Basic Design and Pipe Drafting

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Lecture Times : Tuesdays EST 14-16 on class days

Tutorial Times: Sunday EST 14-15

Pipe Fittings - 45° Elbows

Drawing Symbols for the 45° Elbow

The drawing symbols for the 45° elbow are shown in Figure 3.18.

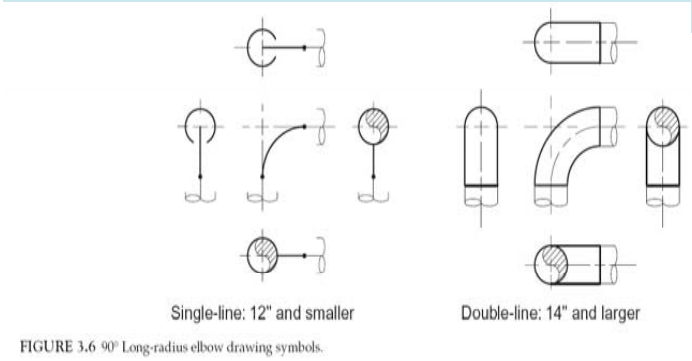


FIGURE 3.6 90° Long-radius elbow drawing symbols.

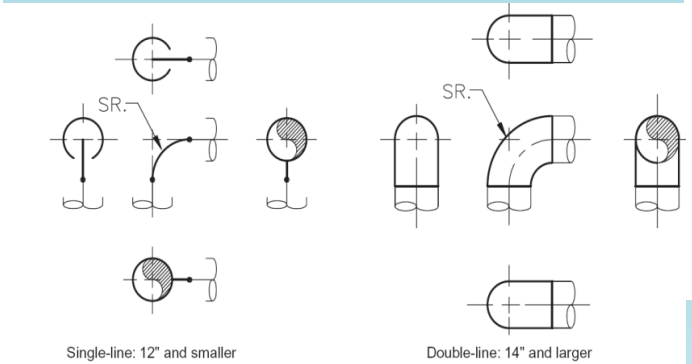


FIGURE 3.12 Short-radius elbow drawing symbols.

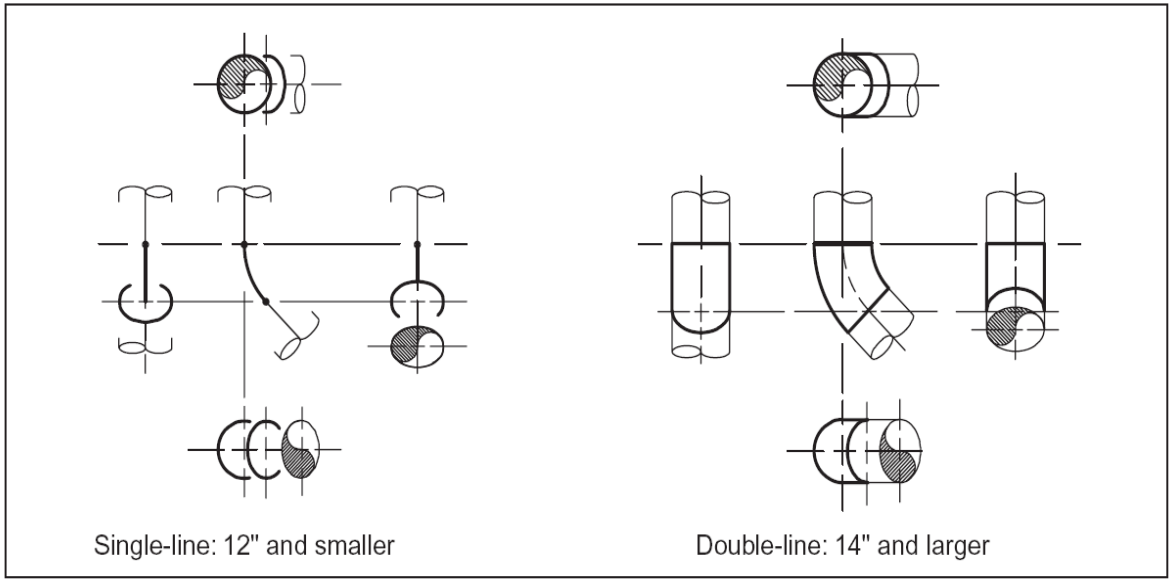


FIGURE 3.18 45° Elbow drawing symbols.

Pipe Fittings - 45° Elbows

Step 1. Using construction lines duplicates the step-by-step procedures used to draw the 90° long-radius elbow.
Step 2. From the centerpoint used to construct the arcs, draw a 45° angle line that will divide the elbow in half.
Step 3. Erase the half of the 90° elbow that is not needed.
Step 4. Draw the attaching 45° pipe.
Step 5. Draw vertical and 45° weld lines from arc's centerpoint. T
Step 6. Change the middle arc to a "Center" linetype.

Figure 3.19 45° elbow manual drawing method.

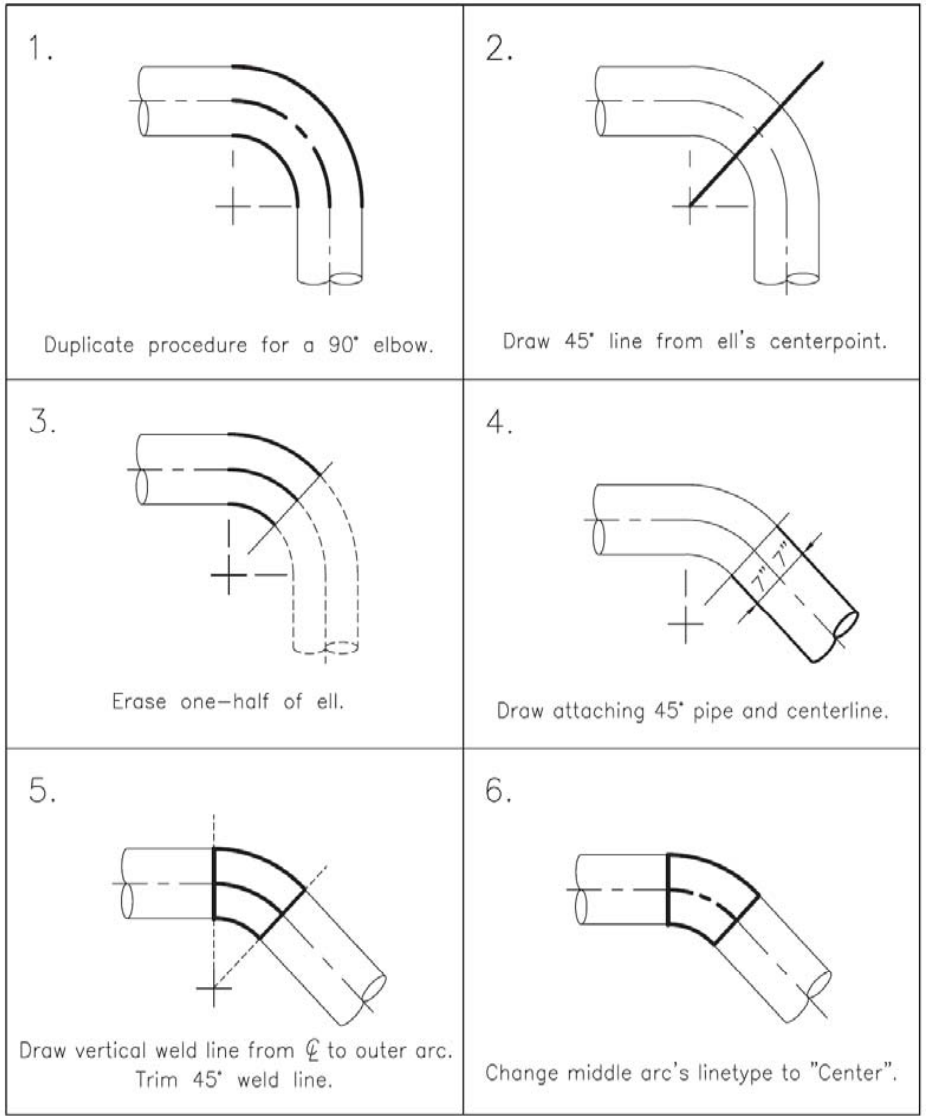


FIGURE 3.19 45° Elbow. Manual step-by-step drafting procedure.

Pipe Fittings - 45° Elbows

Step 1. Draw intersecting 45° construction lines as shown.
Step 2. Using the *B* dimension for a 14″ 45° elbow from the Welded Fittings–Flanges Chart, measure this length along each construction line beginning at the point of intersection.
Step 3. Determine one-half of the pipe's diameter (7″) and mark this distance on each side of each construction line. This will establish the OD of the pipe.
Step 4. Use a circle template or compass to draw concentric … These circles are 21″, 14″, and 28″, respectively.
Step 5. Draw vertical and 45° weld lines from the arc's center …
Step 6. Change the middle arc to a "Center" linetype.

