Basic Design and Pipe Drafting

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8) Codes and Specifications
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Lecture Times : Tuesdays EST 14-16 on class days

Tutorial Times: Sunday EST 14-15

Flange Basics- Flange Types

Threaded Flange

The threaded flange depicted in Figure 4.17 is similar to the slip-on flange, but the bore is threaded. Its principal value is that it can be assembled without welding. This feature makes the threaded flange well suited to extreme pressure services that operate at normal atmospheric temperatures and in highly explosive areas where welding may create a hazard.

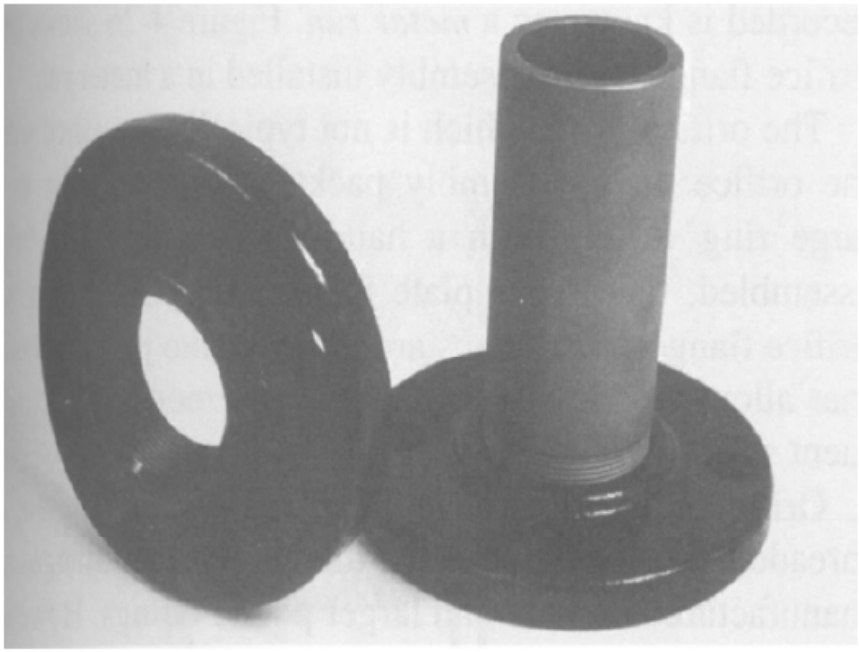


FIGURE 4.17 Threaded flange.

Flange Basics- Flange Types

Threaded Flange

Threaded flanges are not suited, however, for conditions involving temperatures or bending stresses of any significance, particularly when cyclic conditions exist, which may cause leakage through the threads.

A seal weld is sometimes applied. This technique, however, cannot be considered as entirely satisfactory nor is it always possible. Figure 4.18 represents the single-line threaded flange drawing symbol.

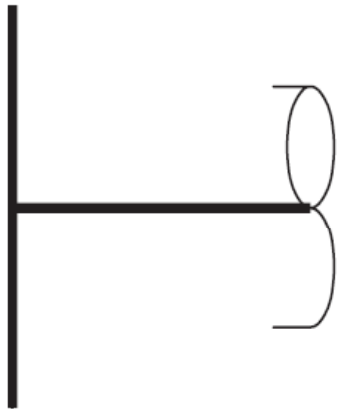


FIGURE 4.18 Single-line threaded flange drawing symbol.

Flange Basics- Flange Types

Socket-Weld Flange

The socket-weld flange shown in Figure 4.19 is also similar to the slip-on flange. It was originally developed for use in small-diameter (½–4") high-pressure piping systems. Pipe is inserted into the socket then welded. An internal weld is often employed and grinded. The single-line drawing symbol for the socket-weld flange is shown in Figure 4.20.

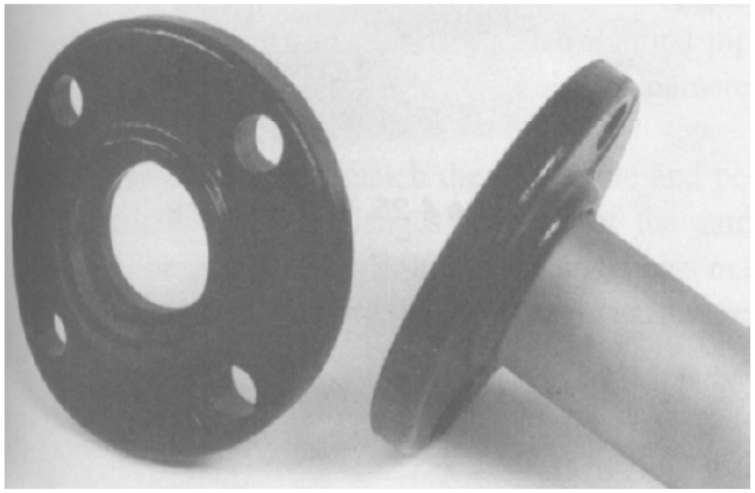


FIGURE 4.19 Socket-weld flange.

FIGURE 4.20 Socket-weld flange drawing symbols.

Flange Basics- Flange Types

Reducing Flange

The reducing flange in Figure 4.21 is used to make a reduction in the diameter of the pipe. A reducing flange is most frequently used in installations with limited space. Be advised however, the flow should travel from the smaller size to the larger. If the flow were reversed, severe turbulence could develop.

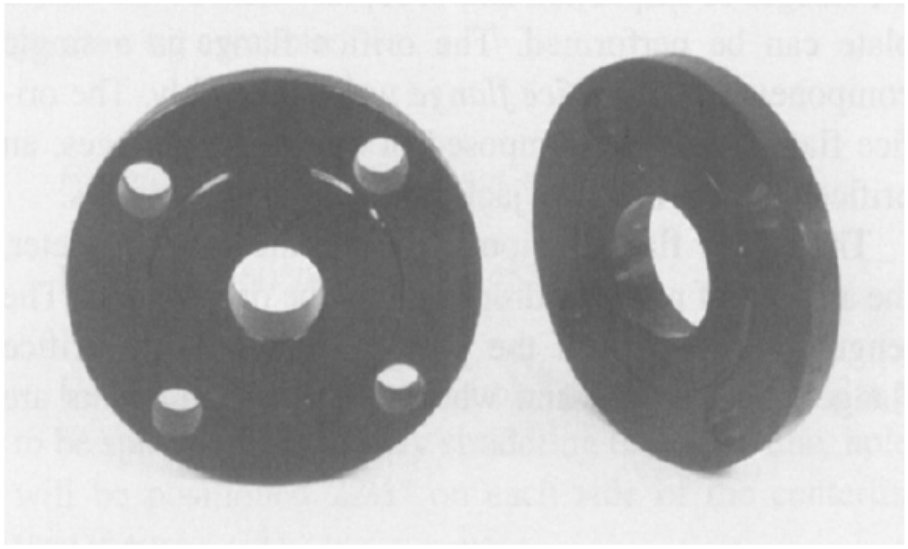


FIGURE 4.21 Reducing flange.

