

temperatures. Piping should be insulated to the same thickness and standards as for steam at the same temperature.

Valves for high temperature water should be made with cast steel bodies

TABLE 8. HEAD LOSS IN FITTINGS*
(For turbulent flow)

FITTINGS	PIPE SIZE INCHES	FEET OF SAME SIZE PIPE HAVING EQUAL LOSS*														
		10	8	6	5	4	3	2½	2	1½	1¼	1	¾	½	¼	⅛
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 ^d		13	10	8	7	5.5	4	3.2	2.6	2	1.7	1.4	1.2	0.8		
Concentric Reducers	to															
	From	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										
	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							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			

* Compiled from data published by Tute 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 33½%.

* Equivalent length of pipe having a Fanning friction coefficient of 0.006.

and stainless steel trim since these have proved far more satisfactory than bronze valves. Wedge-type gate valves are recommended for isolating and for use within the boiler house. For general use throughout the system, globe valves are preferred.

Valves combining flow control and regulation are preferable for high temperature water where heat balancing is necessary, since a small quantity of this water contains a large quantity of heat. As high temperature water is more penetrating than low temperature water, leakage due partly to capillary action should not be ignored because even a small amount of leakage evaporates immediately. This slight leakage becomes noticeable only on the outside of the gland and spindle of the valve where thin deposits of salts are left after evaporation.

Control

The control of temperature is usually obtained by conventional means although it is common practice to place control valves on the outlet line of

TABLE 9. PROPERTIES OF WATER (212 F TO 400 F)

TEMPERATURE F	PRESSURE* psia	DENSITY Lb/CuFt	SPECIFIC HEAT Btu/(lb)(°F)	TOTAL HEAT ABOVE 32 F	
				Btu/Lb*	Btu/CuFt
212	14.70	59.88	1.0055	180.00	10.760
220	17.19	59.66	1.0068	188.06	11.222
230	20.78	59.37	1.0087	198.15	11.764
240	24.97	59.17	1.0104	208.26	12.327
250	29.82	58.84	1.0126	218.39	12.856
260	35.43	58.62	1.0148	228.55	13.403
270	41.85	58.25	1.0174	238.74	13.912
280	49.20	58.04	1.0200	248.95	14.555
290	57.55	57.65	1.0230	259.20	14.942
300	67.01	57.41	1.0260	269.48	15.476
310	77.68	57.00	1.0296	279.80	15.955
320	89.65	56.65	1.0332	290.17	16.444
330	103.03	56.31	1.0368	300.59	16.931
340	117.99	55.95	1.0404	311.05	17.407
350	134.62	55.65	1.0440	321.55	17.899
360	153.01	55.19	1.0486	332.10	18.333
370	173.33	54.78	1.0532	342.71	18.778
380	195.70	54.36	1.0578	353.39	19.213
390	220.19	53.96	1.0624	364.14	19.644
400	247.25	53.62	1.0670	374.96	20.106

* Reprinted by permission from *Thermodynamic Properties of Steam*, by J. H. Keenan and F. G. Keyes published by John Wiley and Sons, Inc., 1938 edition.

the heat absorbing equipment where the temperatures are lower. In larger distribution systems means of controlling differential pressures between the flow and return mains are advisable.

With space and process heating, temperatures can be controlled within close limits by the use of two- and three-way mixing valves modulating or by-passing some of the high temperature water. Such controls are essential at heat exchangers or converters.

Boilers or Hot Water Generators

Almost any high pressure boiler can be used for high temperature water systems, but certain types as, for example, the water tube boiler, are more advantageous than others. Boiler selection is important and such problems as frictional head loss, available water space, flue outlet, type of firing,