Basic Design and Pipe Drafting

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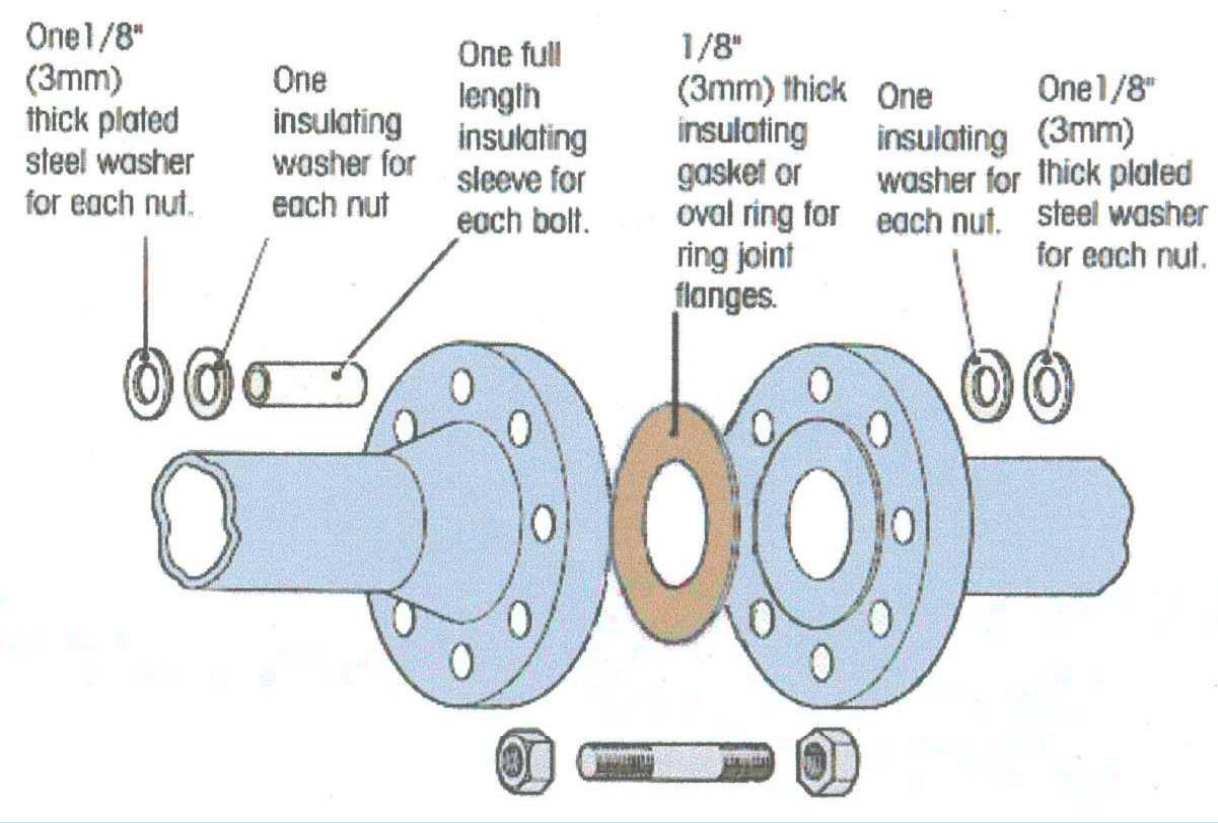
8) Codes and Specifications
9) Isometrics

Lecture Times : Tuesdays EST 14-16 on class days

Tutorial Times: Sunday EST 14-15

Chapter 4 Flange Basics

Chapter 4 describes different flanges and drawings. The flange is a ring-shaped device that is used as an alternative to welding or threading various piping system components together.



Flange Basics

The flange is a ring-shaped device that is used as an alternative to welding or threading various piping system components together. Flanged connections, which require bolting, are the preferred alternative to welding because they can be easily assembled, disassembled, then reassembled when needed for shipping, inspection, maintenance, or replacement.

Flanged connections are favoured over threaded connections because threading large-bore pipe is not an economical or reliable operation, as leakage on large-bore threaded pipe is difficult to prevent. For these reasons, the flange is an important component of any piping system.

Flange Basics

Flanges are primarily used where a connecting or dismantling joint is needed. These joints may include attaching pipe to fittings, valves, mechanical equipment, or any other integral component within a piping configuration.

In the typical pipe facility, every piece of mechanical equipment is manufactured with at least one inlet and outlet connection point. The point where the piping configuration is connected to the equipment is called a nozzle. From this nozzle-to-flange connection point, the piping routing is begun.

Flange Basics

Figure 4.1 depicts multiple examples of how piping configurations are connected to a vertical vessel via a nozzle.