Flange Basics- Flange Types

Reducing Flange

Callouts are placed on drawings: large end first, small end second. The pound rating and flange type are included in the callout. The internal bore is manufactured to match that of the smaller pipe size. Figure 4.22 shows a 12” 6"-300# Raised Face Slip-On flange. Notice the use of abbreviations to keep the size of the callout to a minimum. Reducing flanges are manufactured as weld neck, slip-on, or threaded flange types.

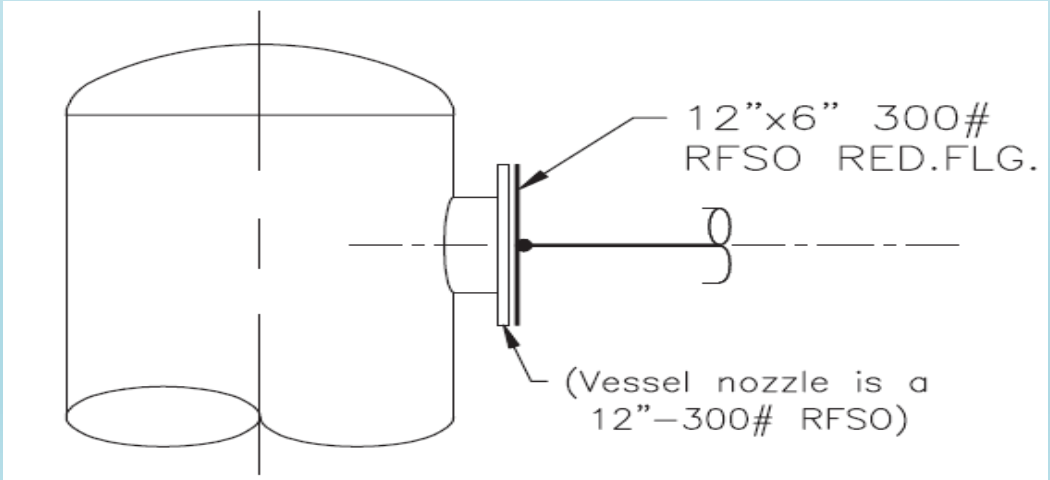


FIGURE 4.22 Reducing flange drawing symbol with callout.

Flange Basics- Flange Types

Blind Flange

The blind flange depicted in Figure 4.23 serves a function similar to that of a plug or cap. It is used to terminate the end of a piping system. Blind flanges have the face thickness of a flange, a matching face type, and similar bolting pattern. Because it is bolted, the blind flange provides easy access to the interior of a vessel or pipe. Figure 4.24 represents the drawing symbol for the blind flan

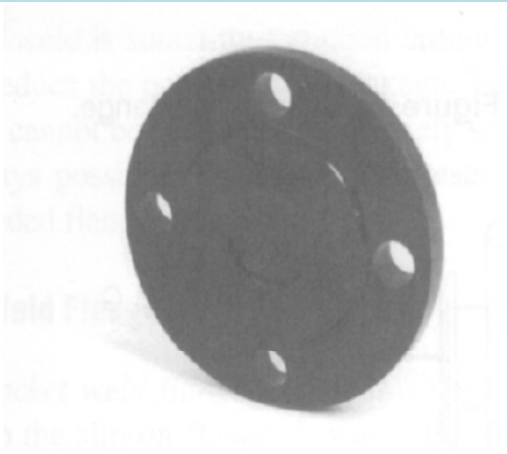


FIGURE 4.23 Blind flange.

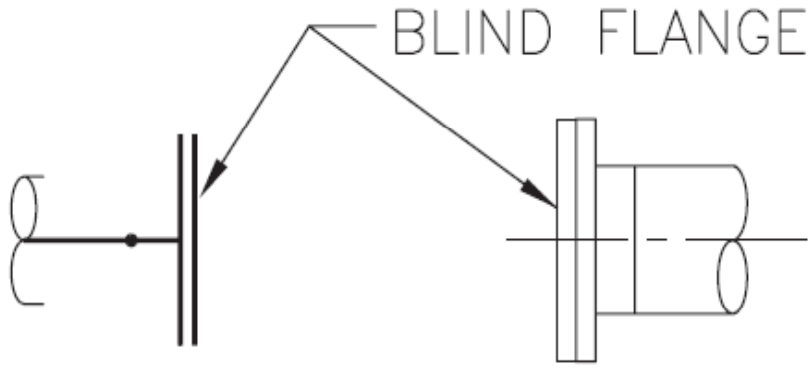


FIGURE 4.24 Blind flange drawing symbols.

Flange Basics- Flange Types

Orifice Flange

The orifice flange (Figure 4.25) is the only one that actually performs a function. The function of the orifice flange is to measure the rate of the flow of the commodity thro

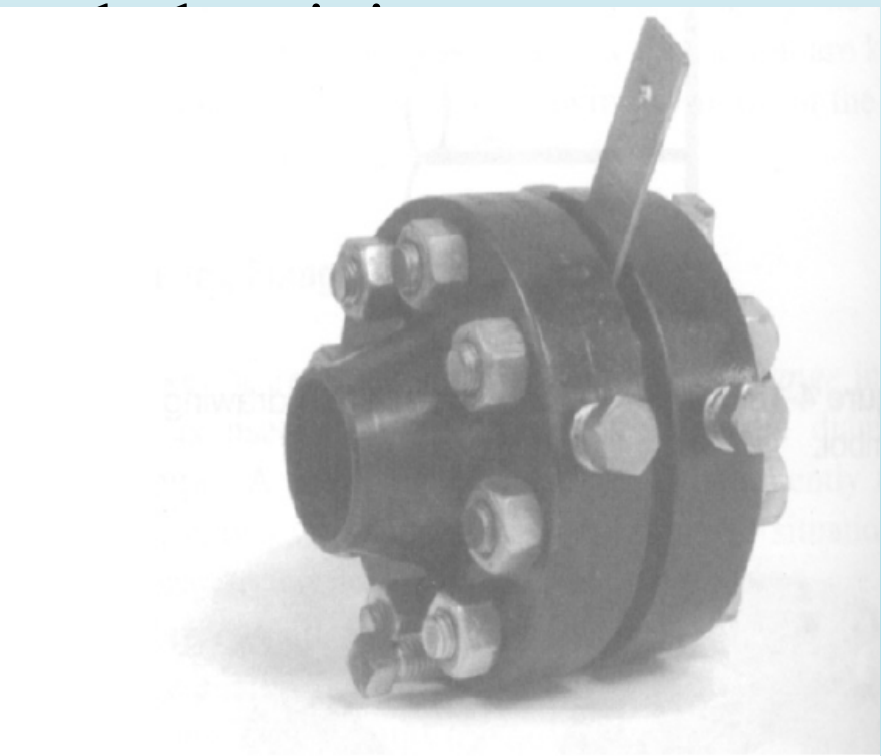


FIGURE 4.25 Orifice flange.