Figure 3.20 45° elbow alternative manual drawing method.

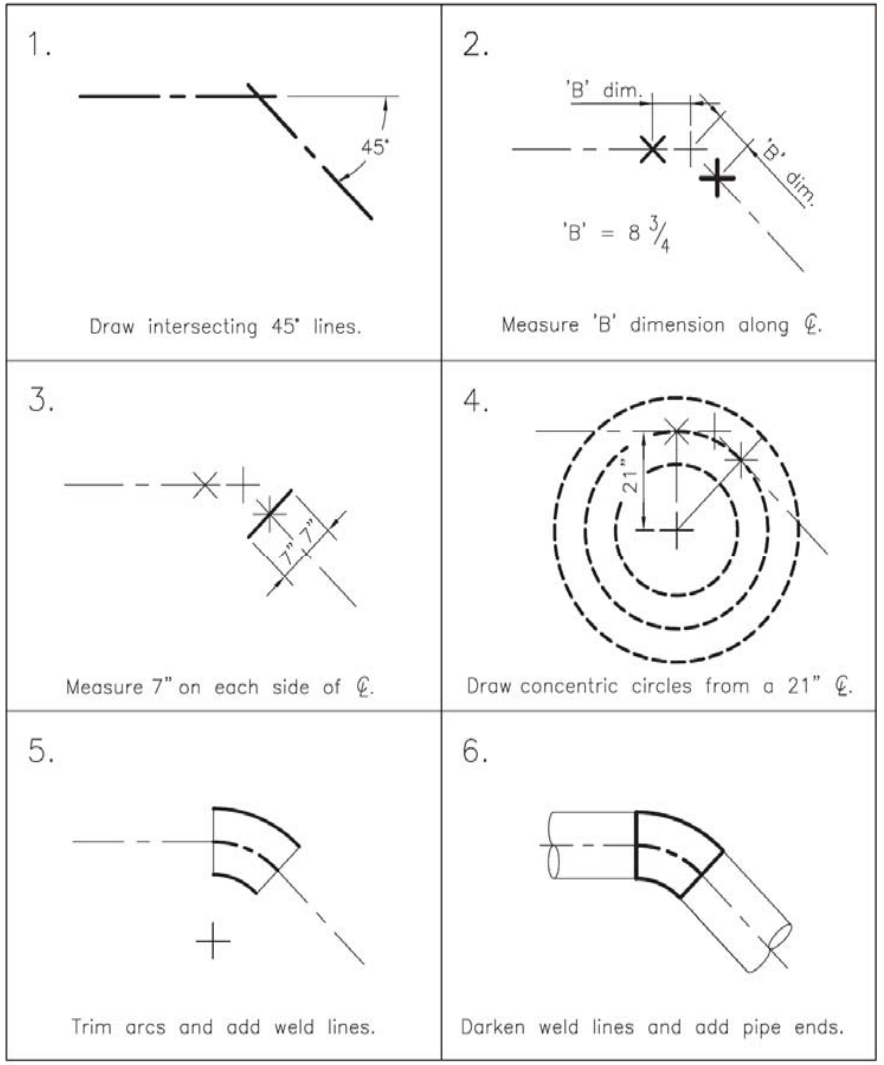


FIGURE 3.20 45° Elbow. Alternative manual step-by-step drafting procedure.

Pipe Fittings - 45° Elbows

90° Elbows Rolled at 45°

Designers will use one 90° ell and one 45° ell welded together (see Figure 3.22).

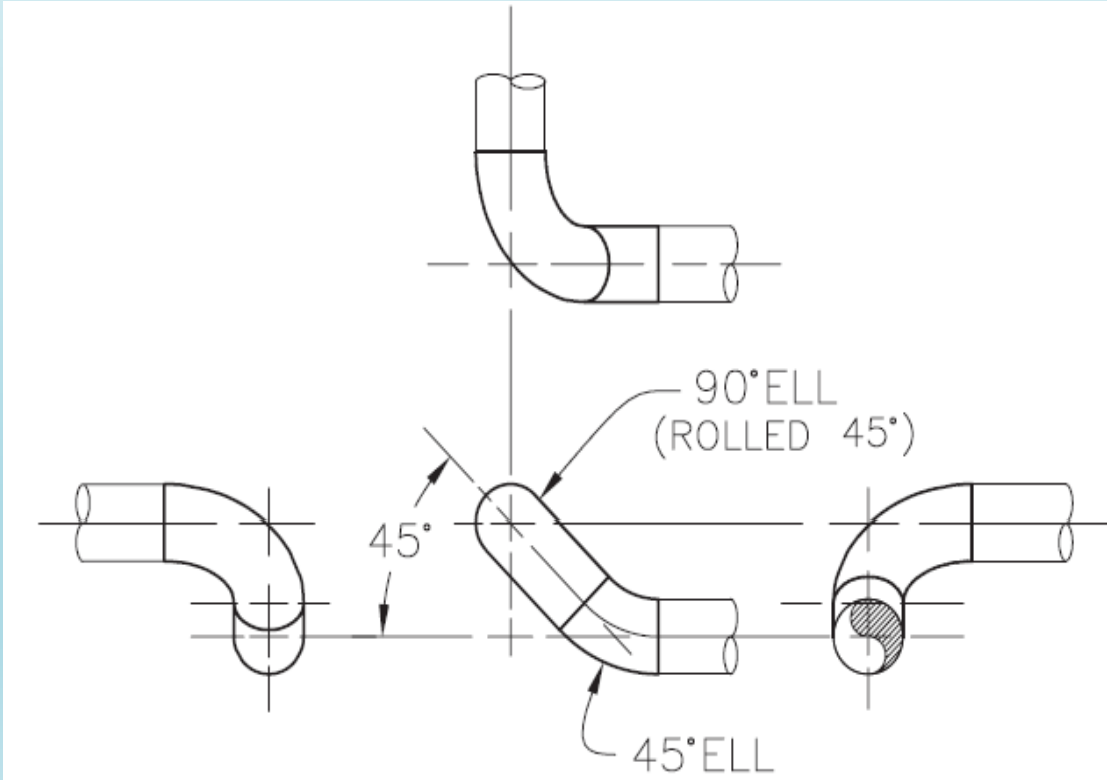
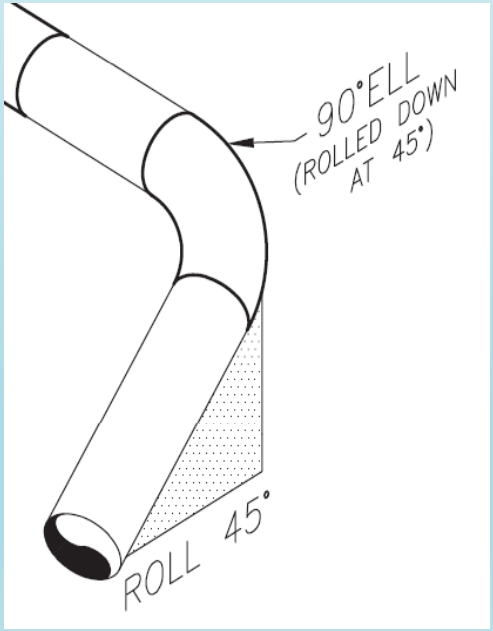


FIGURE 3.22 90° and 45° elbows welded together.

Pipe Fittings - 45° Elbows

90° Elbows Rolled at 45°

Figure 3.23 shows the orthographic views of 90° elbows rolled at a 45° angle.



