ticeable only on the outside of the gland and stem of the valve where thin deposits of salt are left after evaporation.

The insulation of high-temperature water lines is similar to that of steam lines.[a] The selection of the economical thickness of pipe insulation is discussed in Chapter 32.

Thermometers and Pressure Gages

Pressure gages should be installed in the pump discharge and suction and at locations where pressure readings will assist operation and maintenance. Thermometers (preferably dial type) or thermometer wells should be installed in the flow and return pipes, the pump suction and discharge, and at any other points of major temperature change or where temperatures are of importance in operating the system. Thermometers and gages are desirable in the piping at the entrance to each building, hot water converter, or steam converter. (See Chapter 44.)

SPACE HEATING EQUIPMENT

In industrial areas, space heating equipment may often be operated with high-temperature water due to its availability. Convectors and radiators may require water temperatures in the low and medium temperature range (120 to 180 F or 200 to 250 F) depending upon how close they are to the occupants and upon the pressure for which they are designed. The water velocity through the heating equipment affects its capacity. This must be taken into account in selecting the equipment because, if a large water-temperature drop is used, the rate of circulation is reduced and consequently the velocity of flow may be reduced sufficiently to lower appreciably the rate of heat transfer. (See Chapter 5.)

The high temperatures of these systems make them ideally suited for direct use in radiant panel surfaces. Since radiant output is a fourth-power function of the surface temperature, the surface area requirements are materially reduced over low temperature water systems. The surfaces may be flat panels consisting of a steel tube, usually ⅝ or ½ in., welded to sheet steel turned up at the edges for stiffening. Several variations of this are available. Steel pipe may also be used with an aluminum, or similar, reflector to reflect the heat downward and to prevent smudging of the surfaces above the pipe.

Table 2.... Head Loss in Fittings[a]
(For turbulent flow)

Fittings \ Pipe Size, Inches	Feet of Same Size Pipe Having Equal Loss[e]												
	10	8	6	5	4	3	2½	2	1½	1¼	1	¾	½
Globe Valve	340	270	200	170	135	105	83	70	55	45	36	28	21
Gate Valve	7	5.75	4.5	3.5	3	2.2	1.7	1.5	1.2	1	0.8	0.6	0.5
90° Welding Elbow	11	8.5	6.5	5.5	4.5	3.5	2.6	2.2	1.8	1.5	1.2	0.9	0.7
45° Welding Elbow	7	6	4.5	3.6	3	2.4	1.7	1.5	1.2	1	0.8	0.6	0.5
22½° Welding Elbow	5	4	3	2.5	2	1.6	1.3	1.1	0.9	0.7	0.6	0.5	0.3
Lateral[b]	26	20	16	13	11	8	6.5	5.5	4	3.5	2.8	2.2	1.6
Lateral[c]	17	14	10	8.5	7	5	4	3.5	2.8	2.5	1.8	1.5	1.1
Welding Tee[c]	13	10	8	7	5.5	4	3.2	2.6	2	1.7	1.4	1.2	0.8

Concentric Reducers[d] From \ to	10	8	6	5	4	3	2½	2	1½	1¼	1	¾	½
10		1	2.5	3	2.8								
8	3.5		1.2	2	2.2	2.2			CONTRACTING				
6	10	3.5		0.5	1.3	1.8	1.7						
5	12	7.5	1.5		0.5	1.2	1.4	1.5					
4	12	9.5	4.5	1.5		0.6	1.2	1.4	1.5				
3		10	7	5	1.8		0	0.8	1	1			
2½			7.5	6	3.8	0.7		0	0.7	0.8	0.75		
2				6	5	2.5	0.8		0	0.6	0.6	0.6	
1½					5	3.8	2.8	9		0	0.5	0.5	0.5
1¼						4	3	2	0.3		0	0	0.3
1		ENLARGING					3	2.5	1.25	0.5		0	0.3
¾								2.5	2	1.3	0.5		0
½									2	1.8	1.5	0.8	

[a] Compiled from data published by *Tube Turns*, Inc., a Division of the National Cylinder Gas Co. Used by permission.
[b] Water deflected through branch.
[c] Water flowing straight through fitting.
[d] For eccentric reducers, the values read for concentric reducers must be increased by 33⅓%.
[e] Equivalent length of pipe having a Fanning friction coefficient of 0.009.