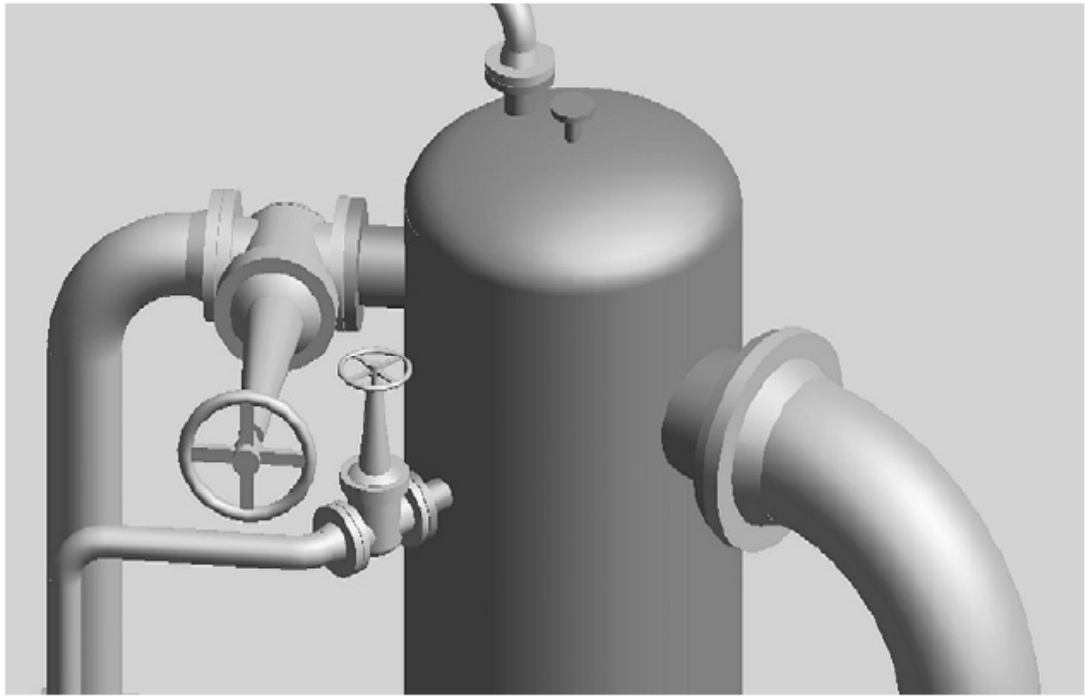


FIGURE 4.1 Vessel nozzles.

Flange Basics- Rating Flanges

Rating, as applied to flanges, may best be defined as the maximum pressure allowed by the Pressure Piping Code for the specific temperature at which the flange will be operating according to pressure ratings established by the American Society of Mechanical Engineers (ASME). These pressure ratings, often called pound ratings, are divided into 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 Basics- Rating Flanges

Pound ratings, when combined with the temperature of the commodity within the pipe, are used to select the appropriate size, rating, and type of flange.

For example, a 150# forged steel flange is rated to perform at 150# PSIG at 500 °F. If the temperature were decreased to 100 °F, this same flange could be used for 275# PSIG. However, if the temperature were increased to 750 °F, the flange could only be used for 100# PSIG.

When temperature decreases, the allowable pressure increases, and vice versa.

Pound ratings are also used to establish the outside diameter and thickness of a flange. Typically as pound ratings increase, so will the flange's diameter and thickness.

Flange Basics- Flange Facings

The mating surface of a flange, nozzle, or valve is called the face. The face is usually machined to create a smooth surface. This smooth surface will help assure a leak-proof seal when two flanges are bolted together with a gasket sandwiched between.

Although numerous types of flange faces are produced, we will focus only on the following three:

- flat face;
- raised face;
- ring-type joint.

Flange Basics- Flange Facings

Flat Face

As the name implies, flanges with flat faces are those that have a flat, level connecting surface (see Figure 4.2). Forged steel flanges with a flat face flange are commonly found in 150# and 300# ratings. Their principal use is to make connections with 125# and 250# cast iron flanges, respectively.

FIGURE 4.2 Flat face flange.

Flange Basics- Flange Facings

Raised Face

The most common face type in use, the raised face, is available in all seven of the aforementioned pound ratings. With shallow grooves etched into the raised surface, this flange face assures a positive grip with the gasket. Flanges rated 150# and 300# have a 1⁄16" raised face, whereas flanges 400# and above have a ¼" raised face (see Figure 4.4).

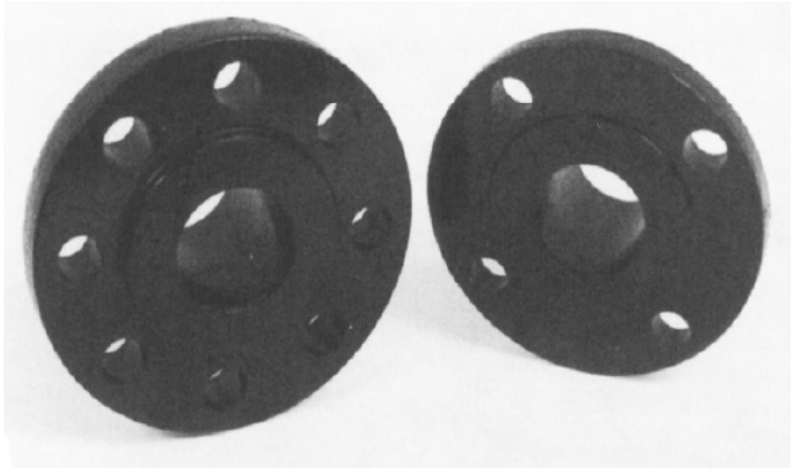


FIGURE 4.4 Raised face flange.

Flange Basics- Flange Facings

Raised Face

To assure accurate dimensioning, always determine if the dimensioning chart being used includes the ¼" raised face thickness for the larger pound rating flanges. Figure 4.5 includes a sectional view of a weld neck flange having a raised face.