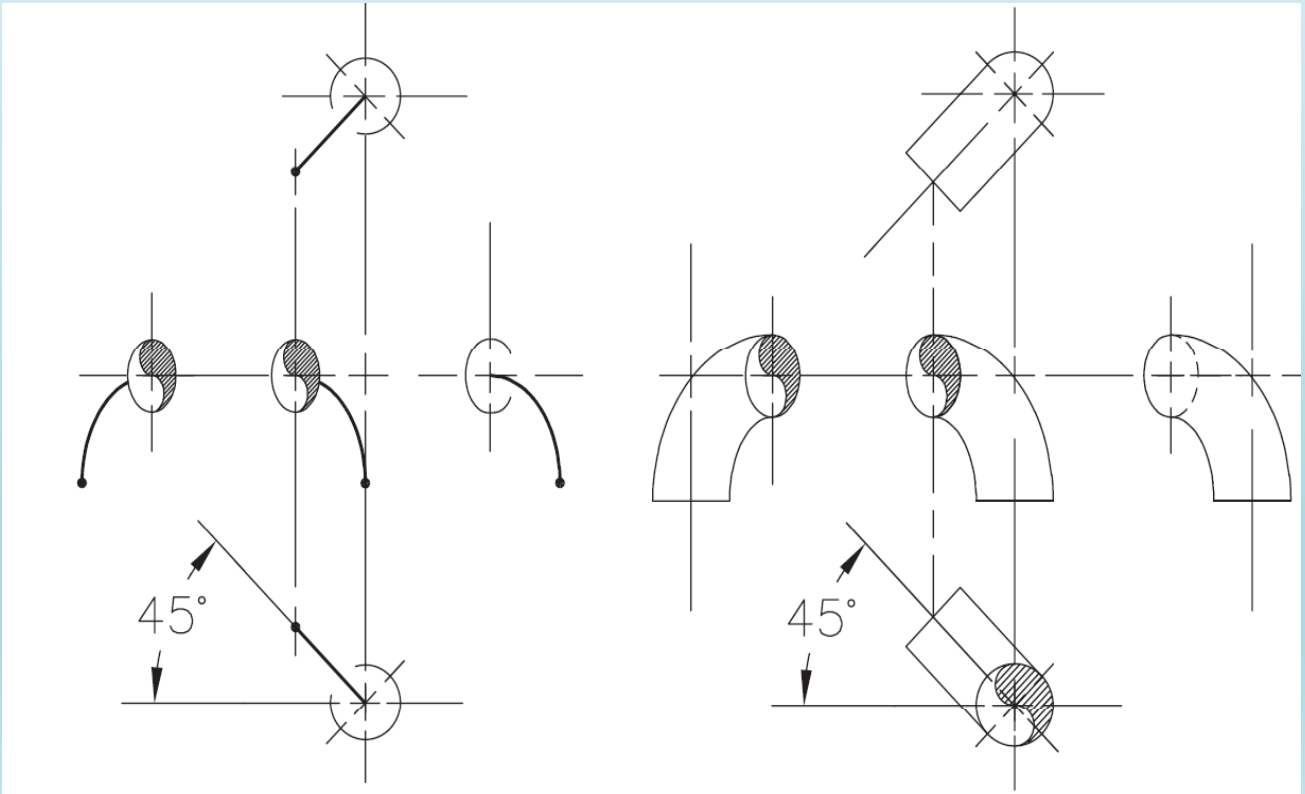
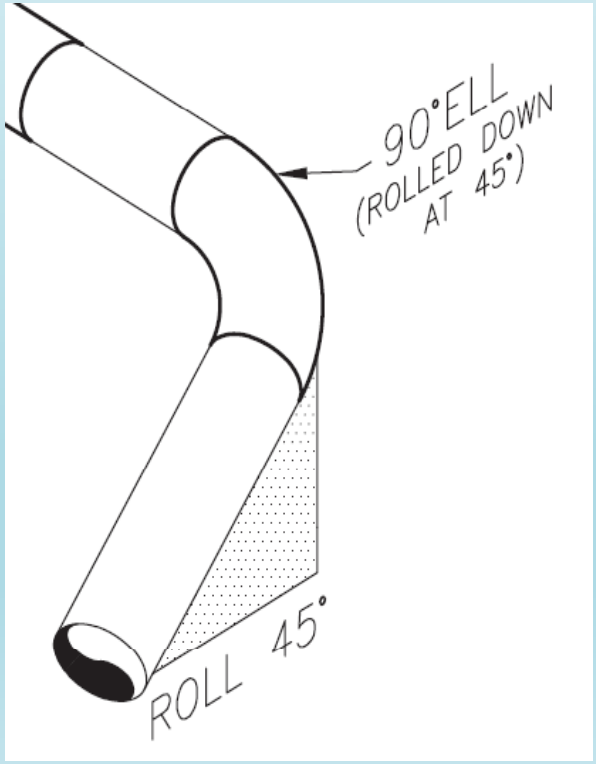


FIGURE 3.23 Orthographic views of 90° rolled at a 45° angle.

Pipe Fittings - 45° Elbows

90° Elbows Rolled at 45°

Figure 3.24 illustrates the use of 45° ellipses to draw the 90° elbow rolled at a 45° angle.



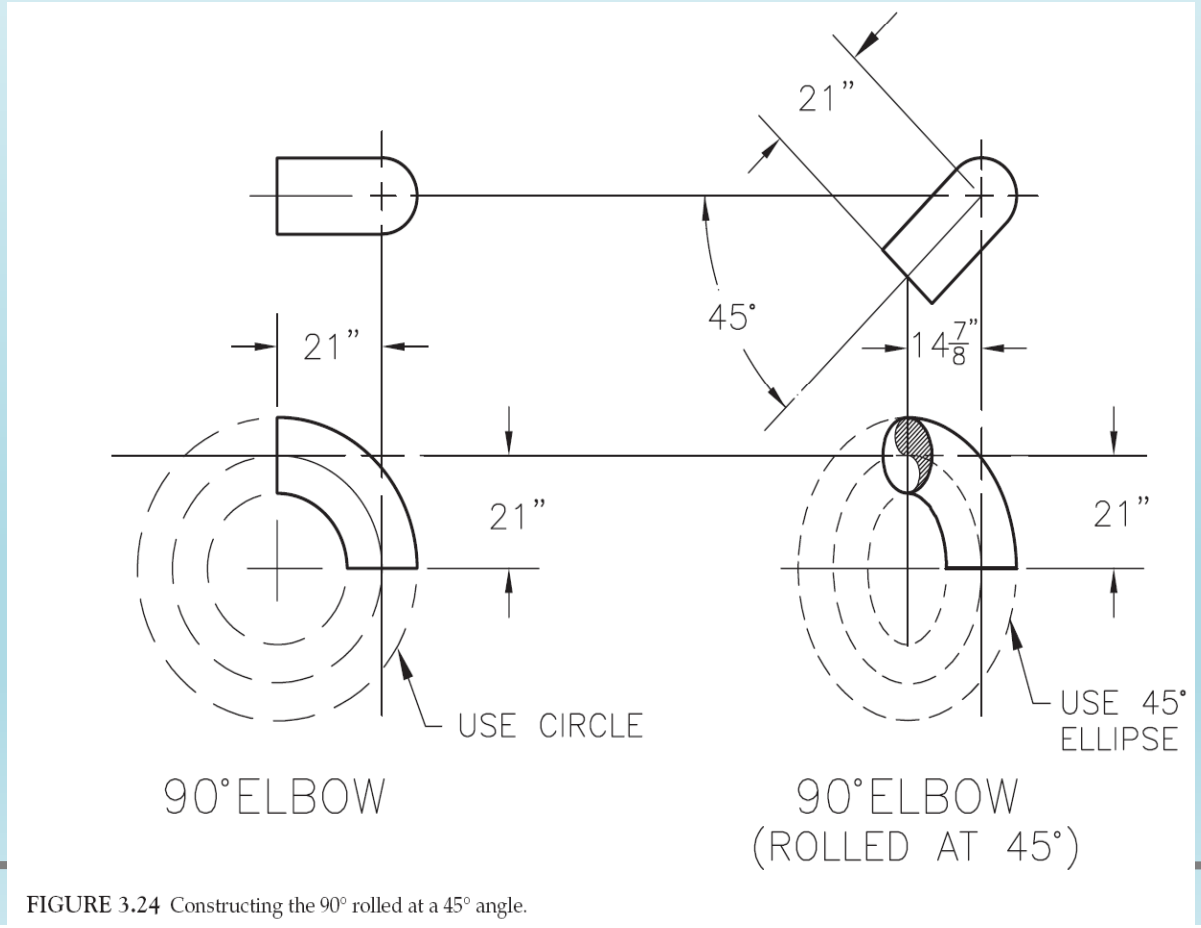


FIGURE 3.24 Constructing the 90° rolled at a 45° angle.

Pipe Fittings - Weld Tee

It is a three-outlet fitting used to make perpendicular connections to a pipe (like a letter T).

