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

Pipe Fittings - 90° Elbows

Long-Radius Elbow

Dimensional sizes of fittings are typically provided by the manufacturer of the fitting.

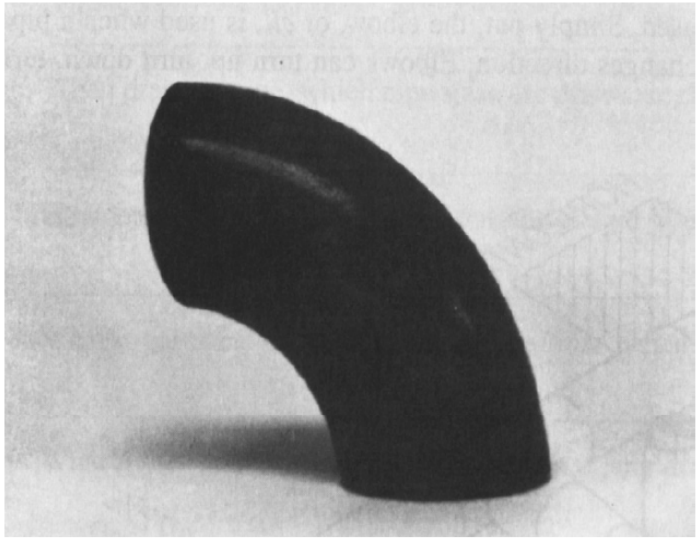
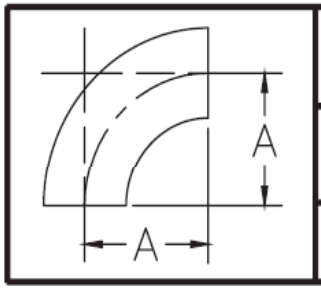


FIGURE 3.2 Long-radius elbow.

Pipe Fittings - 90° Elbows

Long-Radius Elbow

Use the 90° elbow portion of the Welded Fittings–Flanges Chart (Figure 3.4) to find the length of the fitting. Below the nominal pipe size, in row A, the center-to-end dimension is shown.



NOMINAL PIPE SIZE–(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"
90°L.R. ELL	A	3	$4\frac{1}{2}$	6	9	12	15	18	21

FIGURE 3.4 Welded Fittings–Flanges Dimensioning Chart.

Pipe Fittings - 90° Elbows

Long-Radius Elbow

When drawing the elbow, the center-to-end dimension is used as the radius measurement for the elbow's centerline arc.

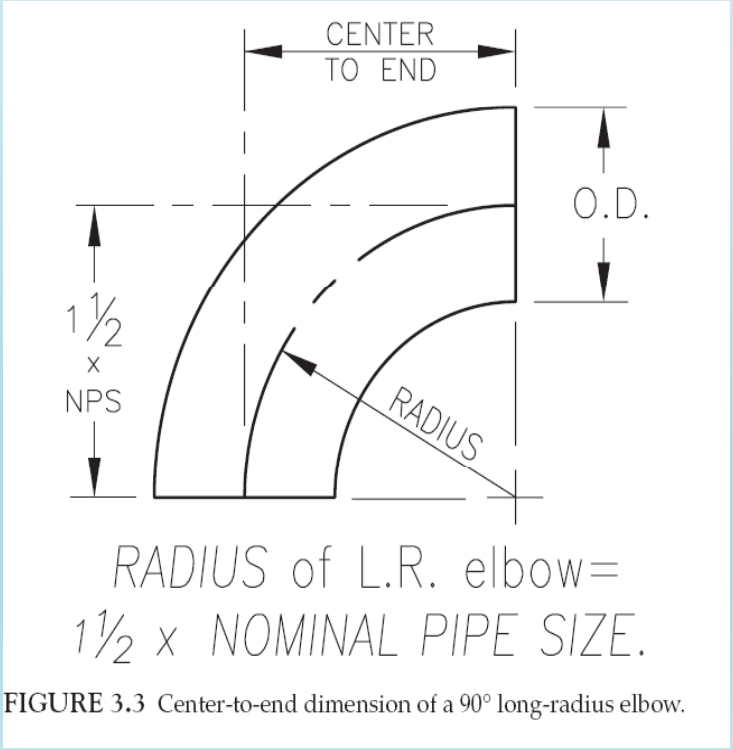


FIGURE 3.3 Center-to-end dimension of a 90° long-radius elbow.

Pipe Fittings - 90° Elbows

Drawing Symbols for the 90° Long-Radius Elbow

As with all drafting disciplines, symbols are used to represent real-world items on drawings. A single elbow can have multiple representations. Looking at it from the side, the top, or the end will yield different symbol shapes.

For example, the 90° long-radius elbow can be rotated in numerous orientations, as shown in Figure 3.5.

