive backed sleeve. Backfilling shall not begin until the heat shrink sleeve has cooled. All insulation and jacketing materials for the field joint shall be furnished by pre-insulated pipe manufacturer.

3.3 Heating and Chilled Water Piping (Above Grade)

A. Make provisions for drainage at system low points with drain valves.

B. Use press fittings and grooved mechanical couplings and fasteners only in mechanical equipment rooms and at major equipment connections where fittings and couplings are accessible.

C. Make provisions for cleaning and flushing water feeds and side stream filter per 232500.

3.4 Condensate Drain Piping

A. All condensate drip pans must be piped to drains. Provide legal air gap.

3.5 Thermometers

A. Provide at inlet and outlet of each heat exchanger and heat producing or cooling piece of equipment. Exception: Terminal heating and cooling

units, fin tube, radiant heaters may omit thermometers if pressure/temperature test plugs are provided.

B. Enlarge pipes as required for installation of thermometer sockets on 24 inches of each side of thermometer. Ensure sockets are extended to allow clearance for insulation. Install where temperature is visible from standing person height.

3.6 Pressure Gauges

A. Provide isolation ball valve and snubbers at each gauge. Extend nipples to allow clearance for insulation.

B. Provide at each pump. Points of connection shall be before pump strainers (or end suction diffuser) and before the suction and after the discharge of pump. Each point of connection shall have an isolation valve and be manifolded to the gauge.

C. Provide on either side of each hydronic bag filter and side stream filter.

3.7 Test Plugs

A. Provide gauge taps/test plugs as follows:

1. Adjacent to pressure gauges
2. Adjacent to thermometers
3. Adjacent to pressure and temperature sensors provided in Section 230900.
4. Inlet and outlet of coil or equipment where pressure and temperature gauges are not furnished.
5. Where gauges and sensors are located at the same hydraulic and thermal point in the piping system a single test plug may be provided.

3.8 Flanges / Unions

A. For pipe 2” and smaller, provide unions downstream of each valve, on each port of control valves, and at each equipment or piping specialty requiring service. Valves with threaded connections that cannot be

rotated shall have unions on both sides of the valve. If equipment or valve has a flanged connection that is acceptable and preferred.

B. For pipe 2 ½" and greater, provide flanged connections on each side of valve, on each port of control valves, and at each equipment or piping specialty requiring service.

A. Unions and flanges for serviceable equipment shall be installed in non--parallel lines to eliminate spreading of pipe assembly during servicing.

B. Utilize dielectric unions when connecting pipe of dissimilar materials. Where possible select new product materials to minimize need and use of dielectric connections.

3.9 Valves

A. Provide isolation valves (ball or butterfly) to isolate each building as indicated below. Each valve shall be as close to the room or equipment that they isolate. In no cases may the valves be located on any other floor or a building but the floor they serve. Exception: housing may have vertical risers due to short floor to floor heights. For housing provide valves with drains at the base of each vertical riser.

1. Each building
2. Branch isolation by floor
3. Mechanical rooms
4. Labs
5. Equipment

B. For direct buried chilled water piping and low temperature heating piping, provide keyed gate valve immediately after connection from campus main. Provide CWU with keys for the valve operation.

C. Provide drain valves at system low points.

D. All valves shall have adequate access for servicing, operation, repairs and/or replacement.

E. It is preferred that valves be installed with the stem in the vertical position. Do not install valves with the stem below the horizontal plane.

F. Provide spring loaded (silent) check valves on the pump discharge where indicated on drawings and where two or more pumps are installed in parallel.

G. Use ¾ inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

H. Use gate valves to isolate buried chilled water piping branch lines.

3.10 Hydronic Pumps

A. Clearances around floor mounted pump motors: refer to 230500-Servicability.

B. Support piping adjacent to pump such that no weight is carried on pump casings.

C. Install single pressure gauge at each pump with isolation gauges to isolate total, suction and discharge pressures.

D. Install floor mounted pumps on concrete housekeeping base or inertia bases as required per project vibration isolation and acoustical requirements.

E. For floor mounted pumps connect piping to pump with double sphere neoprene flexible pipe connectors

F. Start-up strainers in end suction diffusers shall be removed from the system after cleaning and flushing and strapped to the pipe or end suction diffuser.

3.11 Air Separators

A. Provide on suction side of system circulation pump.

B. Provide at each building connected to campus hydronic utilities such as campus chilled water and low temperature heating water.

3.12 Air Vents

A. Install automatic air vents at high points in mechanical rooms and at coils in mechanical rooms. Provide isolation ball valve at each vent for future service of vent. Pipe or tubing of appropriate size shall be run

from these vents to indirect waste in the mechanical space(s). These lines are to be tagged with a label identifying the location of the automatic vent.

B. Install manual air vents on all other water coils and high points of piping systems. All air vents shall have a manual shutoff.

3.13 Flow Balancing Valves (Automatic & Manual)

A. Provide flow control balancing valves at all water coils, pumps, re-circ pump, equipment, and in mains if required to facilitate test and balance.

B. Install flow control balancing valves with meter connections upward.

3.14 Expansion Tanks

A. Provide on all closed loop hydronic systems.

B. Provide on the return side of campus hydronic utilities in each building for utilities such as campus chilled water and low temperature heating water.

3.15 Safety Relief Valves

A. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, expansion tanks, and as required by code.

B. Install relief valves without a vertical lift on the outlet piping.

C. Pipe relief valve outlet to nearest floor drain for water systems or empty chemical drum for glycol systems.

3.16 Strainers

A. Provide strainer upstream of all control valves, balancing valves, coils, reducing valves, other devices with orifices, and when required by equipment manufacturer. When multiple devices are installed in series, a single strainer may service an equipment’s control valve, balancing valve and coil.

3.17 Venturis and Manual Balance Valves

A. Install flow devices with required straight lengths of piping upstream and downstream of valve according to the manufacturer's recommendations.

4 Appendix

4.1 Reserved for future.