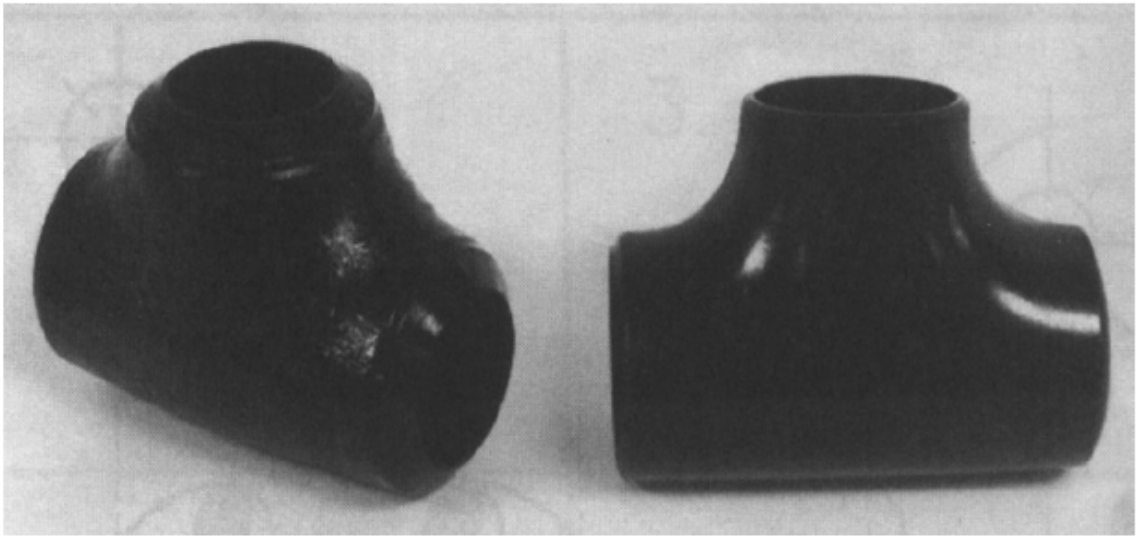


FIGURE 3.25 Weld tee.

Pipe Fittings - Weld Tee

The two terms used to describe the pipe and its perpendicular connection are header and branch.

Figure 3.26 shows a pipe header with two branch connections. One is known as a straight tee and the other is a reducing tee. On a straight tee, all three outlets are of the same nominal pipe size. A reducing tee has a branch that has a smaller line size than the header. Pay particular attention to the weld dot used to represent the weld on the 12" and smaller branch outlet on the reducing tee.

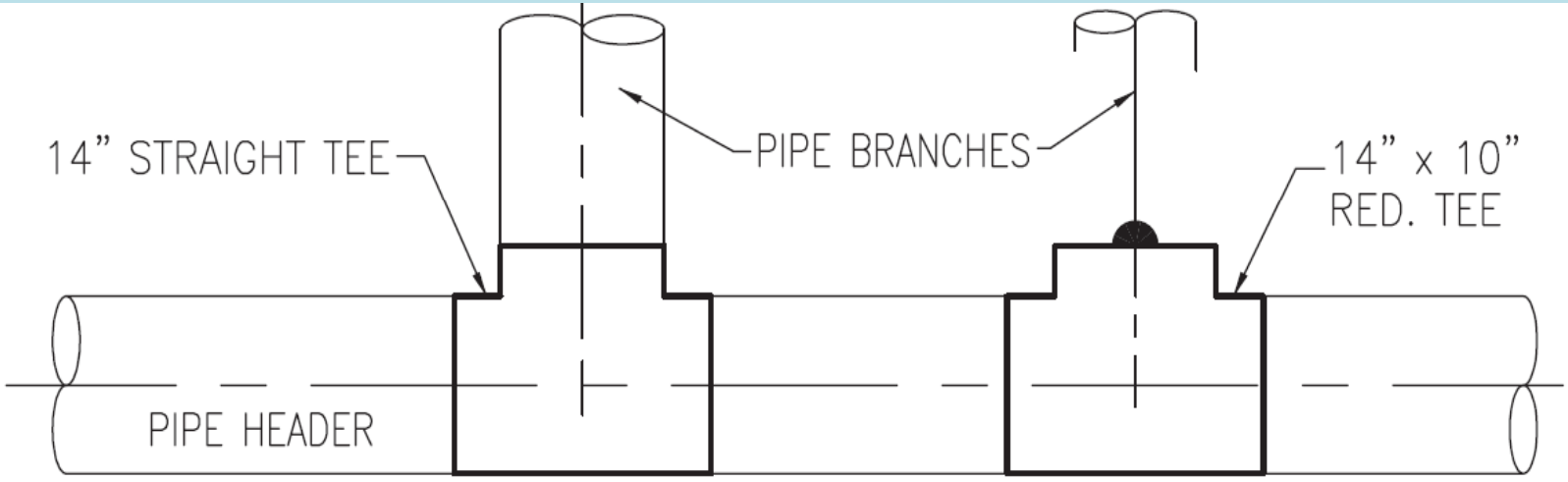


FIGURE 3.26 Header and branch connections.

Pipe Fittings - Weld Tee

Drawing Symbols for the Weld Tee

The drawing symbols used to represent the tee are developed from the rotations of the tee into the various orthographic views. Figure 3.27 depicts the rotations of the tee into the profile and horizontal projection planes.

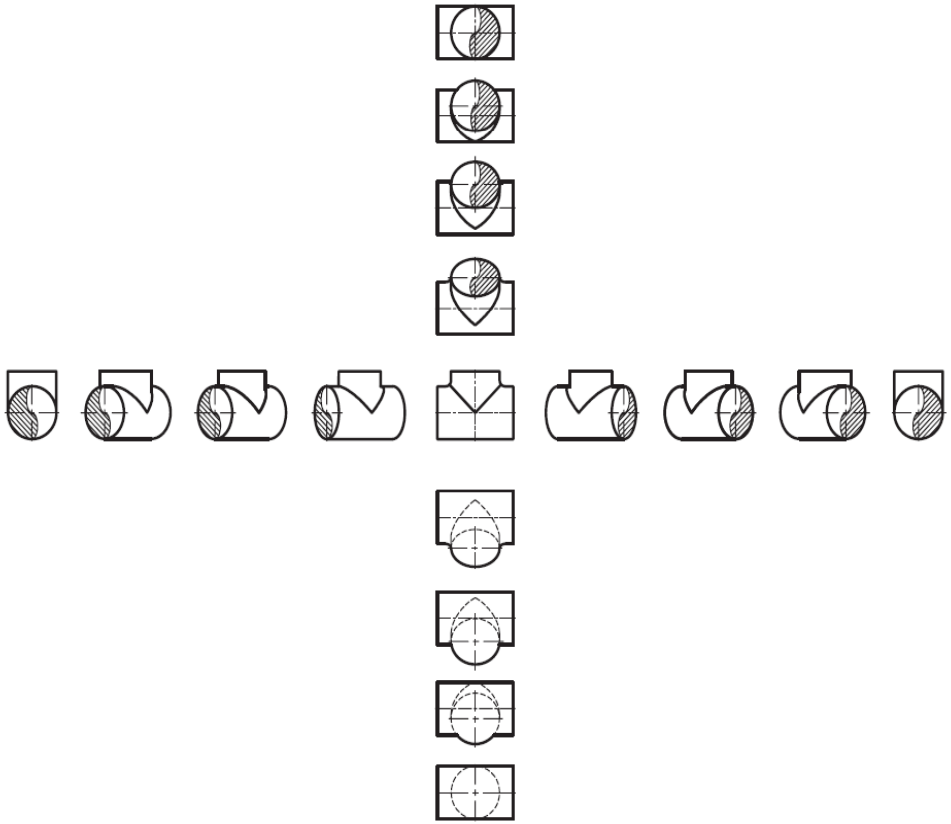


FIGURE 3.27 Weld tee fitting rotations.

Pipe Fittings - Weld Tee

Drawing Symbols for the Weld Tee

Figure 3.28 shows the drawing symbols derived from the 90° rotations of a straight and reducing tee. Remember, a callout is required on the reducing tee to identify the header and branch sizes. The header size is always shown first in the note.