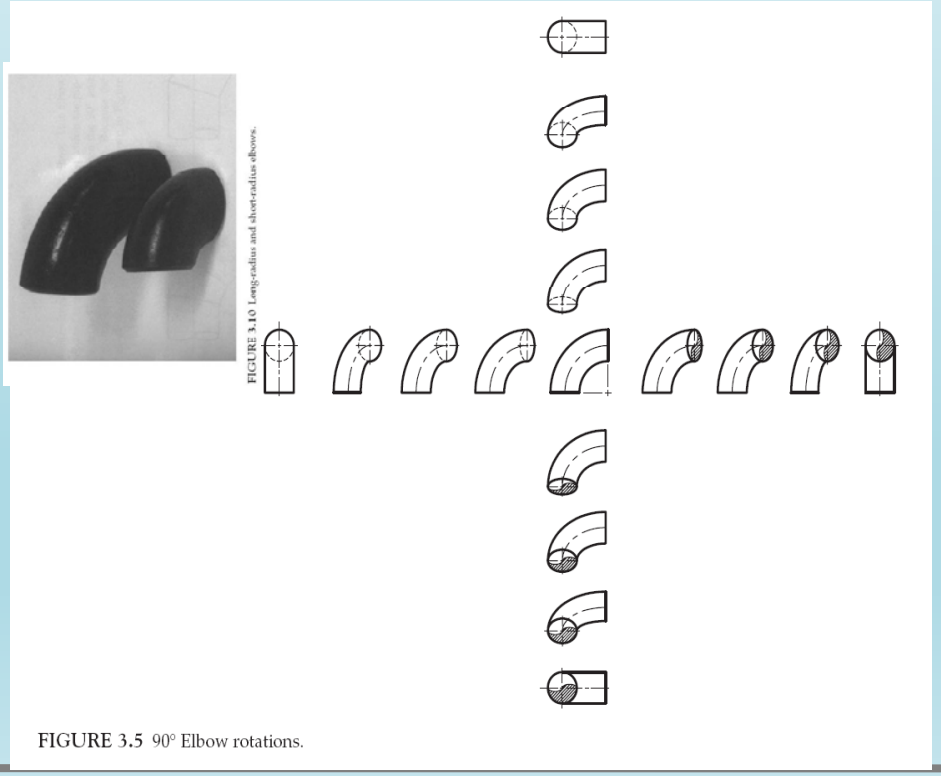


FIGURE 3.5 90° Elbow rotations.

Pipe Fittings - 90° Elbows

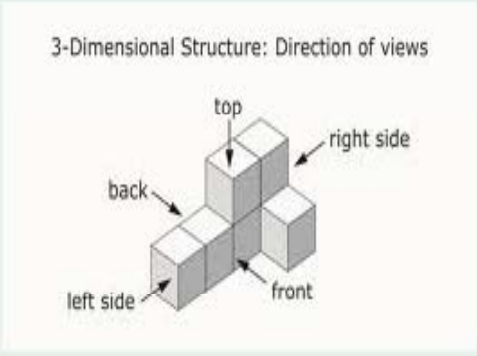
Drawing Symbols for the 90° Long-Radius Elbow

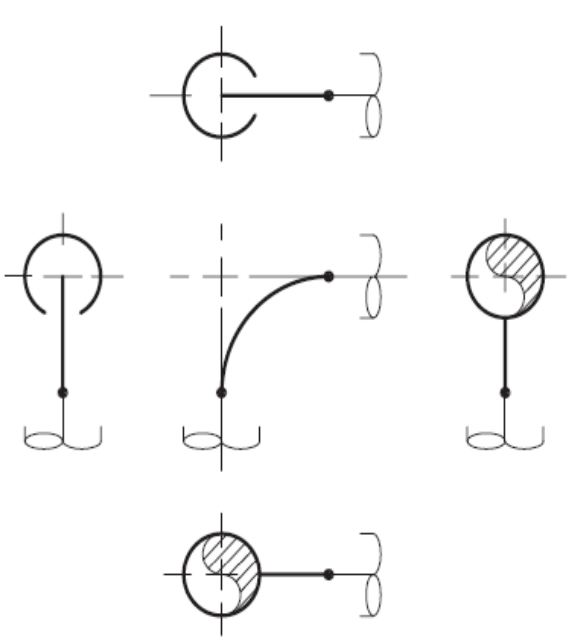
Another drawing technique unique to the piping discipline is that each component, depending on its pipe diameter, can be represented as either a single-line or double-line symbol.