Flange Basics- Flange Types

Orifice Flange

Orifice flanges are easy to recognize because they have a hole drilled through the face of the flange perpendicular to the pipe. They also have an additional set of bolts called jack screws. These screws are used to help separate the flanges so inspection and/or replacement of the orifice plate can be performed. The orifice flange is a single component of the orifice flange union assembly. The orifice flange union is composed of two orifice flanges, an orifice plate, bolts s, and two gas

Flange Basics- Flange Types

Orifice Flange

The orifice flange union is used to measure, or meter, the amount of pressure drop through the orifice plate. The length of pipe within the piping system where orifice flanges are installed and where these measurements are recorded is known as a meter run.

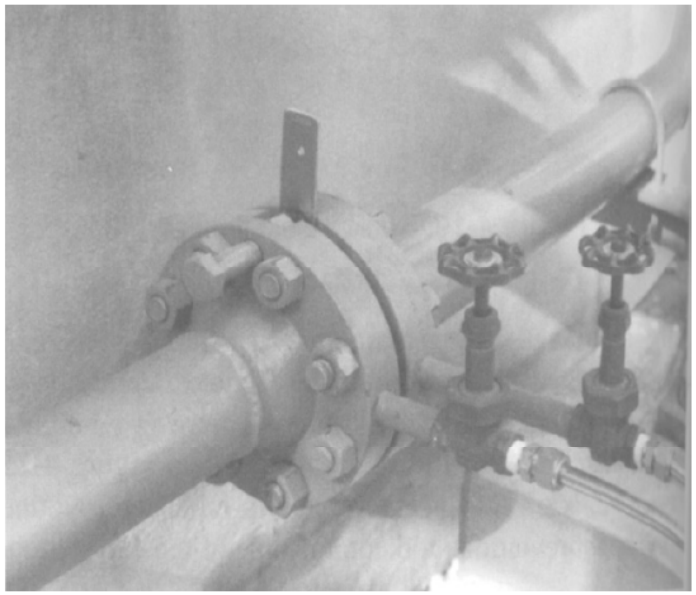


FIGURE 4.26 Orifice flange union assembly. *Courtesy of Nisseki Chemical Texas Inc., Bayport, Texas.*

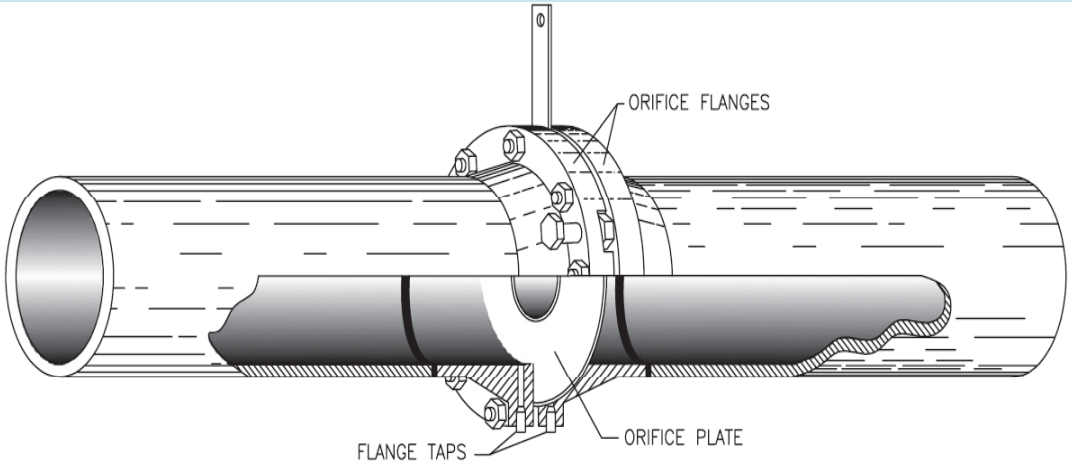


FIGURE 4.27 Broken-out section of meter run.

Flange Basics- Flange Types

Orifice Flange

The orifice plate, which is not typically furnished with the orifice union assembly package, looks similar to a large ring washer with a handle attached. When fully assembled, the orifice plate is sandwiched between the orifice flanges. Valve taps are inserted into pressure holes that allow for the attachment of field monitoring equipment so accurate measurements can be recorded.

Flange Basics- Flange Types

Orifice Flange

Orifice flanges can be either weld neck, slip-on, or threaded. The weld neck and threaded orifice flanges are manufactured in 300# and larger ratings. However, the slip-on orifice flange is only available as a 300# raised face flange. The single-line and double-line drawing symbols for the orifice flange are shown in Figure 4.28.

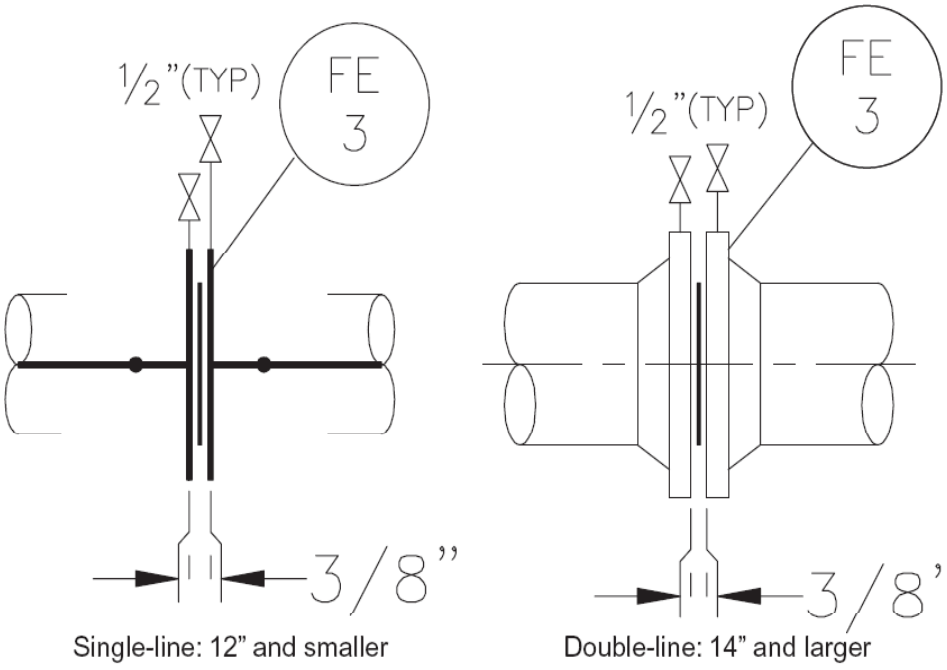
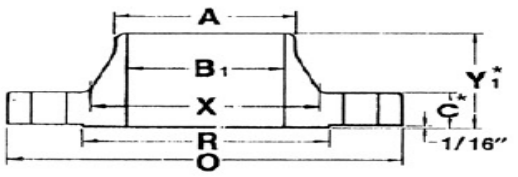


FIGURE 4.28 Orifice flange drawing symbols.