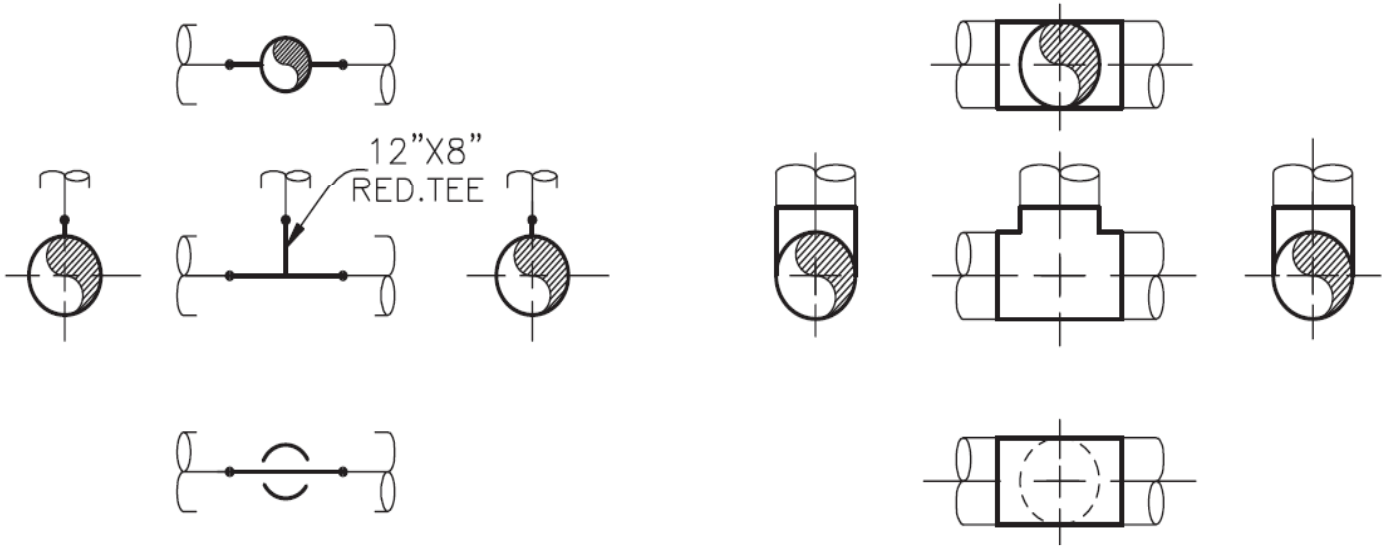
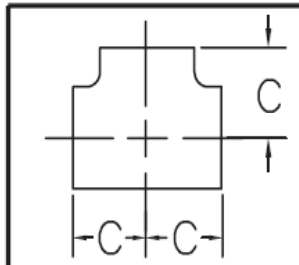


FIGURE 3.28 Weld tee drawing symbols.

Pipe Fittings - Weld Tee

Drawing the Weld Tee

Two dimensions must be determined : the center-to-end length of the header portion of the tee and the length of the branch portion of the tee. If a straight tee is to be drawn, use the Welded Fittings–Flanges Dimensioning Chart to find the C dimension of the tee. The C dimension is the center-to-end measurement for both the header and branch lengths. Therefore, the C dimension must be doubled to find the total length (end-to-end) of the fitting (see Figure 3.29).



NOMINAL PIPE SIZES -(INCHES)		2"	3"	4"	6"	8"	10"	12"	14"
PIPE (OUTSIDE DIAMETER)		$2\frac{3}{8}$	$3\frac{1}{2}$	$4\frac{1}{2}$	$6\frac{5}{8}$	$8\frac{5}{8}$	$10\frac{3}{4}$	$12\frac{3}{4}$	14
Center-to-End	C	$2\frac{1}{2}$	$3\frac{3}{8}$	$4\frac{1}{8}$	$5\frac{5}{8}$	7	$8\frac{1}{2}$	10	11

FIGURE 3.29 Welded Fittings–Flanges Dimensioning Chart.

Pipe Fittings - Weld Tee

Drawing the Weld Tee

Figures 3.30 and 3.31 provide the step-by-step procedures for drawing double-line and single-line tee symbols, respectively.

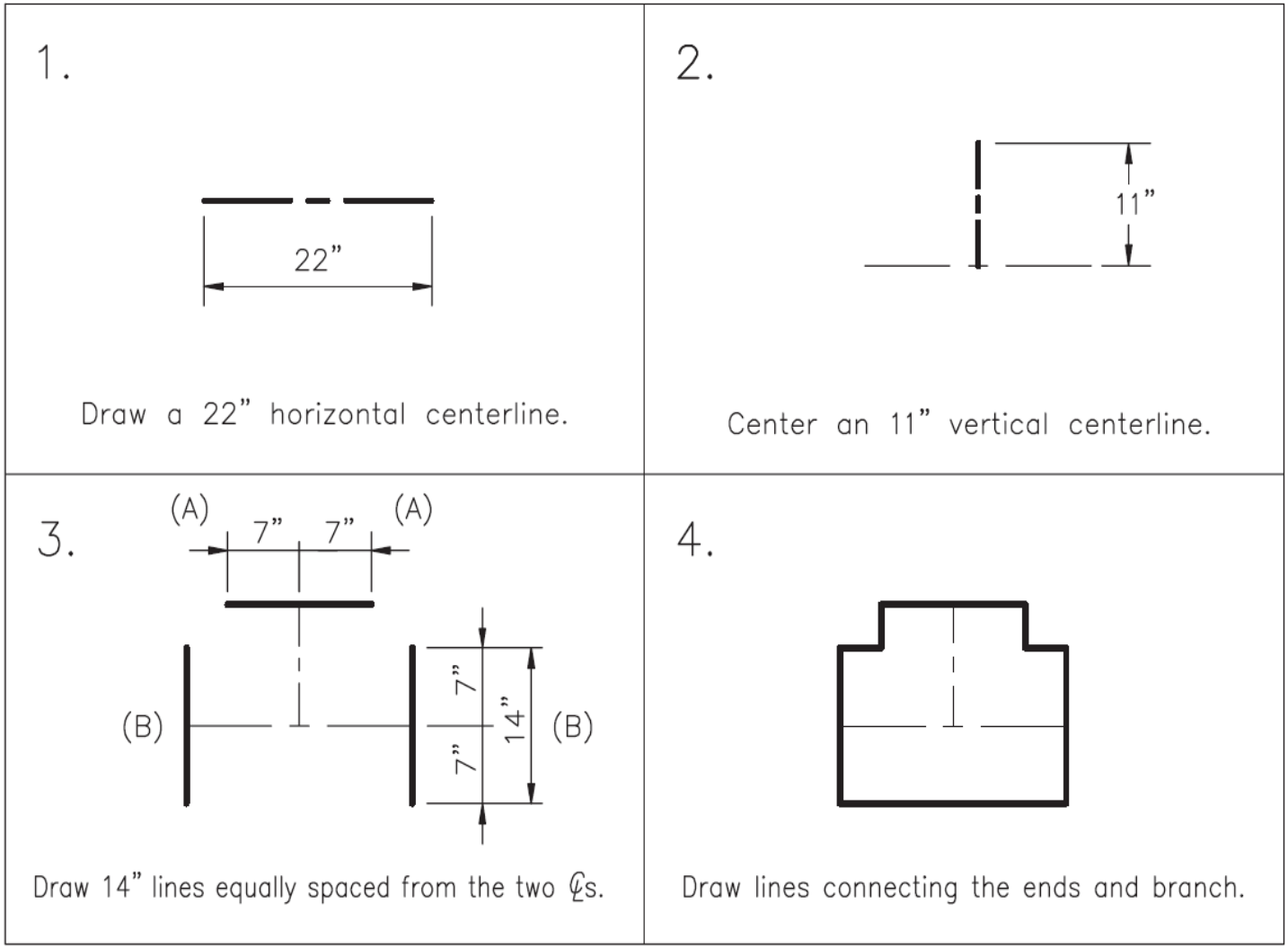


FIGURE 3.30 14″ Welded straight tee drawing symbols.

Step 1. Using the 11″ *C* dimension found in the 14″ column of the Weld tee section of the Welded Fittings–Flanges Dimensioning Chart, draw a centerline 22″ long (11″ [½ a tee] × 2 = 22″) to represent the tee's total length.

Step 2. From the midpoint of the tee's centerline, draw a perpendicular line 11″ long in the desired direction of the branch to represent tee's branch length.

Step 3. Draw a 7″ (½ of the pipe's nominal size) horizontal line on each side of the branch's centerline (A) and two 14″ vertical lines on each end of the header's centerline as shown (B) to establish the weld lines of the tee.

Step 4. Add a 22″ horizontal line to connect the two ends of the tee, then draw two horizontal lines, parallel to the tee's centerline, that will connect the two vertical weld lines. Add two vertical lines that will connect the horizontal weld line of the branch to the header. Trim the horizontal line as necessary.

Pipe Fittings - Weld Tee

Drawing the Weld Tee

Figures 3.31 provide the step-by-step procedures for drawing single-line tee symbols, respectively.