Pipe Fittings - 90° Elbows

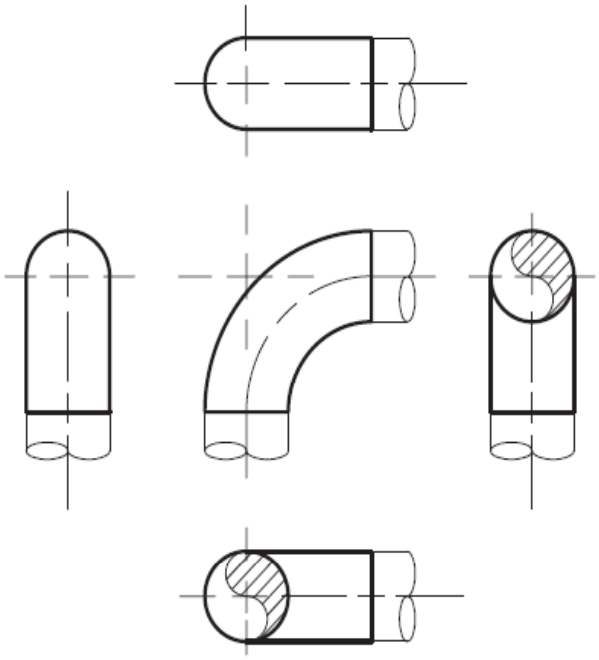
Drawing Symbols for the 90° Long-Radius Elbow

Figure 3.6 shows the drawing symbols for the various orthographic views of a 90° elbow.





Single-line: 12" and smaller



Double-line: 14" and larger

FIGURE 3.6 90° Long-radius elbow drawing symbols.

Pipe Fittings - 90° Elbows

Drawing Symbols for the 90° Long-Radius Elbow

Remember, only the centerline arc of the elbow is drawn when representing the single-line symbols. The double-line symbol requires one-half of the pipe's OD be added and subtracted, respectively, from the centerline arc to represent the total pipe diameter. Keep in mind as the front view of the elbow is rotated, so too will the adjacent orthographic views be rotated.

Pipe Fittings - 90° Elbows

Drawing the 90° Long-Radius Elbow

Three “step-by-step” methods will be presented for constructing the 90° long-radius elbow.

Figure 3.7 describes the step-by-step procedures for drawing an elbow with traditional drafting techniques;

Figure 3.8 shows the steps required to draw double-line symbols using AutoCAD commands;

Figure 3.9 shows the steps required to draw a single-line 12" elbow symbol.

Pipe Fittings - 90° Elbows

Step 1. From the centerline of the intersecting pipes, develop a centerpoint measuring 21″ (14″ NPS × 1½ = 21″) toward the proposed elbow's center.

Step 2. From the centerpoint, draw a 21″ arc, which will represent the elbow's centerline.

Step 3. Draw the elbow's outer arc (28″) by adding 7″ (one-

Step 4. Draw the elbow's inner arc (14″) by subtracting 7″ (

Step 5. Draw two "weld lines" across the ends of the arcs.

Step 6. Remember, for fittings 12″ and below, only the arc r

Figure 3.7 describes the step-by-step procedures for drawing an elbow with traditional drafting techniques;