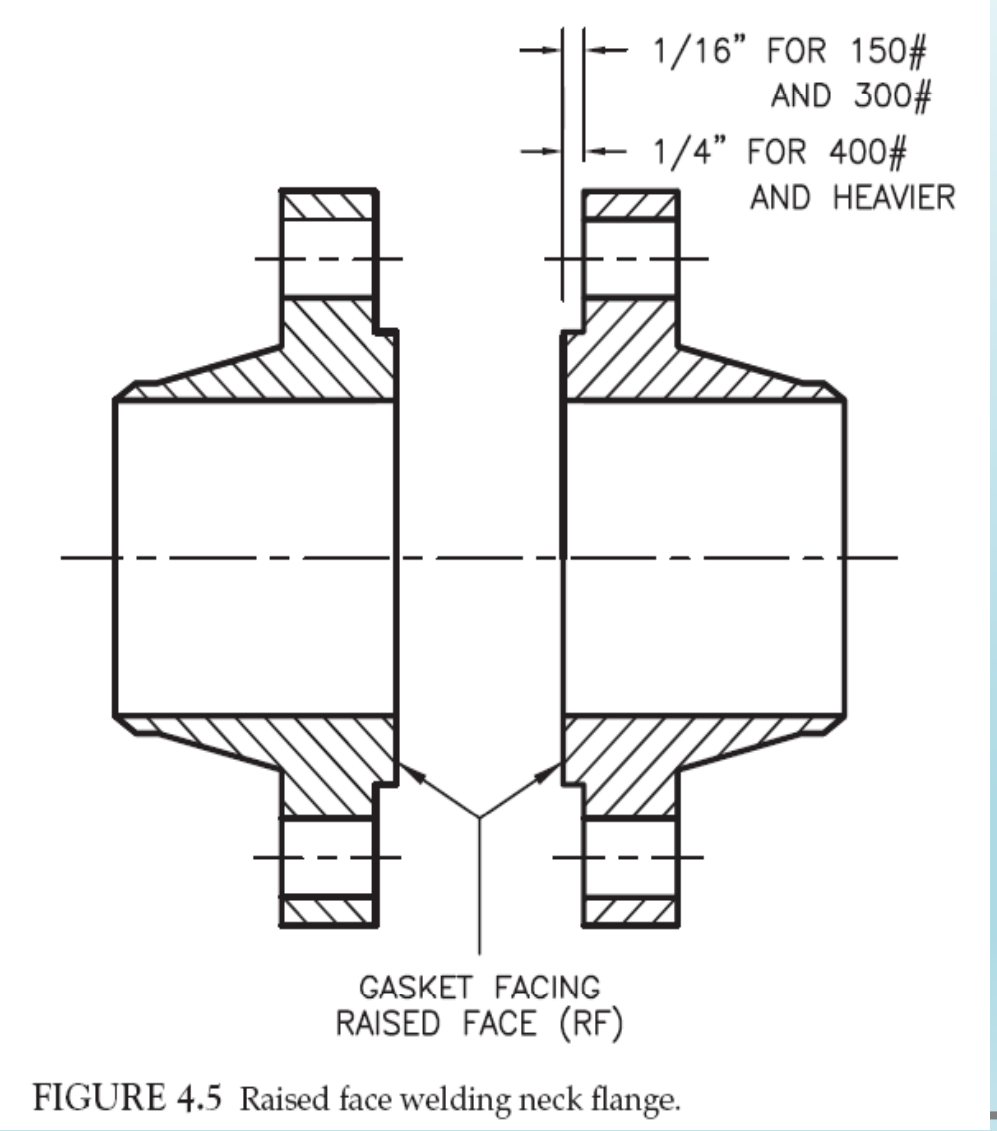


FIGURE 4.5 Raised face welding neck flange.

Flange Basics- Flange Facings

Raised Face

To assure accurate dimensioning, always determine if the dimensioning chart being used includes the ¼" raised face thickness for the larger pound rating flanges. Figure 4.5 includes a sectional view of a weld neck flange having a raised face.

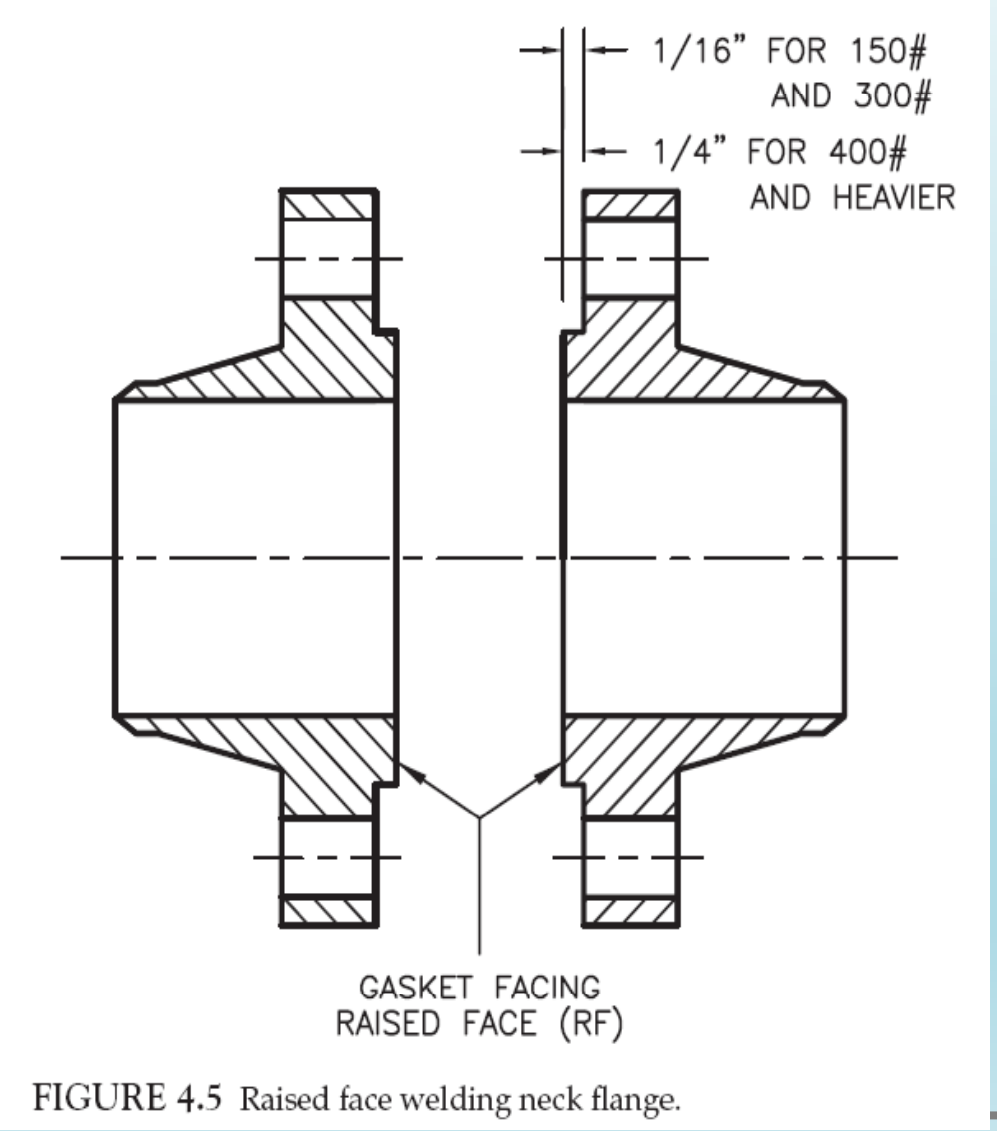


FIGURE 4.5 Raised face welding neck flange.