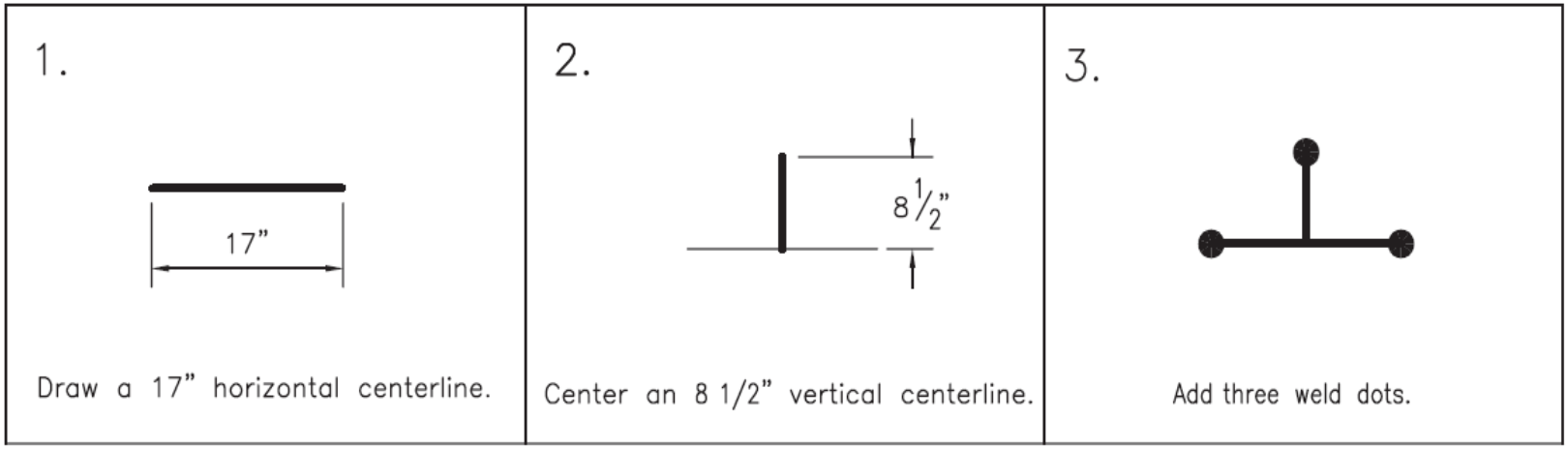


FIGURE 3.31 10″ Straight tee. AutoCAD step-by-step drafting procedure.

Step 1. Draw a LINE 17″ long, having a 0.53 mm lineweight, to represent the tee's total header length (8½″ [center-to-end length] × 2 = 17″).

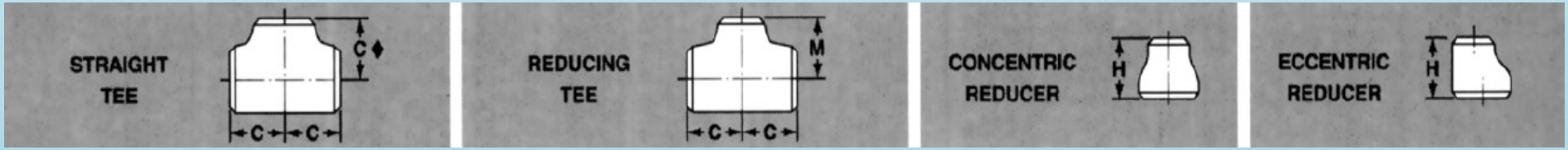
Step 2. To represent the length of the tee's branch, draw an 8½″ perpendicular LINE, from the MIDpoint of the tee's centerline, in the desired direction of the tee, having a 0.53mm lineweight.

Step 3. Add the tee's weld dots. Create the dots with the DONUT command. The DONUT will have an inside diameter of 0″ and outside diameter of 1.75″.

Pipe Fittings - Weld Tee

Drawing the Weld Tee

When a reducing tee is drawn, the branch length is slightly shorter than that of a straight tee. Therefore, the new branch length must be determined. The M dimension, as defined on the Taylor Forge Seamless Welding Fittings Chart, establishes the length of the reducing branch. The Taylor Forge Seamless Welding Fittings Chart is found in Appendix A.



Pipe Fittings – The Stub-In

Another method of branching a pipe from a header is called a stub-in. Quite simply, a hole, either the size of the OD or ID of the desired branch, is bored into the header pipe, and the branch is then stubbed onto it. To create a better fit, the connecting end of the branch pipe is cut, or coped, in such a way as to fit around the hole that has been bored into the header pipe. Although the branch connection can be of the same pipe size as the header or smaller, it cannot be larger. Figure 3.32 depicts the attachment of a stub-in.

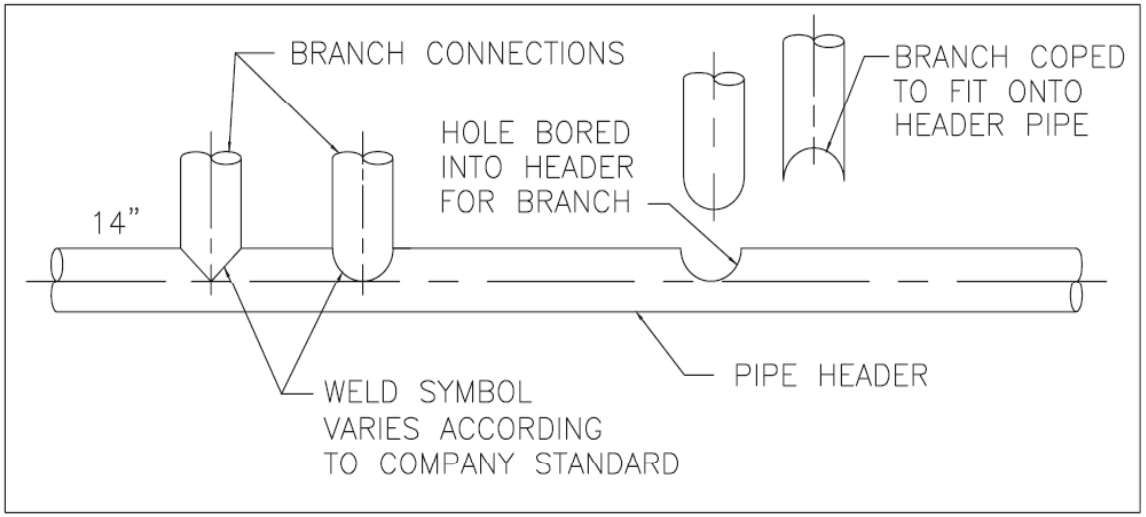


FIGURE 3.32 Stub-in connections.

Pipe Fittings – The Stub-In

Figure 3.33 depicts the single-line and double-line drawing symbols for a stub-in connection. Notice only one weld dot is shown on the single-line symbol and it is placed at the intersection of the header and branch pipe lines. Also notice that the weld dot is not a complete circular shape. It is semi-circular and drawn only on the branching side of the connection.

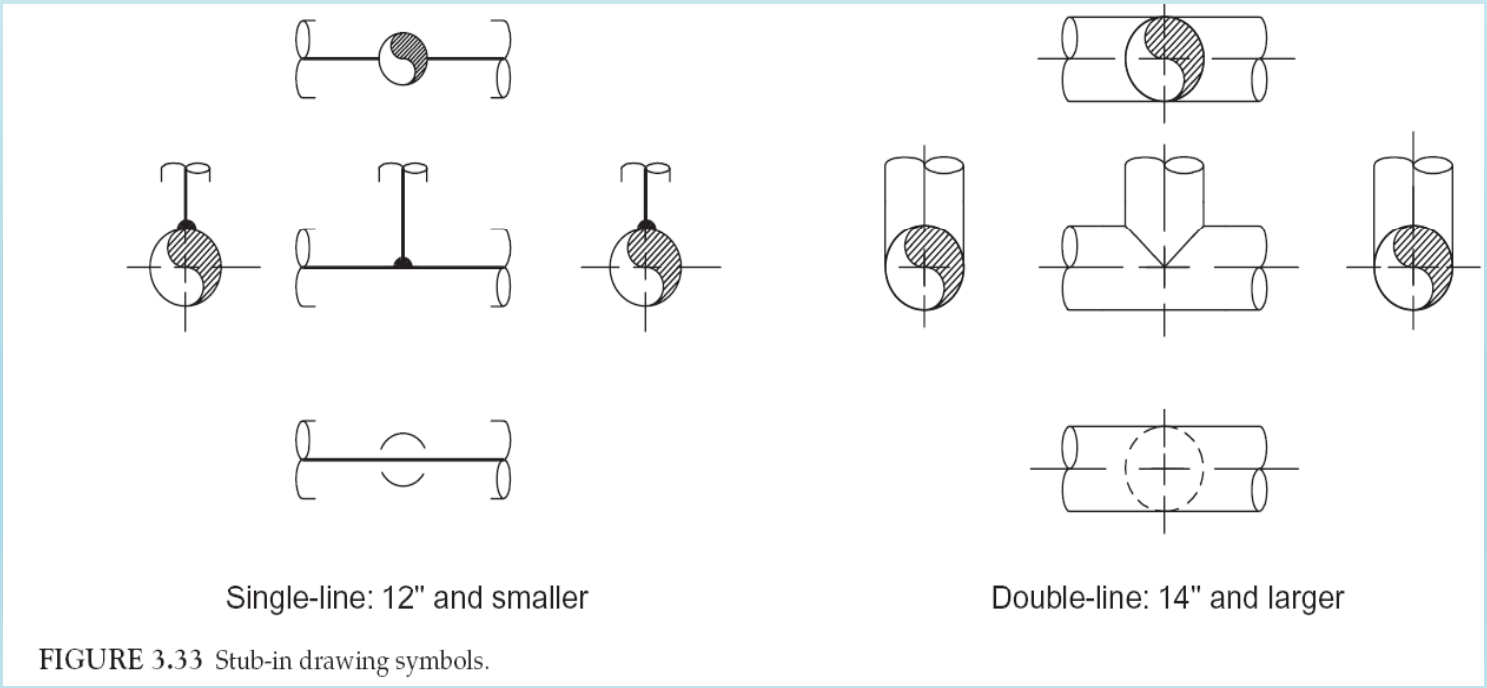


FIGURE 3.33 Stub-in drawing symbols.