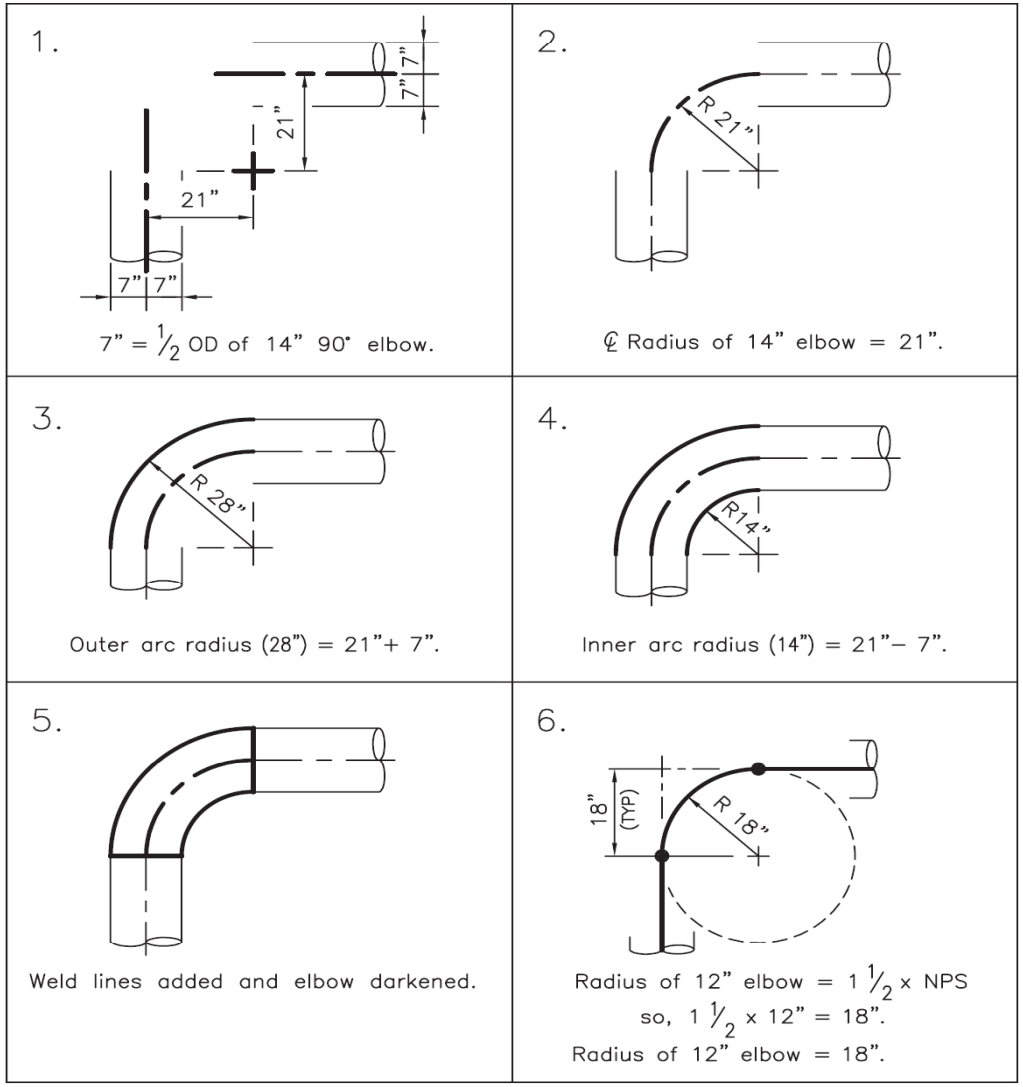


FIGURE 3.7 14″-90° Elbow. Manual step-by-step drafting procedure.

Pipe Fittings - 90° Elbows

Step 1. Use the **OFFSET** command to create construction lines parallel to the pipe's centerline 21″ (14″ NPS × 1½ = 21″) away

Step 2. From the construction line's i

Step 3. Develop the elbow by **OFFSE**

Step 4. Draw the elbow's "weld lines

Figure 3.8 shows the steps required to draw double-line symbols using AutoCAD commands.