Flange Basics- Flange Facings

Ring-Type Joint

The ring-type joint does not use a gasket to form a seal between connecting flanges. Instead a round metallic ring is used that rests in a deep groove cut into the flange face (see Figure 4.6). The donut-shaped ring can be oval or octagonal in design. As the bolts are tightened, the metal ring is compressed, creating a tight seal..

FIGURE 4.6 Ring-type joint flange.

Flange Basics- Flange Facings

Ring-Type Joint

Although it is the most expensive, the ring-type joint is considered to be the most efficient flange used in process piping systems. The ring and groove design actually uses internal pressures to enhance the sealing capacity of the connecting flanges. When dismantling ring joint connections, the flanges must be forcibly separated to release the ring from the groove.

Although available for all pound ratings, flanges with ring-type joint faces are normally used in piping systems rated 400# and higher.

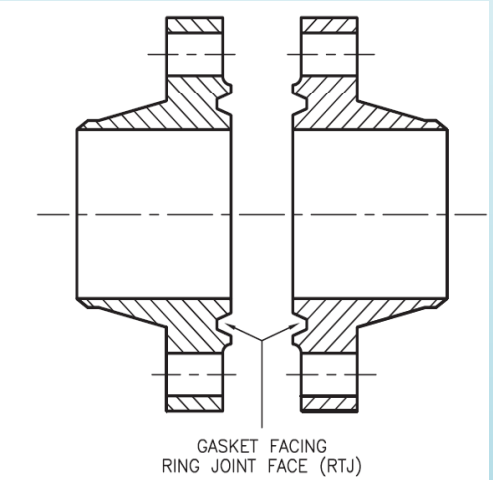


FIGURE 4.7 Ring-type joint welding neck flange.

Flange Basics- Flange Types

Flanges have been designed and developed to be used in a myriad of applications. The following flanges will be discussed :

weld neck; threaded; socket-weld; slip-on; lap-joint; reducing;

blind; orifice.

NOTE: Because all flange symbols are somewhat typical, only the step-by-step drawing techniques used to create the orthographic drawing symbols for a weld neck flange will be shown. The drawing symbols for the remaining flanges can be created in a similar fashion with only a few minor alterations.

Flange Basics- Flange Types

Weld Neck Flange

The weld neck flange shown in Figure 4.8 is designed to reduce high-stress concentrations at the base of the flange by transferring stress to the adjoining pipe. Although expensive, the weld neck flange is the best-designed butt-weld flange available because of its inherent structural value and ease of assembly.

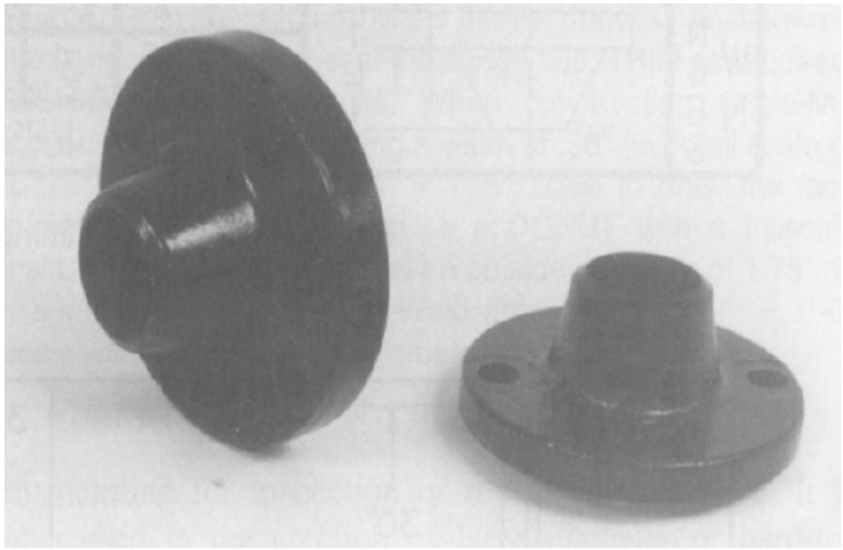


FIGURE 4.8 Weld neck flange.

Flange Basics- Flange Types

Weld Neck Flange

Known for its strength and resistance to dishing, the weld neck flange is manufactured with a long tapered hub created by the gradual increase in metal thickness. This is extremely beneficial under conditions of repeated bending caused by line expansion, contraction, or other external forces. See Figure 4.9 for weld neck flange drawing symbols.

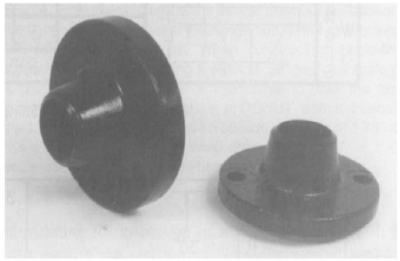


FIGURE 4.8 Weld neck flange.

