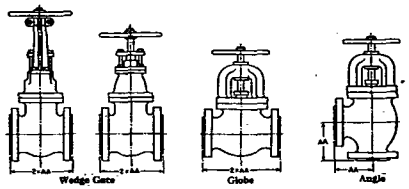
Table 19 .... Dimensions of Flanged Cast-Iron and Steel Valves



Nominal Pipe Size	Contact Surface to Contact Surface Dimensions, (2 × AA)									
	Cast Iron				Steel					
	125	175[a,b]	250[a]	800[a] Hydraulic	150[a]	300[a]	400[a]	600[a]	900[a]	1500[a]
Wedge Gate Valves										
1	....	....	....	....	....	....	*8½	8½	*10	10
1¼	....	....	....	....	....	....	*9	9	*11	11
1½	....	....	....	....	....	7½	*9½	9½	*12	12
2	7	7¼	8½	11½	7	8½	*11½	11½	*14½	14½
2½	7½	8	9½	13	7½	9½	*13	13	*16½	16½
3	8	9¼	11⅜	14	8	11⅜	*14	14	15	18½
3½	8½	10	11⅞	....	8½	11⅞	....	....	....	....
4	9	10½	12	17	9	12	16	17	18	21½
5	10	11½	15	....	10	15	18	20	22	26½
6	10½	13	15⅞	22	10½	15⅞	19½	22	24	27¾
8	11½	14¼	16½	26	11½	16½	23½	26	29	32¾
10	13	16¾	18	31	13	18	26½	31	33	39
12	14	17½	19¾	33	14	19¾	30	33	38	44½
14 OD	15	....	22½	....	15	30	32½	35	40½	....
16 OD	16	....	24	....	16	33	35½	39	44½	....
18 OD	17	....	26	....	17	36	38½	43	48	....
20 OD	18	....	28	....	18	39	41½	47	52	....
24 OD	20	....	31	....	20	45	48½	55	61	....
Globe & Angle Valves										
½	....	....	....	....	....	....	....	....	....	....
¾	....	....	....	....	....	....	7½	7½	....	....
1	....	....	....	....	....	....	8½	8½	10	10
1¼	....	....	....	....	....	....	9	9	11	11
1½	....	....	....	....	....	....	9½	9½	12	12
2	8	....	10½	....	8	10½	11½	11½	14½	14½
2½	8½	....	11½	....	8½	11½	13	13	16½	16½
3	9½	....	12½	....	9½	12½	14	14	15	18½
3½	10½	....	13¼	....	10½	13¼	....	....	....	....
4	11½	....	14	....	11½	14	16	17	18	21½
5	13	....	15¾	....	14	15¾	18	20	22	26½
6	14	....	17¼	....	16	17½	19½	22	24	27¾
8	19½	....	21	....	19½	22	23½	26	29	32¾

Notes for Table 19

From *American Standard for Face-to-Face Dimensions of Ferrous Flanged and Welding End Valves, ASA* B16.10-1939.

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 unification.

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.

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

[b] The connecting end flanges of 175 lb valves are the same as those on 250 lb valves.

* The contact surface to contact surface dimensions and connecting end flanges for 600 lb valves 3 in. size and smaller, are identical with those of 600 lb valves; and the contact surface to contact surface dimensions and connecting end flanges for 900 lb valves 2½ 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 32 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, $a \times 10^6$	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 aE, psi	195	190	71.4	138	149	135

Example: The coefficient of expansion for steel = 0.0000065 in./in. and the modulus of elasticity = 30,000,000 psi. Therefore aE = 195 psi.

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

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

W = Total weight (pipe, fluid, etc.) pounds per foot.
D = OD of pipe, inches.
L = Length of span, feet.
E = Modulus of elasticity, pounds per square inch.
I = Moment of inertia, (inches)^4.

$I = \frac{\pi}{64}\left[(\text{OD})^4 - (\text{ID})^4\right]$, OD, and ID in inches.

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

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

[a] Panel heating copper fittings should be soldered with 95-5 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.

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.

By application of the equations given in this section and the section on Expansion and Flexibility, it is possible to determine the proper location and type of support for straight lines. The types are anchors and hangers.

Anchors are used to guide the expansion (sliding anchors) or to fix the pipe. They are needed to take the stress out of the line and translate the stresses to the foundations. In that way all stress can be taken out of the line before it can be transferred to such equipment as boilers or pumps. By means of solid anchors, the anchors can be used to divide the piping into isolated sections that cannot transmit the stresses to other sections.

Hangers are used to support the piping and to take out the bending stresses. They are of the spring, roller, or rod type. Such types generally allow the free movement of the pipe and yet maintain full support.

The *Code for Pressure Piping*, ASA B31.1, has strict requirements for the materials used in hangers and supports. The structural properties have a safety factor of five, and consequently there is little chance of failure due to a sudden change of load.

There is a type of support for almost every conceivable