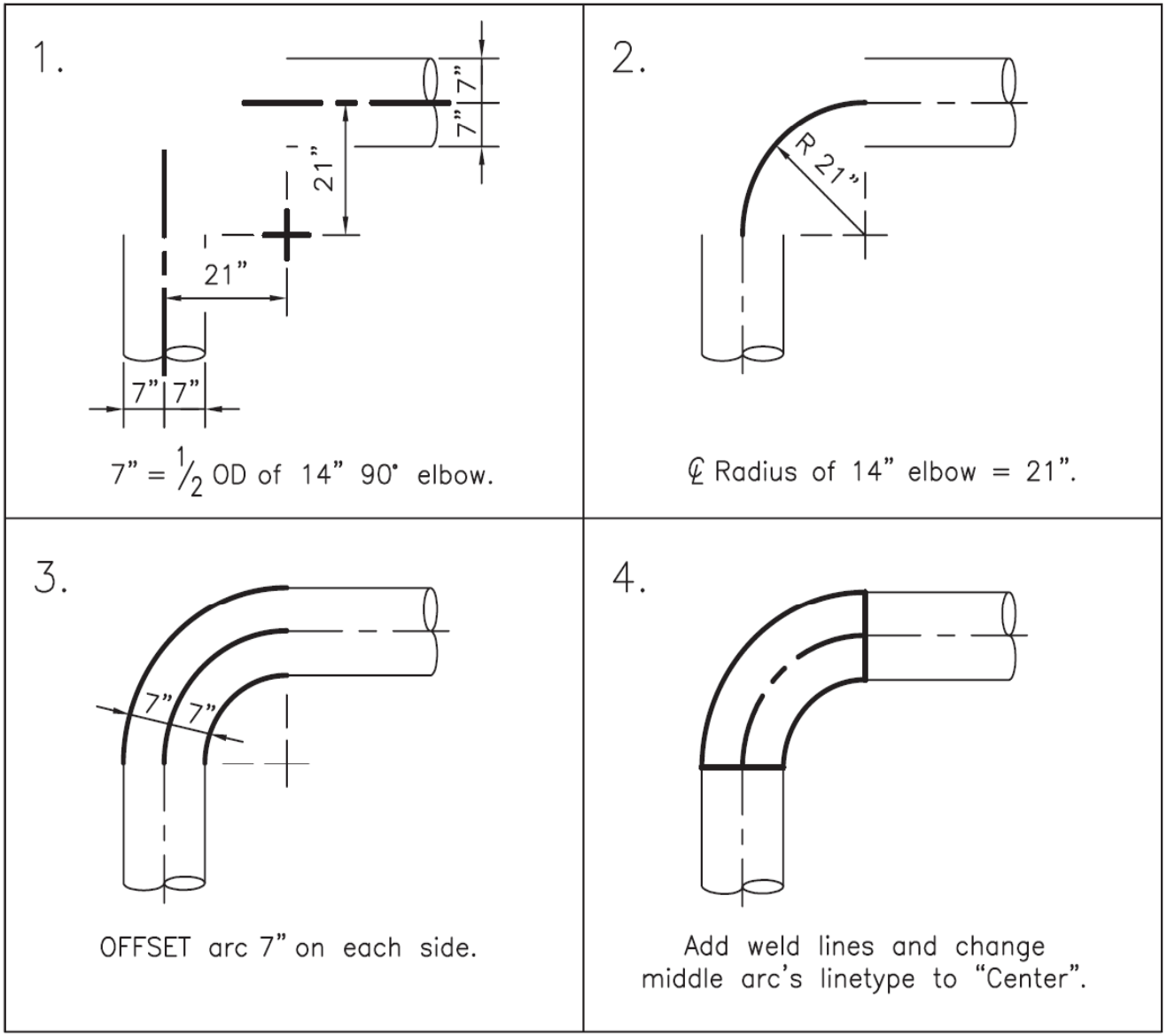


FIGURE 3.8 14″-90° Elbow. AutoCAD step-by-step drafting procedure.

Pipe Fittings - 90° Elbows

Step 1. Use the **OFFSET** command to create construction lines parallel to the pipe 18″ away. The offset distance is equal to the elbow's center-to-end dimension (12″ × 1½ = 18″).
Step 2. From the intersection of the construction lines create an 18″ radius **ARC** using the Center, Start, End option.
Step 3. Change the arc's lineweight to match the pipe's.
Step 4. Add weld dots to complete the elbow symbol. Create the weld dots with the DONUT command. The donut will have an inside radius of 0.0″ and an outside radius of 1.75″.

Figure 3.9 shows the steps required to draw a single-line 12" elbow symbol.

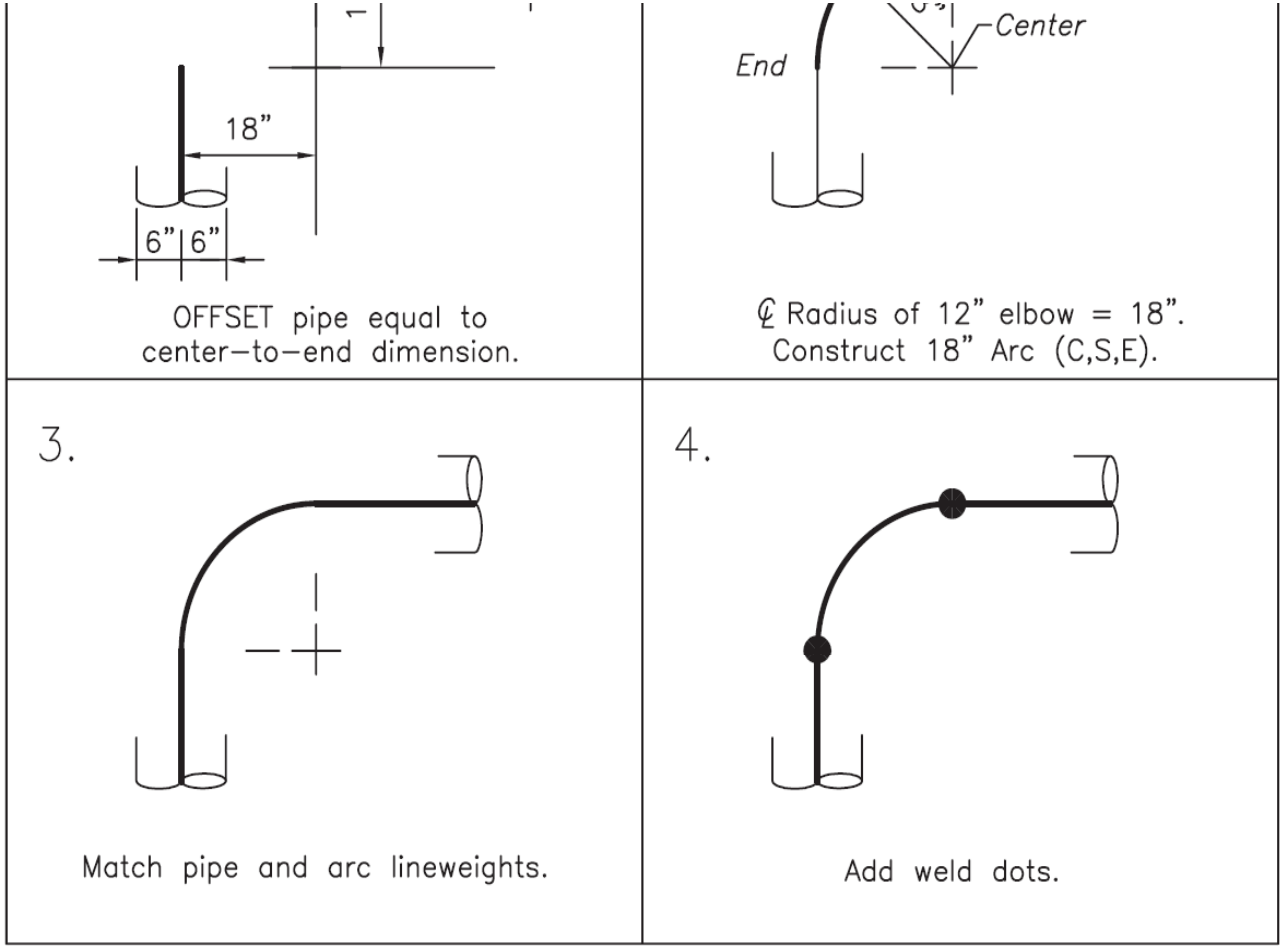


FIGURE 3.9 Single-line 12″-90° elbow. AutoCAD step-by-step drafting procedure.