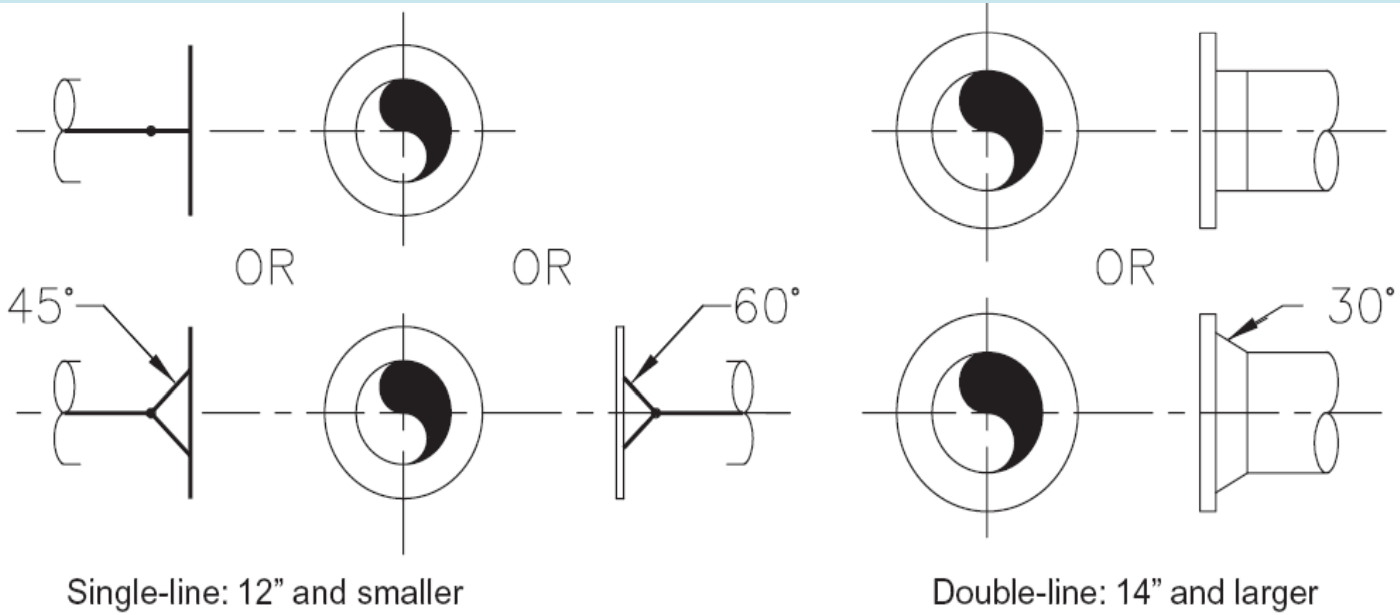


FIGURE 4.9 Weld neck flange drawing symbols.

Flange Basics- Flange Types

Weld Neck Flange

Weld neck flanges are normally used in severe service applications involving high pressures, high temperatures, or subzero conditions.

The hole in a weld neck flange is bored to match the ID of the adjoining pipe. Turbulence and erosion are therefore eliminated.

Flange Basics- Flange Types

Drawing the Weld Neck Flange

Before constructing the orthographic drawing symbols, three important dimensions must be determined. These dimensions can be found on the Welded Fittings—Flanges Dimensioning Chart 300# in Figure 4.10. The thumbnail image in this chart represents the raised face weld neck (RFWN) flange.

NOMINAL PIPE SIZES -(INCHES)		2"	2½"	3"	4"	6"	8"	10"	12"	14"	16"	18"
PIPE (OUTSIDE DIAMETER)		2 3/8	2 7/8	3 1/2	4 1/2	6 5/8	8 5/8	10 3/4	12 3/4	14	16	18
RFWN FLANGES	O	6 1/2	7 1/2	8 1/4	10	12 1/2	15	17 1/2	20 1/2	23	25 1/2	28
	L	2 3/4	3	3 1/8	3 3/8	3 7/8	4 3/8	4 5/8	5 1/8	5 5/8	5 3/4	6 1/4
	T	7/8	1	1 1/8	1 1/4	1 7/16	1 5/8	1 7/8	2	2 1/8	2 1/4	2 3/8
		1/16" RAISED FACE INCLUDED ON 'L' & 'T' DIMENSIONS										

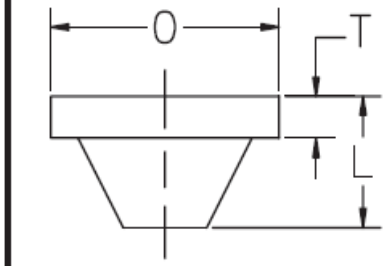


FIGURE 4.10 Welded Fittings—Flanges Dimensioning Chart.

Flange Basics- Flange Types

Drawing the Weld Neck Flange

To find the numerical values, select the appropriate pound rating chart, which is, 150#, 300#, 400#, etc. Next, find the proper size pipe in the Nominal Pipe Size row. Follow the pipe size column down, through the chart, to determine the O, T, and L dimensions.

For demonstration purposes, the procedures to draw double-line drawing symbols for a 14"-300# Raised Face, Weld Neck (RFWN) flange (Figure 4.11), and a single-line 12"-150#-RFWN flange (Figure 4.12) will be presented.

