



DESIGN REQUIREMENTS

PIPES AND TUBES FOR HVAC PIPING AND EQUIPMENT

GENERAL INFORMATION

- 1.1 This section applies to piping systems for chilled water, hot water, condenser water, steam, condensate return, fuel oil, refrigerant and compressed air systems.
 - a. The design documents shall include riser diagrams for each system indicating all major components of the system, isolation and control valves, equipment, drains, vents, pipe sizes, pressure and/or temperature relief devices, direction of flow, etc.
- 1.2 The specifications shall require the contractor to cover, cap or otherwise protect open ends of all piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter.

DESIGN REQUIREMENTS

- 2.1 Design piping, fittings and accessories to be suitable for the pressure and temperatures of the service. Ascertain system working pressure and provide piping accordingly, based on the systems to be tested at 150 percent of maximum system working pressure.
- 2.2 The design drawings shall reflect pipe locations where there is sufficient space to properly support all pipes, including allowances for insulation and pipeline accessories.
- 2.3 Piping shall be designed, in general, to run perpendicular and/or parallel to floors and walls. Where practical, piping and valves shall be grouped so as to avoid reducing headroom.
- 2.4 Provide proper provision for expansion and contraction in all portions of pipework, to prevent undue strains on piping or apparatus connected therewith.
- 2.5 Submit calculations that tabulate each system's pressure requirements.
- 2.6 Groove-type, or Victaulic piping shall not be used in University piping systems. Avoid specifying piping, fittings and equipment with grooved-end fittings.

DESIGN REQUIREMENTS

2.7 Materials and Piping Fittings

Service	Material	Schedule
Chilled Water	Schedule 40 Black Steel	CS-1
Hot Water		
Hot/Chilled Water	Or	
Condenser Water		
Process Cooling	Type 'L' Copper	CU-1
Condensate Drainage	(for pipe sizes 4" and smaller)	
Steam	Schedule 40 Black Steel	CS-2
Condensate Return and	Schedule 80 Black Steel	CS-3
Pumped Condensate		
Fuel Oil Transportation and	Schedule 40 Galvanized Steel	CS-4
Vent / Fill		
Refrigerant	Type 'ACR' Copper	CU-2
Compressed Air	Copper	CU-1
(Controls)	Hard (Exposed Areas)	
	Soft (Concealed Areas)	
Diesel Engine Exhaust	Steel Schedule 80 or Pre-engineered	CS-3
	Double Wall Exhaust System	
Underground High and Low	Schedule 40 Black Steel Carrier pipe	UGP-1
Pressure Steam	with external containment pipe	
Underground Condensate	Schedule 80 Black Steel Carrier pipe	UGP-2
Return	with external containment pipe	
Underground Chilled Water	Schedule 40 Black Steel	UGP-3
and Heating Hot Water		

2.8 Design Criteria for Piping

a. CS-1

Up to 2 ½ inch	Maximum pressure drop of 2 ft wg per 100 ft of pipe.
3 inch to 6 inch	Maximum pressure drop of 2.5 ft wg per 100 ft of pipe.
8 inch and larger	Maximum velocity of 8 ft per second.

DESIGN REQUIREMENTS

b. CS-2

Steam (<15 psig)

Below 4" - 1/8 psi per 100 ft. of length with maximum allowable system pressure drop as noted below

4 inch and larger 1/4 psi per 100 ft. of length with maximum allowable system pressure drop as noted below

<u>Initial Steam pressure,</u> <u>PSIG</u>	<u>Maximum Allowable System</u> <u>Pressure Drop, PSI</u>
2	0.50
5	1.25
10	2.50
15	3.75

Steam (>15 psig)

Maximum velocity of 1,000 fpm per inch of pipe diameter. Velocity not to exceed 9,000 fpm. Do not use pipe size smaller than 1 inch. Maximum allowable system pressure drop shall be as noted below.

<u>Initial Steam pressure,</u> <u>PSIG</u>	<u>Maximum Allowable System</u> <u>Pressure Drop, PSI</u>
16 to 50	5
50 to 100	10
Over 100	15

c. CS-3

1. No restrictions, apply best design practices.

d. CS-4

1. No restrictions, apply best design practices.

e. CU-1

Up to 2 ½ inch	Maximum pressure drop of 2 ft wg per 100 ft of pipe.
3 inch to 4 inch	Maximum pressure drop of 2.5 ft wg per 100 ft of pipe.

f. CU-2

1. No restrictions, apply best design practices.

DESIGN REQUIREMENTS

g. UGP-1

Steam (<15 psig)

Maximum velocity of 1,000 fpm per inch of pipe diameter. Velocity not to exceed 6,000 fpm. Do not use pipe size smaller than 2 inch.