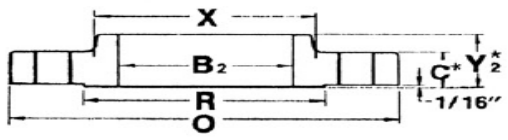
FLANGES

DIMENSIONS

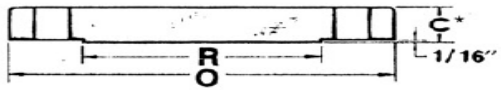
WELDING NECK



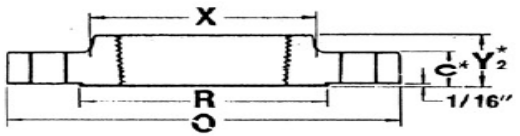
SLIP-ON



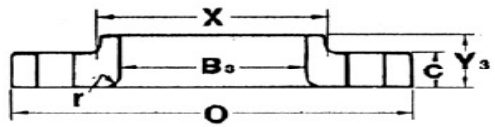
BLIND



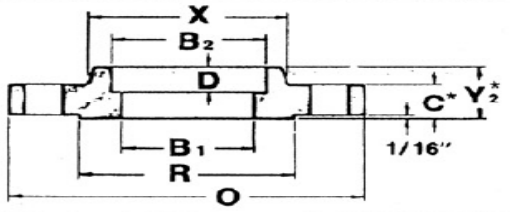
THREADED



LAP JOINT



SOCKET-WELD [3]



150-LB.

Nom. Pipe Size	Out-side Diam.	Thkn. (min.)	O.D. of Raised Face	Hub Diam.	Length thru Hub			Bore □			Depth of Socket	Approx. Weight (Lbs.)				Drilling		
					Wldg. Neck	Slip-on Thrd. Sock. W.	Lap Joint	Wldg. [2] Neck	Slip-on Sock. W.	Lap Joint		Wldg. Neck	Slip-On Thrd. Sock. W.	Lap Joint	Blind	No. Holes	Diam. Holes	Bolt Circle Diam.
	O	C	R	X	Y_1	Y_2	Y_3	B_1	B_2	B_3	D							
½	3½	7/16	1⅜	1 3/16	1⅞	⅝	⅝	0.62	0.88	0.90	⅜	2	1	1	1	4	⅝	2⅜
¾	3⅞	½	1 11/16	1½	2 1/16	⅝	⅝	0.82	1.09	1.11	7/16	2	2	2	2	4	⅝	2¾
1	4¼	9/16	2	1 15/16	2 3/16	11/16	11/16	1.05	1.36	1.38	½	3	2	2	2	4	⅝	3⅛
1¼	4⅝	⅝	2½	2 5/16	2¼	13/16	13/16	1.38	1.70	1.72	9/16	3	3	3	3	4	⅝	3½
1½	5	11/16	2⅞	2 9/16	2 7/16	⅞	⅞	1.61	1.95	1.97	⅝	4	3	3	4	4	⅝	3⅞
2	6	¾	3⅝	3 1/16	2½	1	1	2.07	2.44	2.46	11/16	6	5	5	5	4	¾	4¾
2½	7	⅞	4⅛	3 5/16	2¾	1⅛	1⅛	2.47	2.94	2.97	¾	8	7	7	7	4	¾	5½
3	7½	15/16	5	4¼	2¾	1 3/16	1 3/16	3.07	3.57	3.60	13/16	10	8	8	9	4	¾	6
3½	8½	15/16	5½	4 13/16	2 13/16	1¼	1¼	3.55	4.07	4.10	⅞	12	11	11	13	8	¾	7
4	9	15/16	6 3/16	5 5/16	3	1 5/16	1 5/16	4.03	4.57	4.60	15/16	15	13	13	17	8	¾	7½
5	10	15/16	7 5/16	6 7/16	3½	1 7/16	1 7/16	5.05	5.66	5.69	15/16	19	15	15	20	8	⅞	8½
6	11	1	8½	7 5/16	3½	1 9/16	1 9/16	6.07	6.72	6.75	1 1/16	24	19	19	26	8	⅞	9½
8	13½	1⅛	10⅝	9 11/16	4	1¾	1¾	7.98	8.72	8.75	1¼	39	30	30	45	8	⅞	11¾
10	16	1 3/16	12¾	12	4	1 15/16	1 15/16	10.02	10.88	10.92	1 5/16	52	43	43	70	12	1	14¼
12	19	1¼	15	14⅜	4½	2 3/16	2 3/16	12.00	12.88	12.92	1 3/16	80	64	64	110	12	1	17
14	21	1⅜	16¼	15¾	5	2¼	3⅛	13.25	14.14	14.18	1⅝	110	90	105	140	12	1⅛	18¾
16	23½	1 7/16	18½	18	5	2½	3 7/16	15.25	16.16	16.19	1¾	140	98	140	180	16	1⅛	21¼
18	25	1 9/16	21	19⅞	5½	2 11/16	3 13/16	17.25	18.18	18.20	1 15/16	150	130	160	220	16	1¼	22¾
20	27½	1 11/16	23	22	5 11/16	2⅞	4 1/16	19.25	20.20	20.25	2⅛	180	165	195	285	20	1¼	25
22	29½	1 13/16	25¼	24¼	5⅞	3⅛	4¼	21.25	22.22	22.25	2⅜	225	185	245	355	20	1⅜	27¼
24	32	1⅞	27¼	26⅛	6	3¼	4⅜	23.25	24.25	24.25	2½	260	220	275	430	20	1⅜	29½

Flange Basics- Bolts

To complete any flanged assembly, two additional items are required: bolts and gaskets. Bolts obviously hold mating flanges, nozzles, or valves together. The pressure rating of a flange will determine the size, spacing, and number of bolts required. As the nominal pipe size and pressure ratings change, so will the diameter, spacing, and number of bolts.

Flange Basics- Bolts

Flanges are designed to match the bolt circle and bolt hole dimensions of other flanges that are of the same diameter and pressure rating. It is critical that drawings convey the exact orientation of flanges to the fabricator. ANSI standards require all flanges straddle the horizontal, vertical, or north–south centerlines of pipe and equipment, as shown in Figure 4.29, unless otherwise noted on a drawing.