Pipe Fittings – The Stub-In (Calculation)

The proximity to which stub-ins can be placed adjacent to one another is another important consideration. The generally accepted welding practice is to allow a minimum of 3" between welds or one header pipe diameter, whichever is larger, between welds. This means 18" (in Figure 3.34) is the minimum spacing between the two branches (16" and 14").

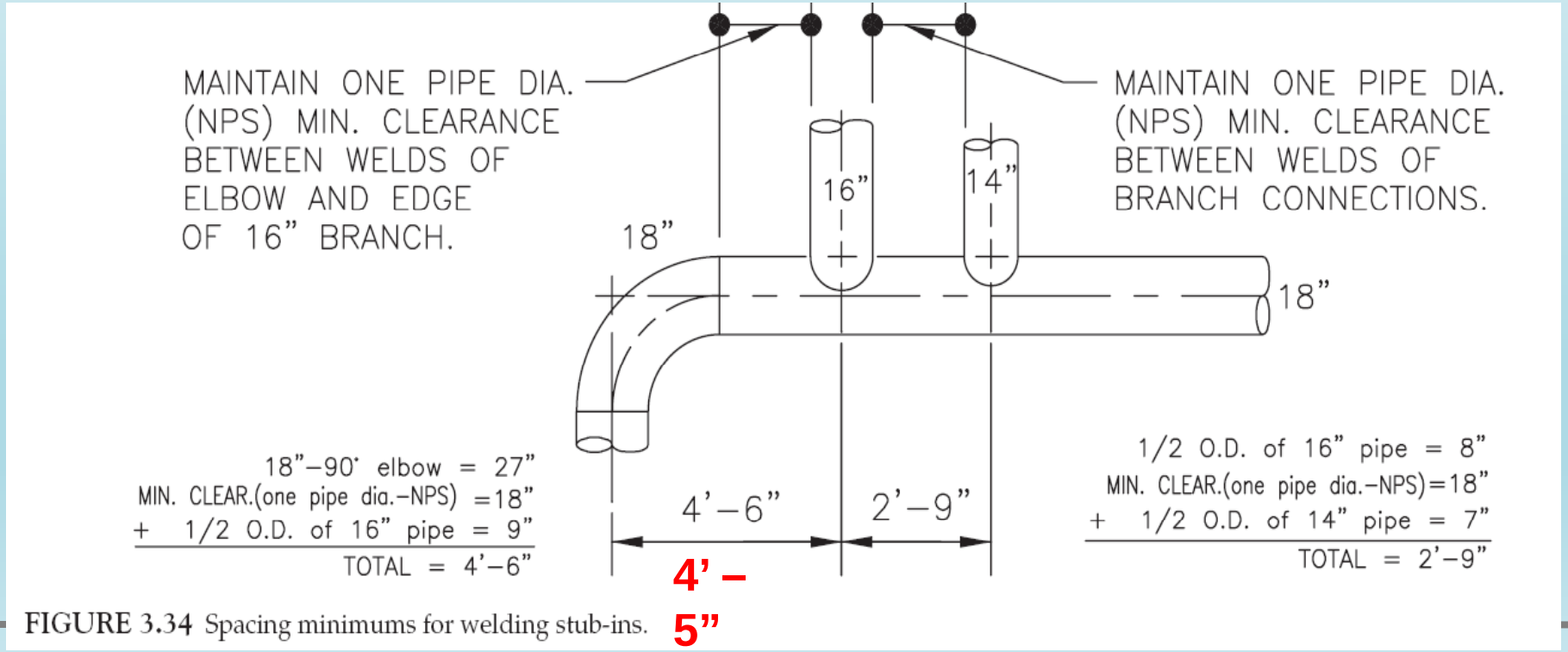


FIGURE 3.34 Spacing minimums for welding stub-ins.

Pipe Fittings – The Stub-In

Stub-in Reinforcements

Its chief advantage over the tee is cost. Not only is a cost saving realized in the purchase of a fitting, but also in the installation. The stub-in requires only one weld, whereas the tee requires three.

When internal conditions such as pressure or temperature of the commodity or external forces such as vibrations or pulsations are placed on a stub-in, special reinforcement may be necessary to prevent the branch from separating from the header. Three reinforcing alternatives are listed below:

Pipe Fittings – The Stub-In

Stub-in Reinforcements

Three reinforcing alternatives are listed below:

- Reinforcing pad. Resembling a round, metal washer that has been bent to conform to the curvature of the pipe, the reinforcing pad is a ring cut from steel plate that has a hole in the center equal to the outside diameter of the branch connection. Once the branch has been welded to the header, the reinforcing pad is slid down the branch to cover the weld connection. The reinforcing pad is then welded to both the branch and the header.
- Welding saddle. A precision manufactured reinforcing pad, the welding saddle has a short neck on the branch outlet that is designed to give additional support to the branch connection. Figure 3.35 shows single-line and double-line drawing representations of reinforcing pads and welding saddles.

Pipe Fittings – The Stub-In

Stub-in Reinforcements

Three reinforcing alternatives are listed below:

Figure 3.35 shows single-line and double-line drawing representations of reinforcing pads and welding saddles.

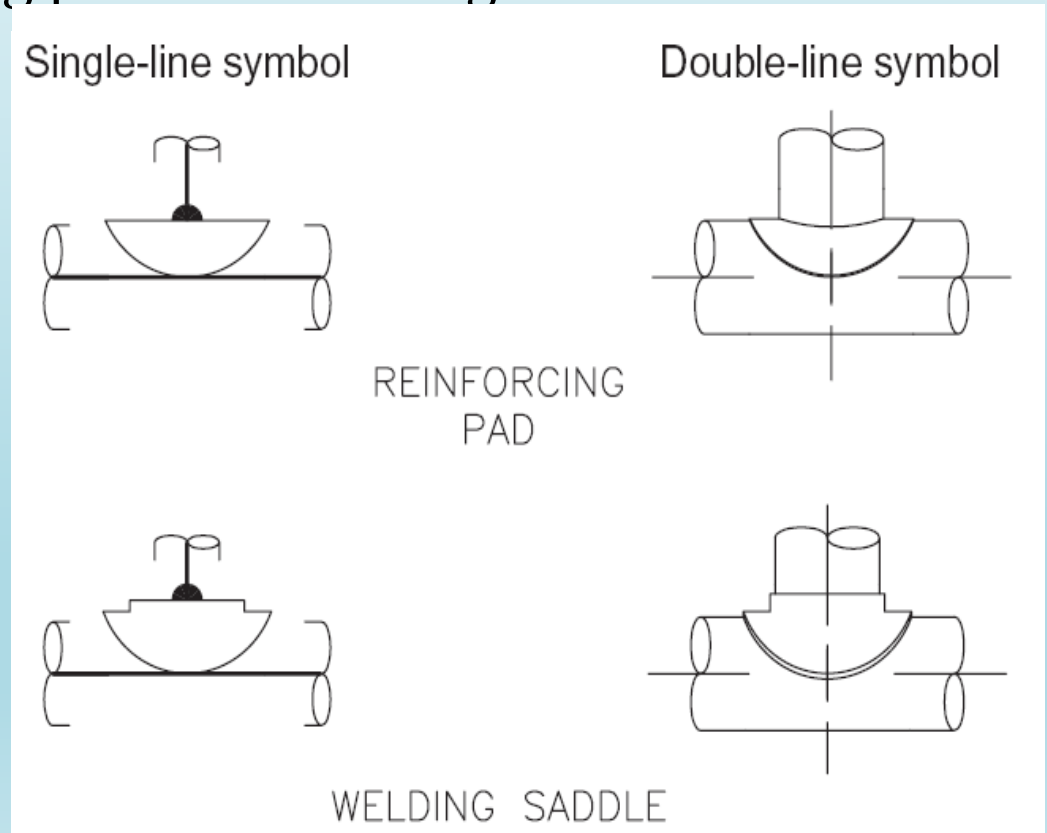


FIGURE 3.35 Reinforcing pads and saddles.