Steam (>15 psig)

Maximum velocity of 1,000 fpm per inch of pipe diameter. Velocity not to exceed 9,000 fpm. Do not use pipe size smaller than 2 inch.

h. UGP-2

Maximum velocity of 600 fpm. Do not use pipe size smaller than 1 ½ inch.

i. UGP-3

Up to 2 ½ inch

Maximum pressure drop of 2 ft wg per 100 ft of pipe.

3 inch to 6 inch

Maximum pressure drop of 2.5 ft wg per 100 ft of pipe.

8 inch and larger

Maximum velocity of 8 ft per second.

CONSTRUCTION REQUIREMENTS

- 3.1 Provide and erect in a workmanlike manner, according to the best practices of the trade, all piping shown on the drawings or required to complete the installation intended by these specifications.
- 3.2 Install piping tight to slabs, beams, joists, columns, walls and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- 3.3 Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves. All valves and piping specialties must be accessible when all of the trades have completed their work.
- 3.4 All piping shall be run perpendicular and/or parallel to floors and interior walls. Piping and valves shall be grouped neatly and shall be run so as to avoid reducing headroom.
- 3.5 Closely plan and coordinate concealed piping and ductwork above suspended ceilings to avoid interferences, and install to maintain suspended ceiling heights shown on architectural drawings.
- 3.6 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.

DESIGN REQUIREMENTS

- 3.7 Cap all openings in pipes during progress of the work. Temporarily cover the open ends of all pipes not actively being installed and at the end of each work day to prohibit the influx of foreign materials.
- 3.8 Reductions in pipe size made with eccentric reducers shall have the tops level for water piping and bottoms level for steam piping.
- 3.9 Piping shall be concealed wherever possible. Piping shall be installed so that same can be drained of all water.
- 3.10 Use fittings for all changes in direction, at all branch connections, terminations, and for change in pipe size.
- 3.11 Remake leaking joints using new materials.
- 3.12 No piping or work of any kind shall be concealed or covered until all required tests have been satisfactorily completed. Portions of work concealed prior to CU Facilities inspection and signoff shall be reopened at the Contractors expense.
- 3.13 Whenever welded piping connects to equipment valves or other units needing maintenance, servicing, or possible removal, flange the connecting joints. Match the pressure rating of the pipe flanges with the pressure rating of the flanges on the equipment to which the piping connects. Provide flanged pipe sections to permit removal of equipment components.
- 3.14 Dielectric Fittings: Connections between any two dissimilar metals will be made with dielectric couplings, unions or flanges. Flanges will use Bolts and Nuts incorporating a dielectric separation. For further information regarding Dielectric Couplings, refer to Section 232116 – Hydronic Piping Specialties.
- 3.15 Pitch steam piping 1 inch in 40 feet (maximum) and gravity return 1 inch in 20 feet in direction of flow.
- 3.16 Piping Pressure Test
 - a. Piping hydrostatic tests must be performed before covering is applied.
 - b. An anti-freeze solution shall be used where piping is subject to freezing.
 - c. Where controls and accessories are not designed to withstand the pipe test pressure, they must be properly protected against damage.
 - d. All piping shall be tested to a hydrostatic pressure at least 1-1/2 times the maximum designed working pressure (but not less than 25 psig for open plumbing systems and not less than 125 psig for closed systems) for a minimum of 2 hours. Tests must be repeated

DESIGN REQUIREMENTS

at least once after all leaks and defects have been repaired. The following shall be tested for four consecutive hours without loss of pressure:

System	Test Pressure
High pressure steam and condensate piping	300 psi
High pressure vents (steam safety and relief)	300 psi
Low pressure steam	150 psi
Compressed air (temperature controls)	100 psi
Overflow and drain	25 psi (10ft head)
Hot water (Heating)	200 psi
Primary Chilled water (loop)	300 psi
Primary Chilled water (building)	200 psi
Chemical treatment (same as system it is connected to)	

- e. Leaks that are detected during the pressure test must be corrected by replacing all defective materials or welds. Caulking of screwed joints or peening of welds is not acceptable. Wherever it is necessary to cut out a weld and the ends of the pipe cannot be conveniently brought together, a short piece shall be fitted in and welded.

REFERENCE

- 4.1 The applicable CSI Specification Section is 23 05 03.