Pipe Fittings - 90° Elbows

Short-Radius Elbow

The 90° short-radius ell makes a much sharper turn than does the long-radius ell (see Figure 3.10). Conversely, the short-radius ell also creates a rather large pressure drop inside the line and does not have the smooth flow characteristics the long-radius ell has. For these reasons, the short-radius ell is seldom used.

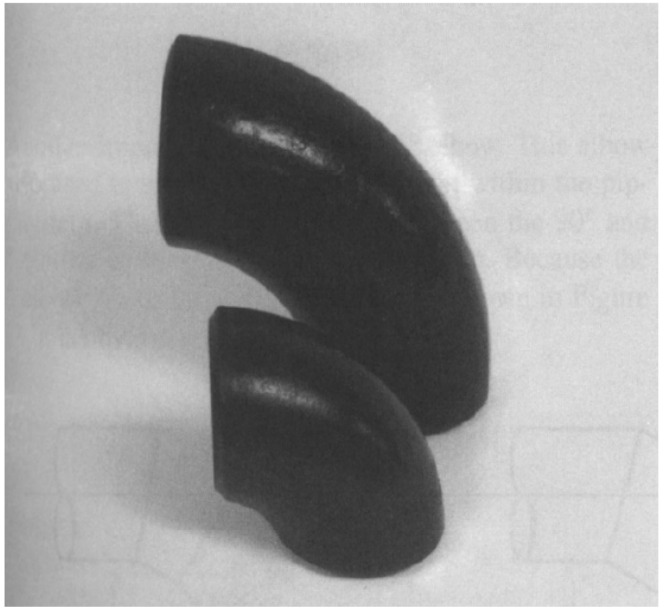


FIGURE 3.10 Long-radius and short-radius elbows.

Pipe Fittings - 90° Elbows

Short-Radius Elbow

A simple formula can be used to calculate the center-to-end dimension of a 90° short-radius ell: Fitting length equals nominal pipe size.

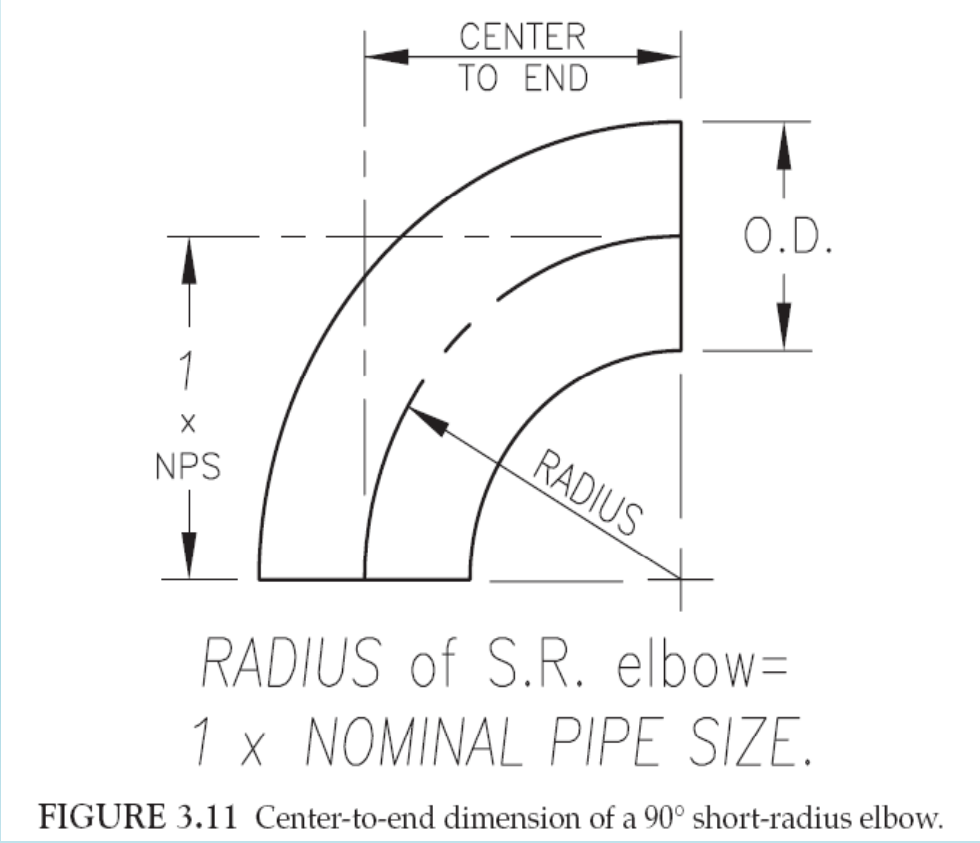


FIGURE 3.11 Center-to-end dimension of a 90° short-radius elbow.