Pipe Fittings – The Stub-In

Stub-in Reinforcements

Three reinforcing alternatives are listed below:

- O-lets. Purchased fittings, o-lets have one end shaped to the contour of the outside diameter of the pipe header and the other end manufactured to accept the type of end connections being used on the branch. O-lets are manufactured for butt-welded, socket-welded, and threaded connections. Weld-o-lets are manufactured for butt-weld fittings. Sock-o-lets are made for socket-weld fittings. And thread-o-lets are available for screwed fittings.

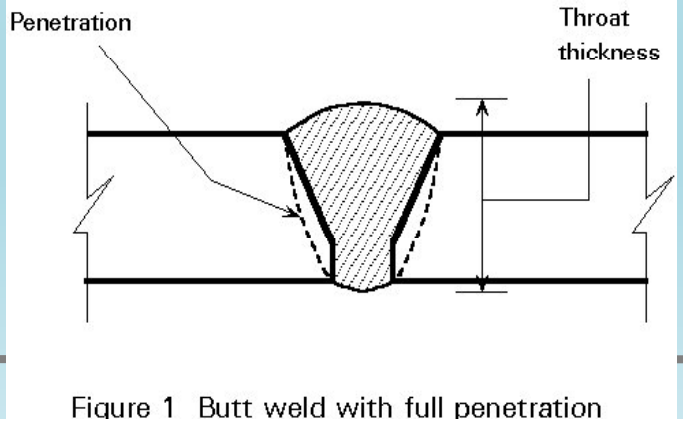
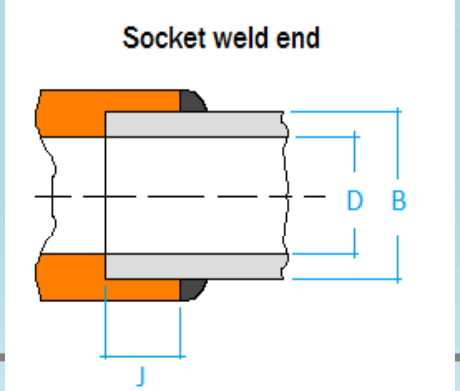


Figure 1 Butt weld with full penetration



Pipe Fittings – The Stub-In

Stub-in Reinforcements

The photograph in Figure 3.36 shows how a thread-o-let sits atop a header pipe before welding.

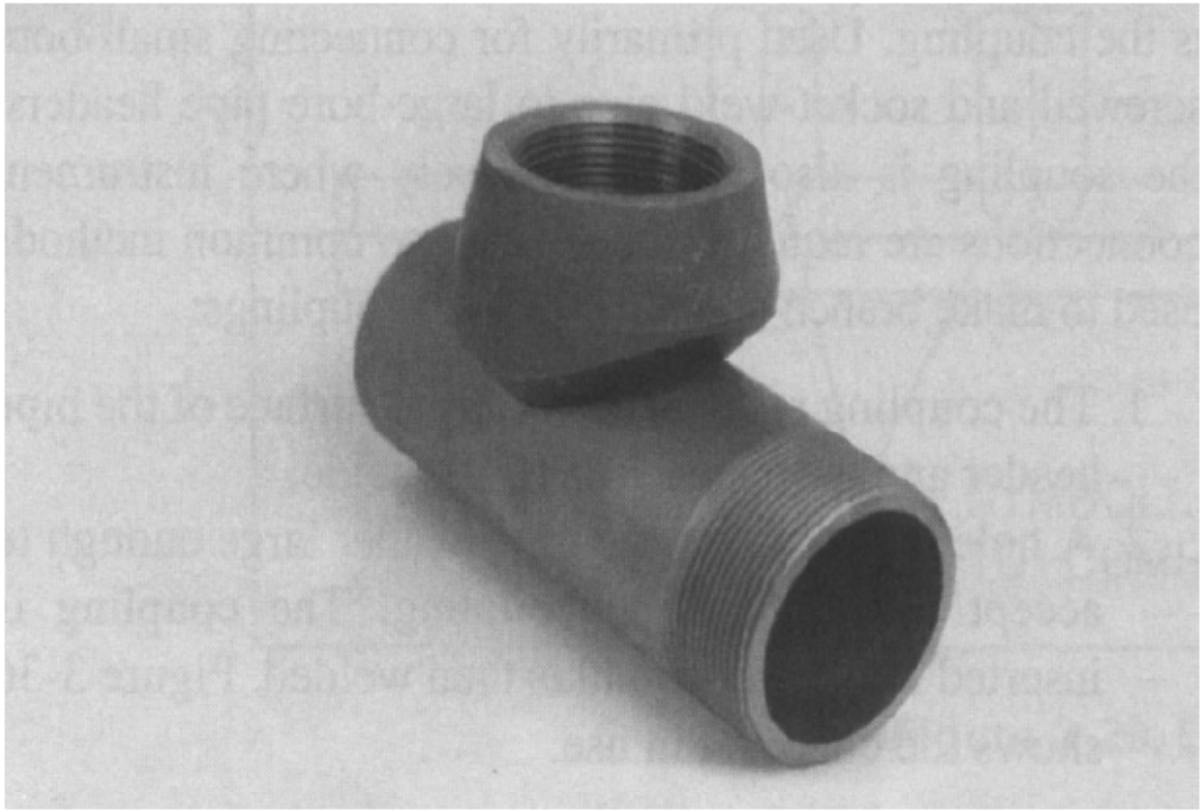


FIGURE 3.36 Thread-o-let.

Pipe Fittings – The Stub-In

Stub-in Reinforcements

Figure 3.37 provides drawing symbols for weld-o-lets, sock-o-lets, and thread-o-lets.

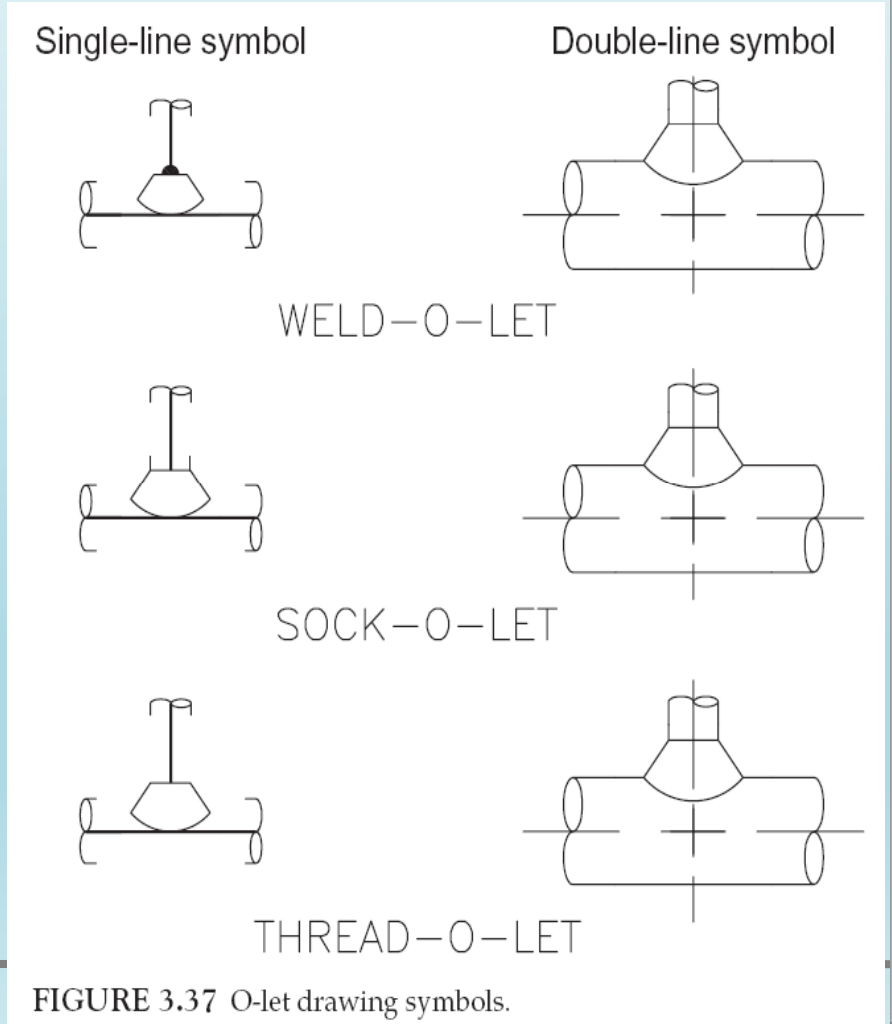


FIGURE 3.37 O-let drawing symbols.