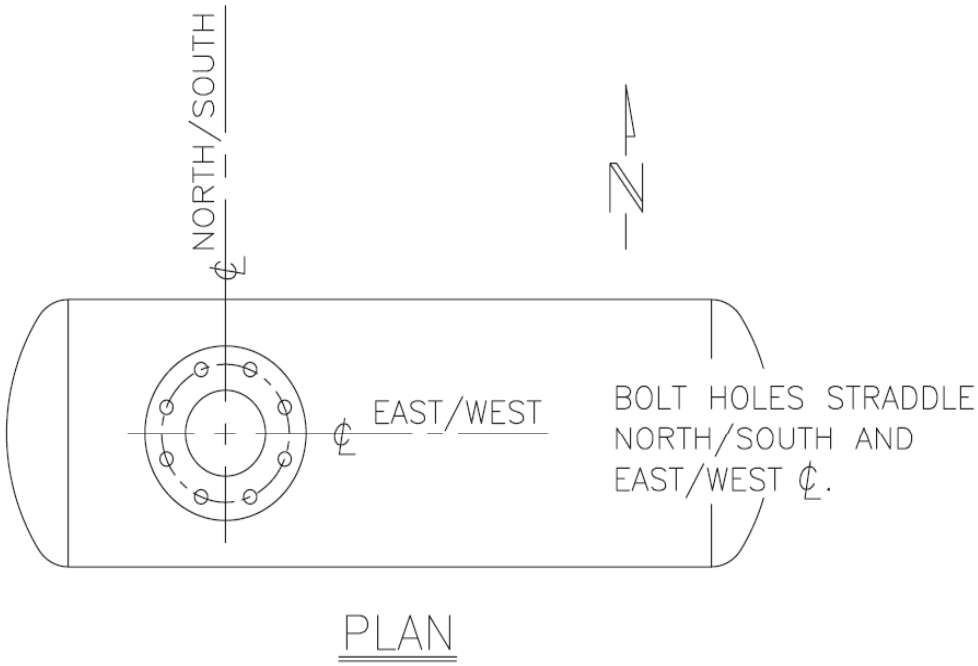


FIGURE 4.29 Bolt hole orientation.

Flange Basics- Bolts

To assure that bolt holes on flanges, nozzles, or valves align properly, holes are equally spaced around the flange. One column on the Taylor Forge Forged Steel Flanges Dimensioning Chart found in Appendix A indicates the number and diameter of the bolt holes on flanges. Notice bolts are found in quantities of 4, that is, 4, 8, 12, 16, etc. The following formula makes bolt hole location and alignment quick and simple.

Formula: 360°/# of holes = angular location

Example: 360°/8 (holes) = 45°

Flange Basics- Bolts

Using this formula shows holes on an eight-hole flange to be spaced 45° apart. By straddling the center-line, holes will be positioned 22½° on each side of the centerline (see Figure 4.30).

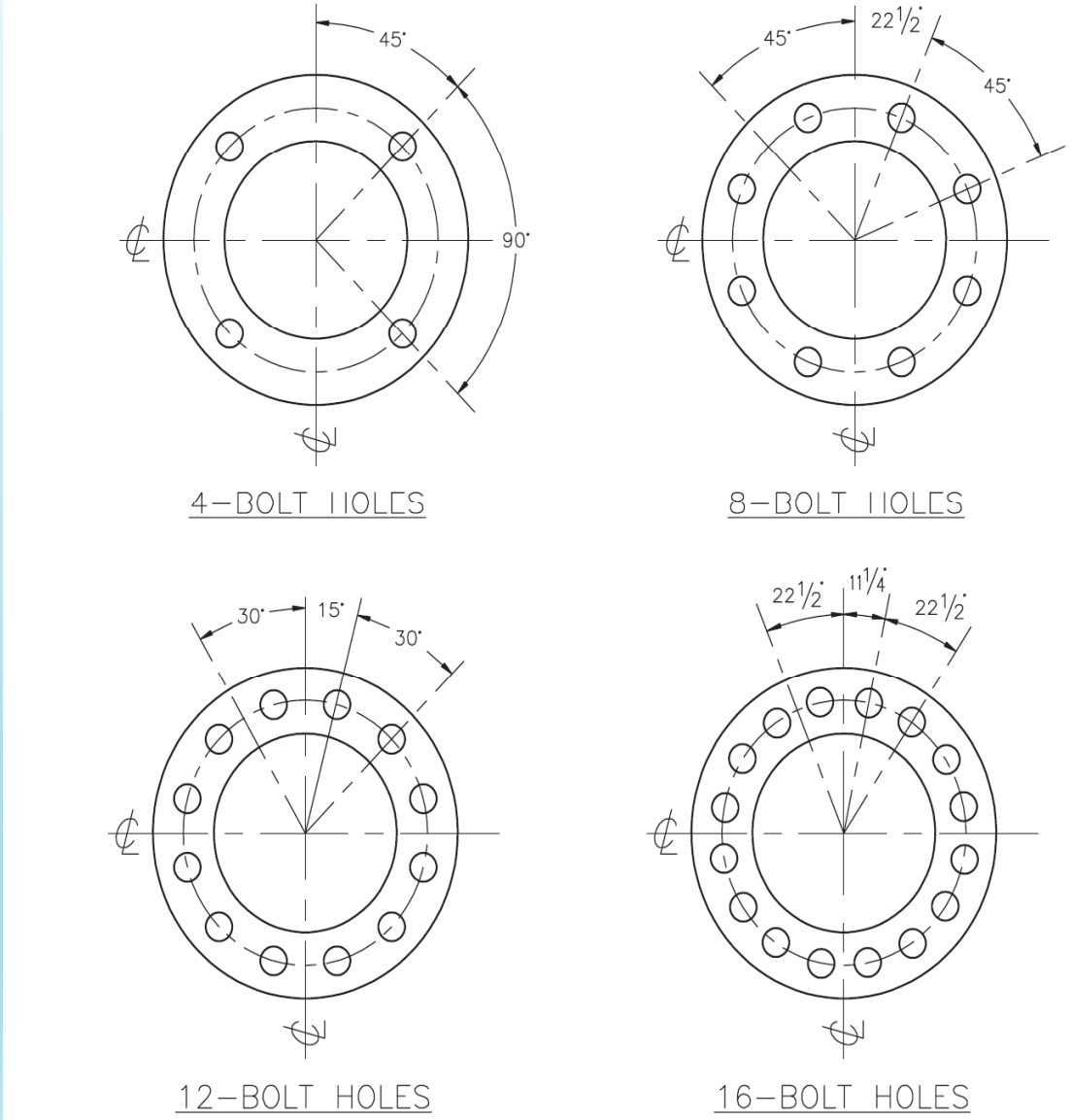


FIGURE 4.30 Bolt hole spacing.