Flange Basics- Flange Types

Drawing the Weld Neck Flange

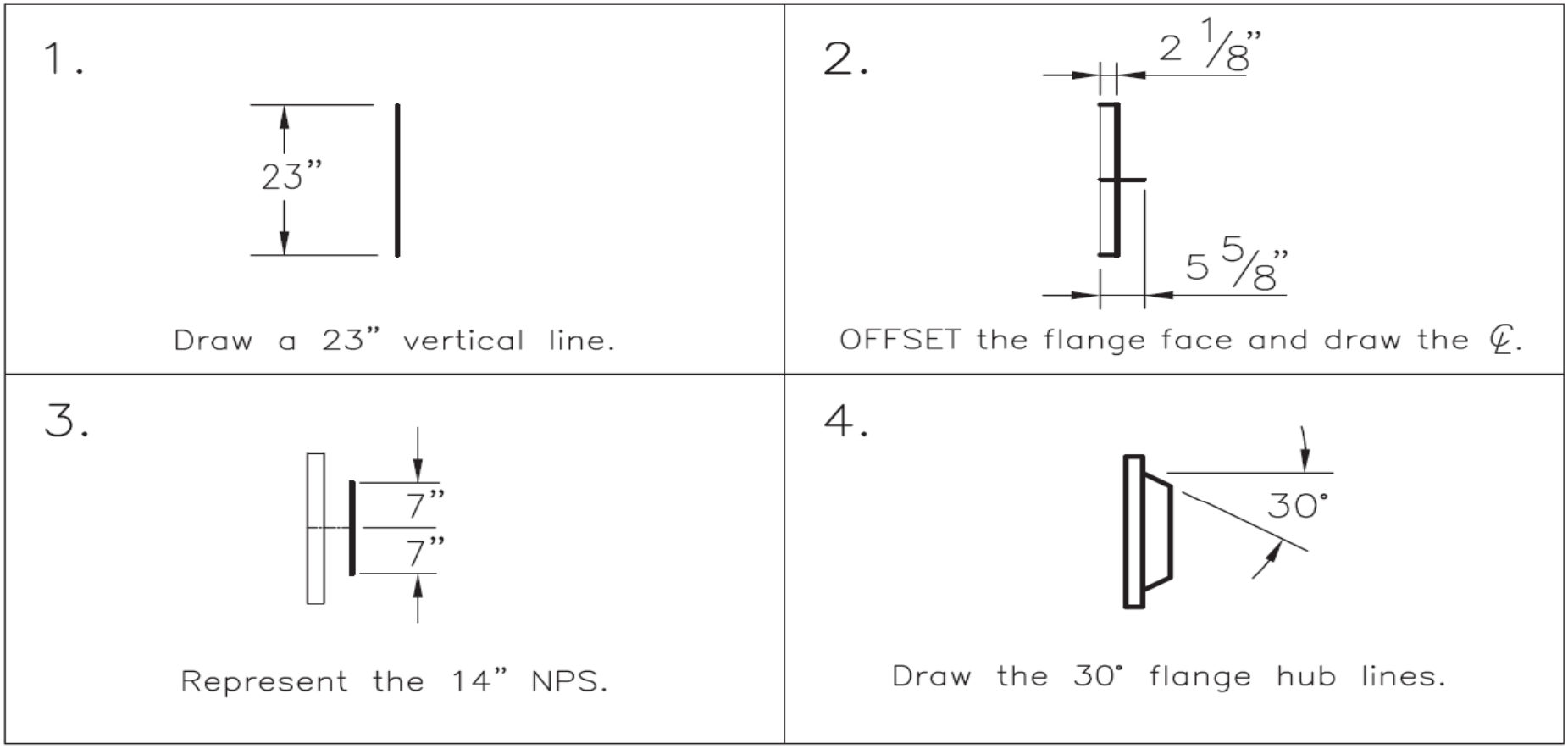


FIGURE 4.11 Drawing procedures for a 14”-300#RFWN flange.

Step 1. Using architectural units, draw a vertical line 23” tall. This line will represent the flange’s face diameter.

Step 2. **OFFSET** a line $2\frac{1}{8}$” to the right to represent the flange face thickness. Draw a horizontal line across the ends of the two vertical lines to cap the flange face. From the MIDpoint of the flange’s face (left line), draw a centerline $5\frac{5}{8}$” to the right to represent the flange length (length thru hub).

Step 3. From the right end of the centerline, draw a vertical line 7” upward and downward to represent the pipe’s 14” NPS.

Step 4. From the vertical ends, draw 30° lines to the flange face to represent the hub. (45° lines are used when constructing single-line symbols.)

