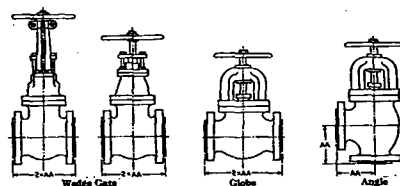


Table 19 . . . Dimensions of Flanged Cast-Iron and Steel Valves



Nominal Pipe Size	Contact Surface to Contact Surface Dimensions, (2" X AA)															
	Cast Iron								Steel							
	125	175 ^a	250 ^a	300 ^a	350 ^a	400 ^a	450 ^a	500 ^a	150	200	250	300	350	400	450	500
1	1 1/2	2 1/4	3 1/4	4 1/4	5 1/4	6 1/4	7 1/4	8 1/4	1 1/2	2 1/4	3 1/4	4 1/4	5 1/4	6 1/4	7 1/4	8 1/4
2	2 1/4	3 1/4	4 1/4	5 1/4	6 1/4	7 1/4	8 1/4	9 1/4	2 1/4	3 1/4	4 1/4	5 1/4	6 1/4	7 1/4	8 1/4	9 1/4
3	3 1/4	4 1/4	5 1/4	6 1/4	7 1/4	8 1/4	9 1/4	10 1/4	3 1/4	4 1/4	5 1/4	6 1/4	7 1/4	8 1/4	9 1/4	10 1/4
4	4 1/4	5 1/4	6 1/4	7 1/4	8 1/4	9 1/4	10 1/4	11 1/4	4 1/4	5 1/4	6 1/4	7 1/4	8 1/4	9 1/4	10 1/4	11 1/4
5	5 1/4	6 1/4	7 1/4	8 1/4	9 1/4	10 1/4	11 1/4	12 1/4	5 1/4	6 1/4	7 1/4	8 1/4	9 1/4	10 1/4	11 1/4	12 1/4
6	6 1/4	7 1/4	8 1/4	9 1/4	10 1/4	11 1/4	12 1/4	13 1/4	6 1/4	7 1/4	8 1/4	9 1/4	10 1/4	11 1/4	12 1/4	13 1/4
8	8 1/4	9 1/4	10 1/4	11 1/4	12 1/4	13 1/4	14 1/4	15 1/4	8 1/4	9 1/4	10 1/4	11 1/4	12 1/4	13 1/4	14 1/4	15 1/4
10	10 1/4	11 1/4	12 1/4	13 1/4	14 1/4	15 1/4	16 1/4	17 1/4	10 1/4	11 1/4	12 1/4	13 1/4	14 1/4	15 1/4	16 1/4	17 1/4
12	12 1/4	13 1/4	14 1/4	15 1/4	16 1/4	17 1/4	18 1/4	19 1/4	12 1/4	13 1/4	14 1/4	15 1/4	16 1/4	17 1/4	18 1/4	19 1/4
14 OD	14 1/4	15 1/4	16 1/4	17 1/4	18 1/4	19 1/4	20 1/4	21 1/4	14 1/4	15 1/4	16 1/4	17 1/4	18 1/4	19 1/4	20 1/4	21 1/4
16 OD	16 1/4	17 1/4	18 1/4	19 1/4	20 1/4	21 1/4	22 1/4	23 1/4	16 1/4	17 1/4	18 1/4	19 1/4	20 1/4	21 1/4	22 1/4	23 1/4
18 OD	18 1/4	19 1/4	20 1/4	21 1/4	22 1/4	23 1/4	24 1/4	25 1/4	18 1/4	19 1/4	20 1/4	21 1/4	22 1/4	23 1/4	24 1/4	25 1/4
20 OD	20 1/4	21 1/4	22 1/4	23 1/4	24 1/4	25 1/4	26 1/4	27 1/4	20 1/4	21 1/4	22 1/4	23 1/4	24 1/4	25 1/4	26 1/4	27 1/4
24 OD	24 1/4	25 1/4	26 1/4	27 1/4	28 1/4	29 1/4	30 1/4	31 1/4	24 1/4	25 1/4	26 1/4	27 1/4	28 1/4	29 1/4	30 1/4	31 1/4

Notes for Table 19

From American Standard for Face-to-Face and End-to-End Dimensions of Ferrous Valves, ASA B16.10-1957.

All dimensions given in inches. Where dimensions are not given, the sizes either are not made or there is insufficient demand to warrant the expense of uniformity. Female and groove joint facings have bottom of groove in same plane as flange edge, and center to contact surface dimensions for these facings are reduced by the amount of the raised face.

* These are pressure designations which refer to the primary service ratings in lb per sq in. of the connecting end flanges.

^a The connecting end flanges of 175 lb valves are the same as those on 250 lb valves.

^b The contact surface to contact surface dimensions and connecting end flanges for 400 lb valves 2 in. size and smaller, are identical with those of 500 lb valves; and the contact surface to contact surface dimensions and connecting end flanges for 500 lb valves 3/4 in. size and smaller, are identical with those of 1500 lb valves.

Table 20 . . . Thermal Stresses Due to Total Constraint

Temperature Change, F Deg	Thermal Stresses, Psi					
	Steel	Wrought iron	Cast iron	Brass or bronze	Copper	Aluminum
20	3900	3800	1428	2760	2980	2700
40	7800	7600	2856	5520	5960	5400
60	11700	11400	4284	8280	8940	8100
80	15600	15200	5712	11040	11920	10800
100	19500	19000	7140	13800	14900	13500

* For temperatures between 22 and 400 F.