Pipe Fittings - 90° Elbows

Drawing Symbols for the Short-Radius Elbow

The drawing symbols for a short-radius elbow are shown in Figure 3.12.

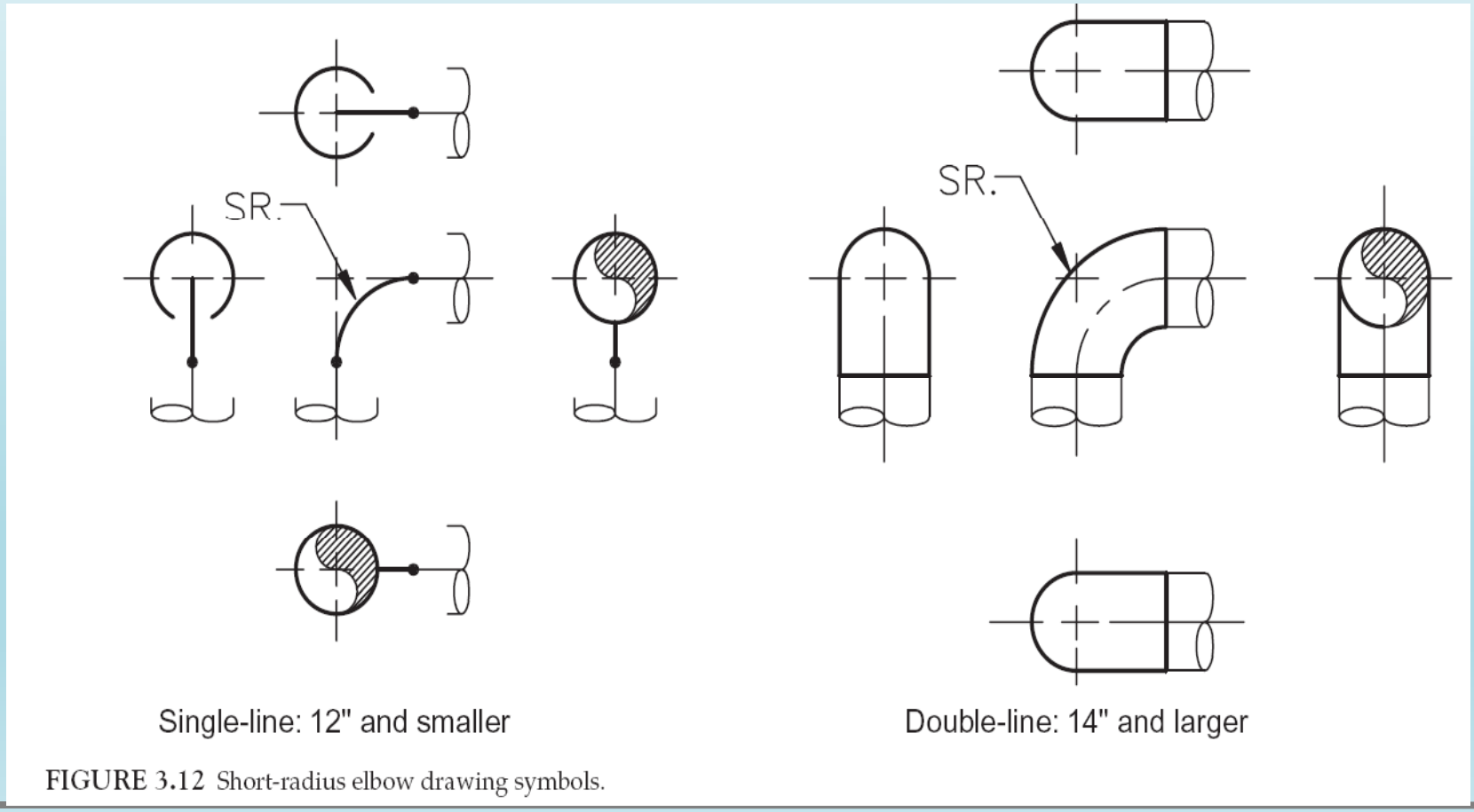


FIGURE 3.12 Short-radius elbow drawing symbols.

Pipe Fittings - 90° Elbows

Reducing Elbows

It was thought that a new fitting could be manufactured that combined a 90° long-radius elbow and a pipe reducer to save money and shorten the installation measurement, one fitting as opposed to two.

However, though theoretically correct, in practical application the shortened fitting length made it more difficult to install and remove bolts when it was welded to flanges that were to be bolted to valves or nozzles.