Flange Basics- Bolts

Bolts are available in two types. Machine bolts have a “head” on one end and threads on the other. Stud bolts have threads throughout their entire length and require the use of two nuts (see Figure 4.31). Stud bolts are the most commonly used type and are available in two grades: A-193-B7 and A-193-B16. B7 grade bolts are used for temperatures up to 1,000 °F. B16 bolts are used when temperatures exceed 1,000 °F.

- Celsius

$$[°C] = 273.15[K] - 273.15 = 0$$

- Fahrenheit

$$[°F] = 273.15[K] \times \tfrac{9}{5} - 459.67 = 32$$

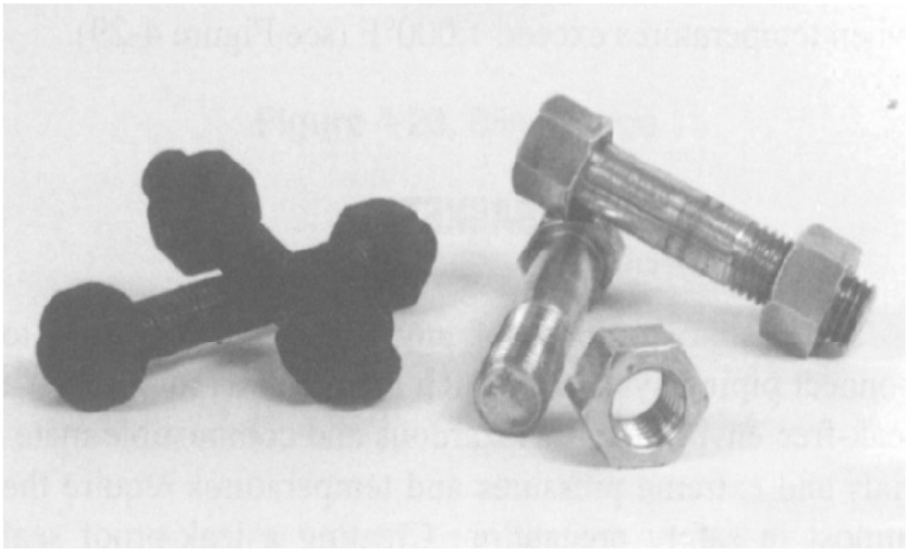


FIGURE 4.31 Stud and machine bolts.

Flange Basics- Bolts

Figure 4.32 depicts a sectional view of two flanges being mated around a gasket and secured with stud and machine bolts.

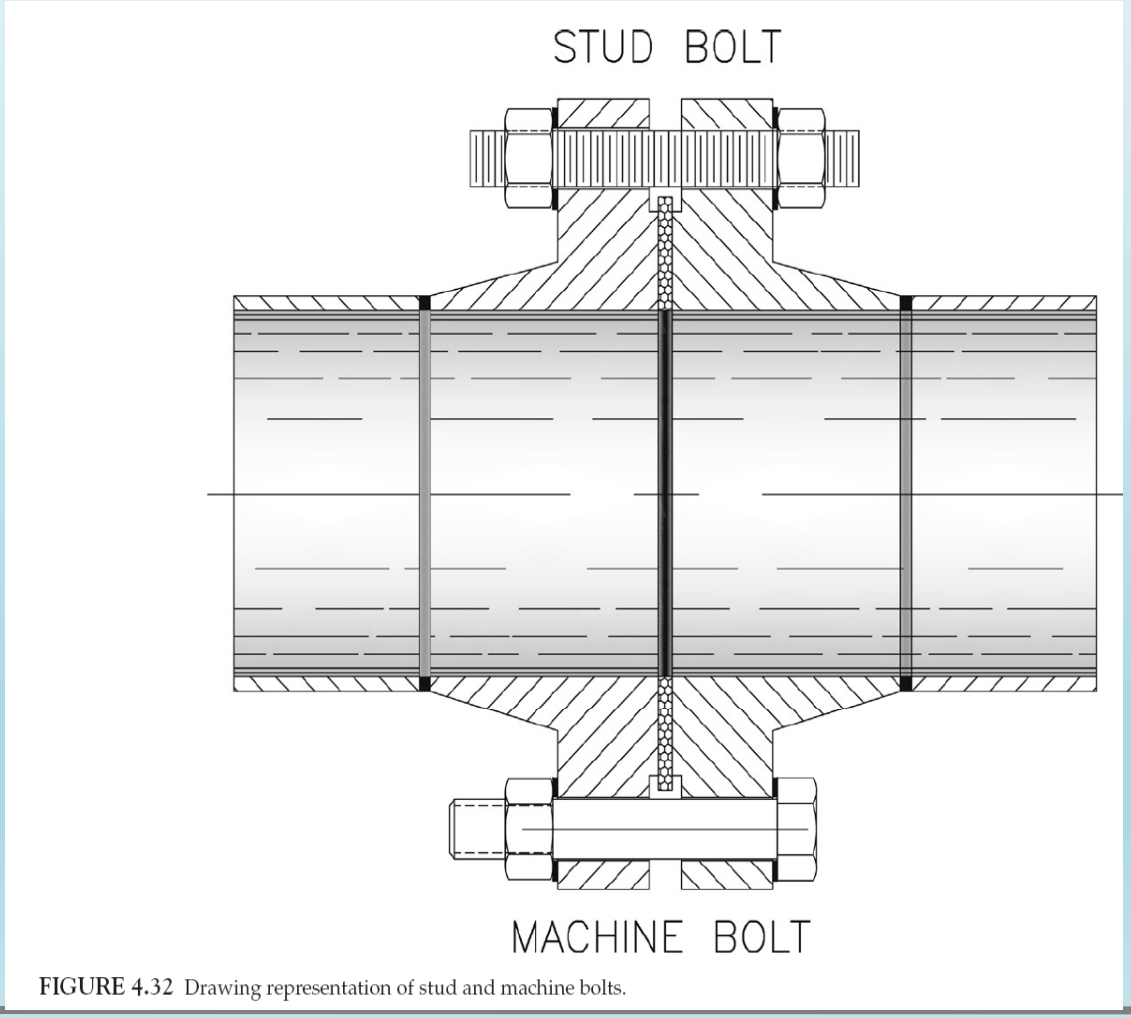


FIGURE 4.32 Drawing representation of stud and machine bolts.

Flange Basics- Gaskets

The primary purpose of any flanged assembly is to connect piping systems in such a manner as to produce a leak-free environment. Hazardous and combustible materials and extreme pressures and temperatures require the utmost in safety precaution. Therefore, gaskets perform a vital function in plant safety.

Using a gasket material softer than two adjoining flanges is an excellent way to eliminate the possibility of a fluid escape. Gaskets can be made of materials such as asbestos (silicate), rubber, neoprene, Teflon, lead, or copper. When bolts are tightened and flange faces are drawn together, the gasket material will conform to any imperfections in the flange faces to create a uniform seal.