Flange Basics- Flange Types

Drawing the Weld Neck Flange

Appendix A

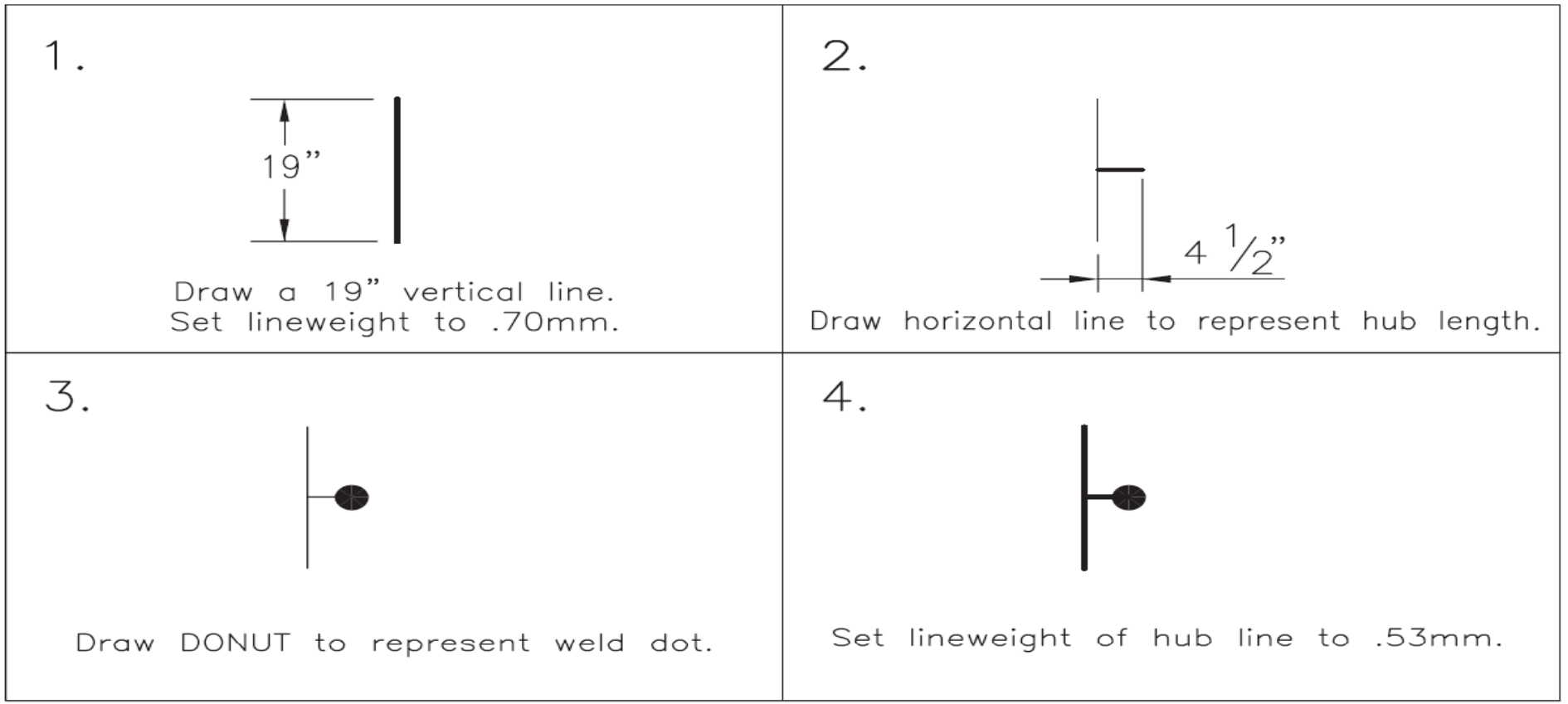


FIGURE 4.12 Drawing procedures for a 12″-150#RFWN flange.

Step 1. Using architectural units, draw a vertical LINE 19″. (O dimension from Welded Fitting-Flanges dimensioning chart) tall. Give the line a 0.70 mm lineweight. This line will represent the flange's face diameter.

Step 2. From the MIDpoint of the flange's face, draw a horizontal line 4½″ (T dimension) to the right to represent the flange's length (length thru hub).

Step 3. On the right end of the horizontal line, draw a DONUT having a 0.0″ inside diameter and a 1.75″ outside diameter to represent the weld dot.

Step 4. Change the LINEWEIGHT of the horizontal line (hub) to 0.53 mm. This will match the lineweight of the pipe when the symbol is attached to it.

Flange Basics- Flange Types

Slip-on Flange

The slip-on flange shown in Figure 4.13 has a low hub that allows the pipe to be inserted into the flange prior to welding. Available with a flat (FFSO) or raised face (RFSO) and shorter in length than a weld neck flange, the slip-on flange is used in areas where short tie-ins are necessary or space limitations necessitate its use.

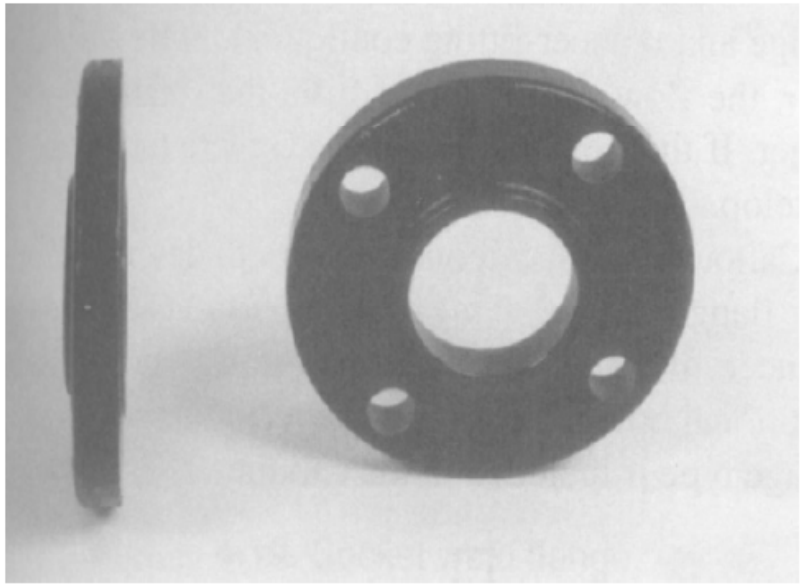


FIGURE 4.13 Slip-on flange.

Flange Basics- Flange Types

Slip-on Flange

The slip-on flange does have two significant disadvantages, however: the requirement of two fillet welds, one internal and one external, to provide sufficient strength and prevent leakage, and a life span about one-third that of the weld neck flange. They are preferred over welding neck flanges by many users because of their lower initial cost. However, the total cost after installation is not much less than the welding neck because of the additional welding involved.

Flange Basics- Flange Types

Slip-on Flange

See the Taylor Forge Seamless Fittings Dimensioning Chart in Appendix A for dimensions of the slip-on flange. The drawing symbols for the slip-on flange are shown in Figure 4.14.