Table 21 . . . Physical Properties for Determining Thermal Stress (Temperatures between 32 and 400 F)

	Steel	Wrought iron	Cast iron	Brass or bronze	Copper	Aluminum
Coefficient of Linear Expansion, $\alpha \times 10^{-6}$	6.5	6.8	5.95	9.85	9.3	13.5
Modulus of Elasticity, E, psi $\times 10^{-6}$	30	28	12	14	16	10
Product of αE , psi	195	190	71.4	138	149	135

Example: The coefficient of expansion for steel = 0.000065 in./in. and the modulus of elasticity = 30,000,000 psi. Therefore $\alpha E = 195$ psi.

Table 22 . . . Equations for Bending Stress and Deflection between Supports

Type of Support	Bending Stress, Psi	Deflection, inches
Single span (free ends)	$S = \frac{0.75 WL^2 D_o}{I}$	$Y = \frac{22.5 WL^4}{EI}$
Continuous line	$S = \frac{0.5 WL^2 D_o}{I}$	$Y = \frac{4.5 WL^4}{EI}$

W = total weight (pipe, fluid, etc.) pounds per foot.

D_o = outside diameter of pipe, inches.

L = length of span, feet.

E = modulus of elasticity, pounds per square inch.

I = moment of inertia, (inches)⁴.

$I = \frac{\pi}{64} [(D_o)^4 - (D_i)^4]$

D_i = inside diameter of pipe, inches.

Table 23 . . . Application of Pipe, Tube, and Fittings for Heating and Air Conditioning

Application	Materials Commonly Used	Application	Materials Commonly Used
Chilled water	Type K or L hard copper, wrought iron, or black steel, Schedule 40	Hot water heating ^a	Type K or L hard copper, black steel, or wrought iron, Schedule 40
Cooling tower	Type K or L hard copper, wrought iron, or black steel, Schedule 40	Refrigerant ^a	Type K or L hard copper, wrought iron or black steel, Schedule 40
Underground water 2-in. and smaller	Type K soft copper, galvanized wrought iron, or galvanized steel, Schedule 40 (for corrosive soils, a coated steel pipe should be used)	Steam heating Supply 125 psi and less	Type L hard copper, black steel, Schedule 40, standard fittings
2 1/2-in. and larger	Type K, soft copper cast iron, Class 150, galvanized wrought iron, or galvanized steel, Schedule 40 (for corrosive soils, a coated steel pipe should be used)	125 to 250 psi	Type K hard copper, black steel, Schedule 40. For fittings see Table 8
City water—inside building	Type K or L hard copper, galvanized wrought iron, or galvanized steel, Schedule 40	Return pipe All sizes	Type K or L hard copper, black wrought iron or steel, Schedule 40. Standard fittings
Underground rain water conductors	Vitrified clay or cast-iron soil	Receiver vent All sizes	Copper drainage tube DWV, galvanized wrought iron or steel, Schedule 40. Standard fittings
Small installations	Vitrified clay or cast-iron soil	Sanitary ^{a,b} Small installations Waste: 1 1/2-in. and smaller	Copper drainage tube DWV, galvanized wrought iron or steel, Schedule 40
Under paved areas Large installations 8-in. and smaller	Cast-iron soil XH or vitrified clay	2-in. and larger	Cast iron, copper drainage tube DWV, galvanized steel, Schedule 40, or vitrified clay
10 to 24-in.	Vitrified clay or concrete	Vents: 2 1/2-in. and smaller	Copper drainage tube DWV, galvanized wrought iron or steel, Schedule 40
30-in. and larger	Vitrified clay or concrete	3-in. and larger	Cast iron, copper drainage tube DWV, or galvanized steel, Schedule 40
5 feet outside bldg. and under paving	Cast-iron soil XH or vitrified clay	Large installations Waste: 2-in. and larger	Cast iron, galvanized steel, Schedule 40, copper drainage tube DWV or vitrified clay
Interior rain water conductors	Copper drainage tube DWV, black or galvanized wrought iron or steel, Schedule 40	Vents: 2-in. and larger	Cast iron, galvanized steel, Schedule 40, or copper drainage tube DWV
Small installations	Copper drainage tube DWV, cast-iron soil XH, black or galvanized wrought iron or steel, Schedule 40	Gas (all kinds) All sizes	Black steel, Schedule 40, malleable iron fittings
Large installations	Copper drainage tube DWV, cast-iron soil XH, black or galvanized wrought iron or steel, Schedule 40		
Panel heating ^a	Type K or L hard or soft copper, black steel or wrought iron, Schedule 40		

^a Panel heating copper fittings should be soldered with 85-5 solder. Steel fittings should be welded.

^b All underground feed and return lines buried in slab, should be equipped with fittings as outlined for panel heating.

^c Refrigerant fittings on copper pipe must be wrought copper. All welded fittings should be long turn.

^d House sewer to main should be cast iron XH.

^e Materials must comply with local plumbing codes.

the fluid being carried. There is also the bending moment that may be caused by the flexure of the pipe. For this chapter, however, the flexure loading will not be treated for the reason of complexity, as previously stated for the problem of expansion.

Since hangers should always be designed to take the bending moment (including buckling) from the pipe, it is necessary to design the hangers or supports for the maximum bending stress. Even with perfect support spacing there will

be some sagging; therefore, the supports should be on a gradient if it is necessary to prevent pockets. Such a condition arises for condensate piping.

Typical bending and deflection equations are given in Table 22 in order that supports can be properly sized, and if necessary, pitched. These equations are typical beam equations. If more complex loadings exist, proper beam equations can be applied. Such equations are found in standard texts on mechanics of materials.