Flange Basics- Gaskets

Figure 4.33 demonstrates the three types of gaskets that can be found in piping systems. They are full face, flat ring, and metal ring. Full face gaskets (Figure 4.34) are used on flat face flanges. Flat ring gaskets (Figure 4.35) are used on raised face flanges. Metal rings (Figure 4.36) are used on ring-type joint flanges.

FIGURE 4.33 Gaskets. *Courtesy of Flexitallic, Inc.*

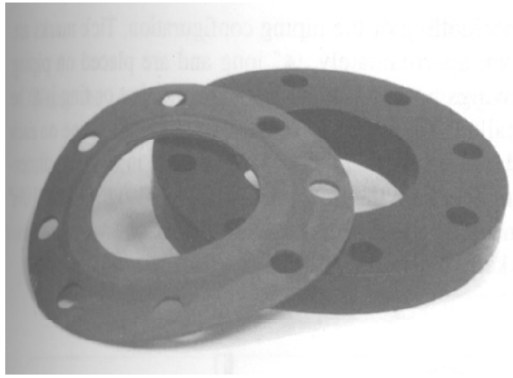


FIGURE 4.34 Full face gaskets.

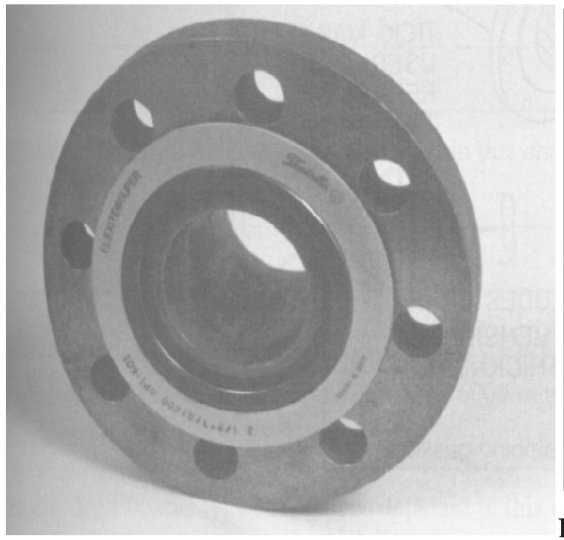


FIGURE 4.35 Flat ring gaskets. *Courtesy of Flexitallic, Inc.*

FIGURE 4.36 Metal rings for ring-type joint flanges. *Courtesy of Flexitallic, Inc.*

Flange Basics- Gaskets

A gasket's thickness must be accounted for when dimensioning the piping system. The typical gasket has a thickness of 1⁄8" (3.175 mm). At every occurrence, a gasket thickness must be added to the length of the pipe components. Figures 4.37 and 4.38 show that a flat-ring gasket does occupy space. Though it is only 1⁄8" thick, a gasket cannot be ignored.

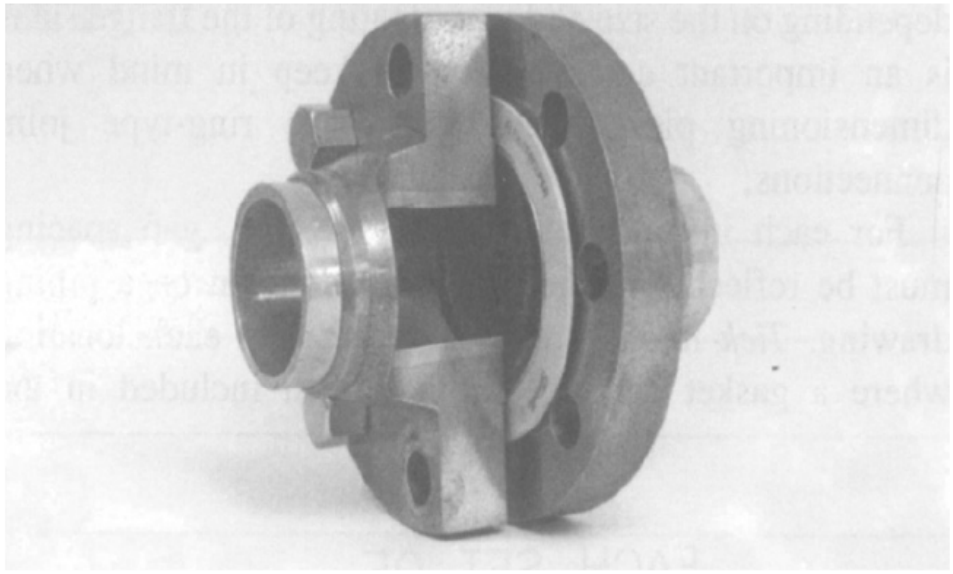


FIGURE 4.37 Flat ring gasket and flange. *Courtesy of Flexitallic, Inc.*

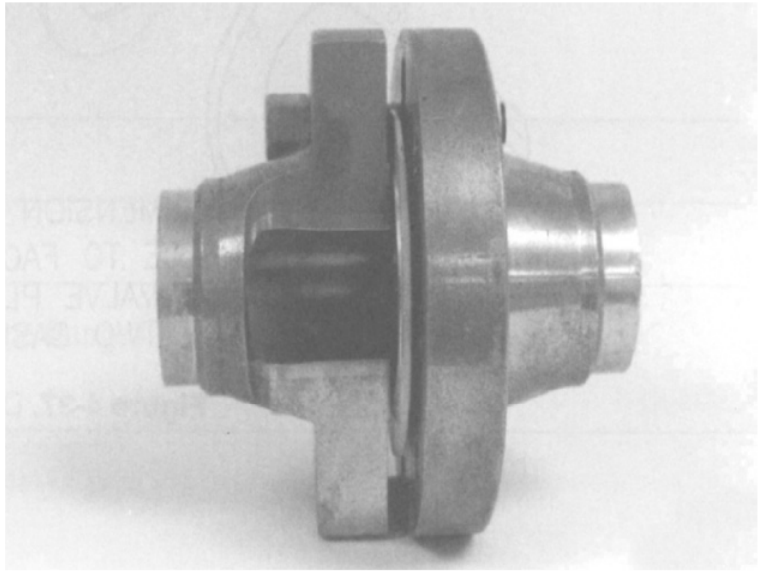


FIGURE 4.38 Flat ring gasket between flanges. *Courtesy of Flexitallic, Inc.*

Flange Basics- Gaskets

Figure 4.39 depicts the gap between ring-type joint flanges. The ring-type joint section of the Welded Fittings–Flanges Dimensioning Chart gives the gap measurement as the G dimension. This dimension will vary depending on the size and pound rating of the flange. This is an important consideration to keep in mind when dimensioning piping runs that have ring-type joint connections.