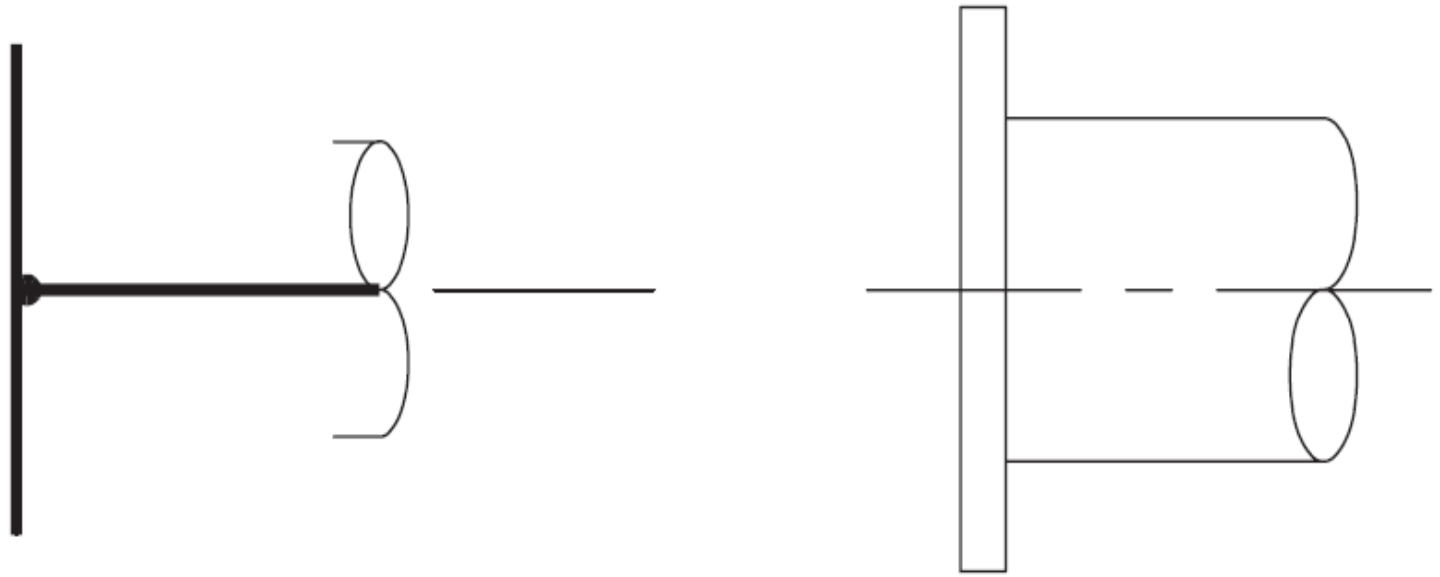


FIGURE 4.14 Slip-on flange drawing symbols.

Flange Basics- Flange Types

Lap-Joint Flange

The lap-joint flange in Figure 4.15 is primarily used in carbon or low alloy steel piping systems. Attachment of the lap-joint flange to the piping system requires a lap-joint stub end. The lap-joint flange and stub end assembly are used mainly in piping systems that necessitate frequent dismantling.

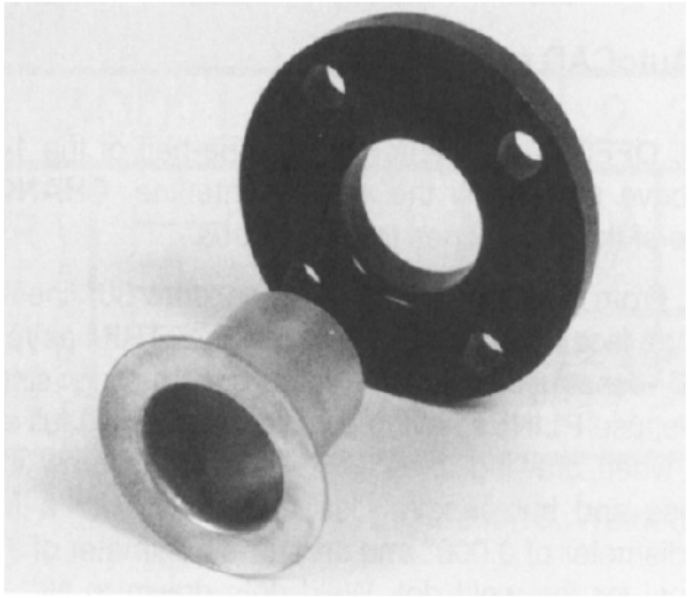
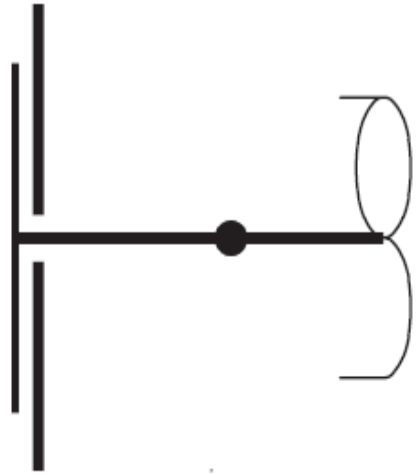


FIGURE 4.15 Lap-joint flange.

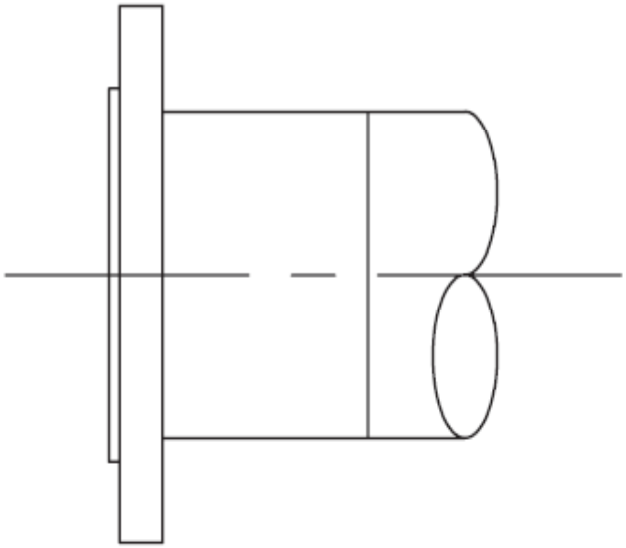
Flange Basics- Flange Types

Lap-Joint Flange

It is also used in the erection of large-diameter or hard-to-adjust piping configurations because of its quick bolt hole alignment. Figure 4.16 depicts the drawing symbols for the lap-joint flange.



Single-line: 12” and smaller



Double-line: 14” and larger

FIGURE 4.16 Lap-joint flange drawing symbols.