TEMPERATURE CONTROL

The principles discussed under Control of Flow in Chapter 43 apply to high-temperature water systems, but added consideration should be given to the selection and location of control components.

Valve Selection

Valve selection and sizing are very important because of the relatively high temperature drops and smaller flows encountered in high-temperature water systems. To obtain good control, the valve must be sized so that it is effective over its full range of stem travel. It is recommended that the valve size be selected on the basis of a pressure drop at full flow equal to approximately 50 percent of the pressure difference between supply and return mains at the location of the equipment served. The pressure drop across the valve must not be sufficient to result in a downstream pressure below the saturation pressure at the temperature existing at any point or flashing into steam will result. A valve with equal percentage flow characteristics is desirable. Sometimes two small valves are used rather than one large valve to improve the controllability of the system. Stainless steel trim is recommended, and all valve body materials and packing should be suitable for the high temperatures and pressures encountered. The valve should have a close-off rating at least equal to the maximum head produced by the circulating pump. Generally, two-way valves are more desirable than the three-way type because of the equal percentage flow characteristics and the smaller capacities available in two-way valves. Single-seated valves are recommended in preference to double-seated valves since the latter do not provide tight closing.

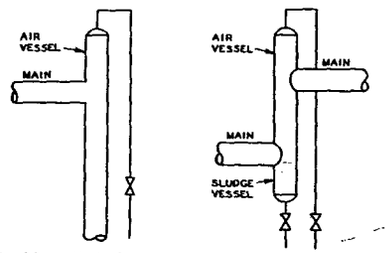


Fig. 14.... Methods of Venting High-Temperature Water Mains

Valve Location

Control valves preferably should be located in the return lines from heat transfer units in order to reduce the valve operating temperature and to prevent the high-temperature water from flashing to steam at the lower discharge pressure. Sometimes valves are located as low as practicable to increase the static head at the valve and further minimize the possibility of flashing. This problem is minimized in systems pressurized by inert gas, since a greater difference is maintained between the system and saturation pressures.

Typical Applications

A typical application is the control of the temperature of water leaving a heat exchanger in which high-temperature water is used as the heating medium. The temperature measuring element should be located where it can best detect changes and thus prevent overheating of the outlet water and possible flashing. When the measuring element is located in the leaving water, there must be a continuous flow through the exchanger and past the element. If the water leaving the exchanger is used for space heating, the set point of the thermostat in this water (which controls the temperature of the leaving water by controlling the inlet temperature to the exchanger) can be readjusted in accordance with outdoor temperature.

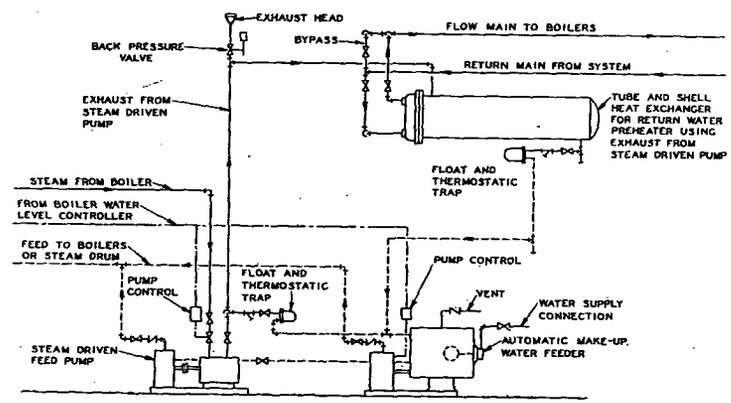


Fig. 15.... Arrangement of Boiler Feed Where Exhaust Steam Is Available