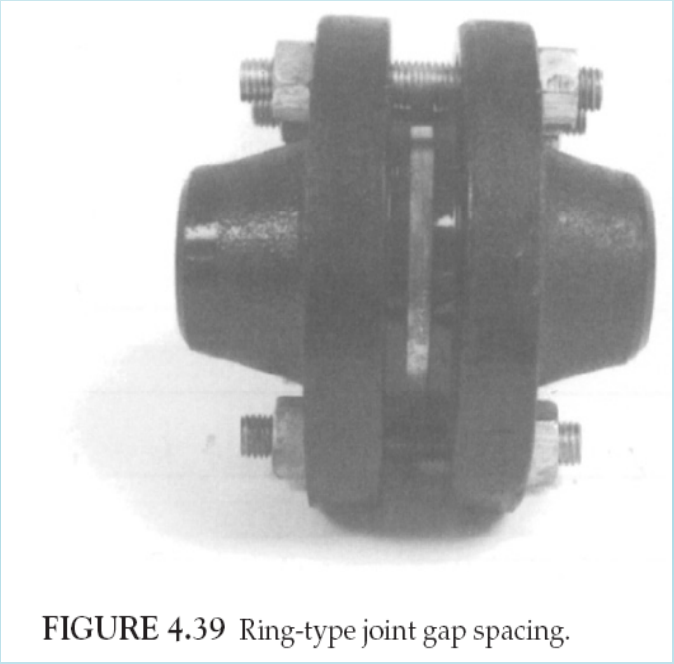


FIGURE 4.39 Ring-type joint gap spacing.

Flange Basics- Gaskets

For each instance of a gasket or ring, gap spacing must be reflected in the dimensions. Tick marks are used to indicate each location. Tick marks are drawn approximately 1⁄8" long and are placed on piping drawings near the location where a gasket or ring is to be installed. Figure 4.40 depicts two tick marks. The dimension would be the sum total of one valve and two gaskets.

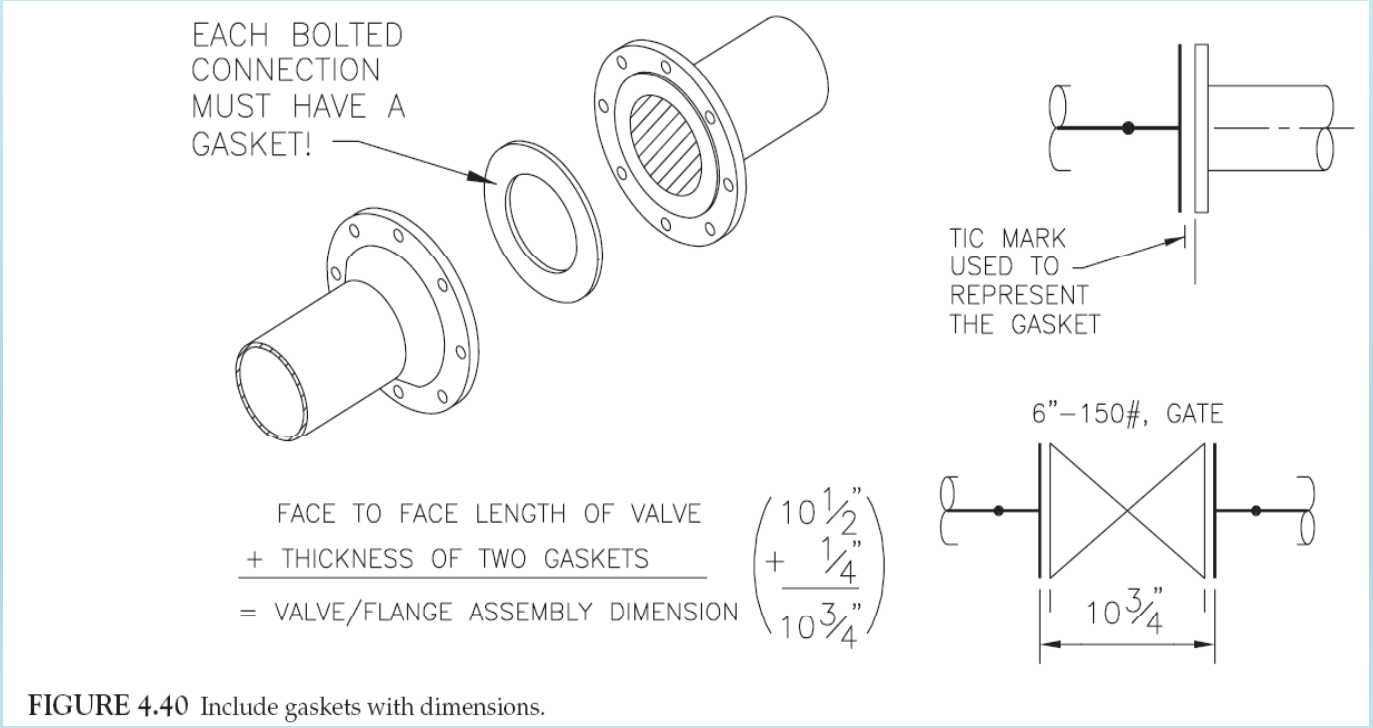


FIGURE 4.40 Include gaskets with dimensions.

Flange Basics- Summary

Flange Ratings: seven categories for forged steel flanges. They are 150#, 300#, 400#, 600#, 900#, 1500#, and 2500#. Cast iron flanges have pound ratings of 25#, 125#, 250#, and 800#.

Flange Facings: flat face (FF); raised face (RF); ring-type joint (RTJ).

Flange Types: weld neck; threaded; socket-weld; slip-on; lap-joint; reducing; blind; orifice.

Bolts: Bolts are available in two types: machine or stud.

Gaskets: They are full face, flat ring, and metal ring to produce a leak-free environment.

Flange Drawing Symbols

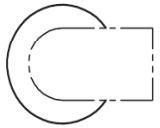
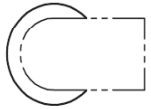
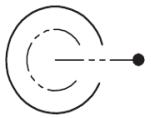
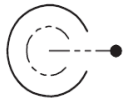
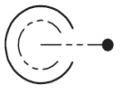
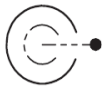
SIZE \ RATING	300# RFWN		150#RFWN	
14"	 14"–300 OD	 14"–300 LT	 14"–150 OD	 14"–150 LT
12"	 12"–300 OD	 12"–300 LT	 12"–150 OD	 12"–150 LT
10"	 10"–300 OD	 10"–300 LT	 10"–150 OD	 10"–150 LT
8"	 8"–300 OD	 8"–300 LT	 8"–150 OD	 8"–150 LT
6"	 6"–300 OD	 6"–300 LT	 6"–150 OD	 6"–150 LT
4"	 4"–300 OD	 4"–300 LT	 4"–150 OD	 4"–150 LT

FIGURE 4.41 Flange drawing symbols.