Pipe Fittings - 90° Elbows

Mitered Elbows

A mitered elbow is a field-fabricated bend in the routing of the pipe configuration. Generally used on 24 and larger pipe sizes, a mitered elbow is much less expensive to fabricate at the job site.

Pipe Fittings - 90° Elbows

Mitered Elbows

The miter ell is made by making angular cuts through a straight run of pipe and then welding the pipe back together after the cut sections have been rolled at varying angles (see Figure 3.13).

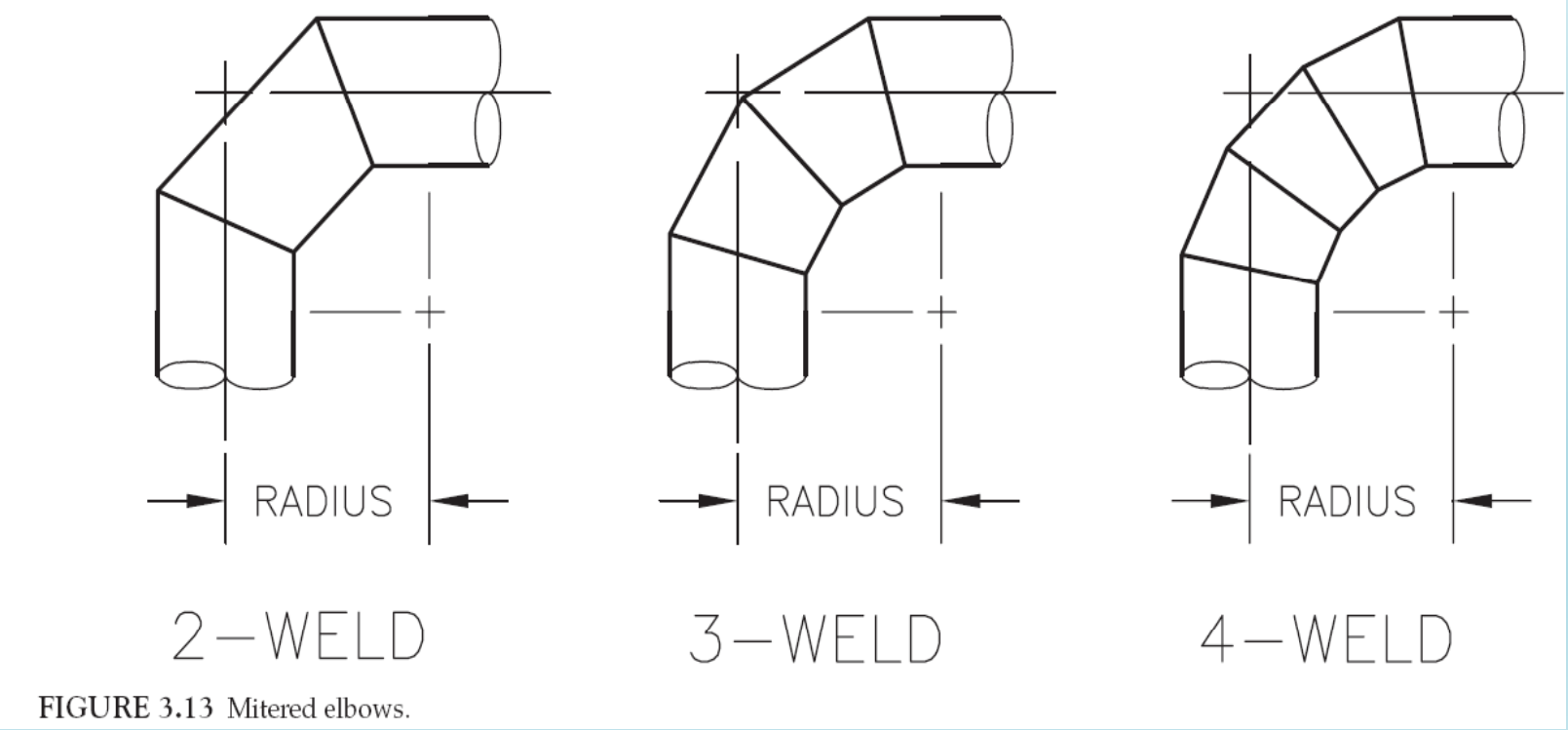


FIGURE 3.13 Mitered elbows.

Pipe Fittings - 90° Elbows

Mitered Elbows

A 90° mitered ell can be fabricated in two, three, or four welded sections. The number of welded sections used depends on the smoothness of flow required through the turn.

A two-weld miter will create more commodity turbulence within the pipe than will a four-weld miter. Though one-weld miters are used, they are rare and typically reserved for 30°, 45°, or 60° turns.

Pipe Fittings - 90° Elbows

Drawing Symbols for Mitered Elbows

Figure 3.14 shows the single-line and double-line drawing symbols for mitered elbows. Unlike the pre-vious ells, the weld dots and weld lines in the adjacent orthographic views of the mitered elbow are repre-sented by ellipses. Ellipses are used because the welds are not perpendicular to your line of sight.

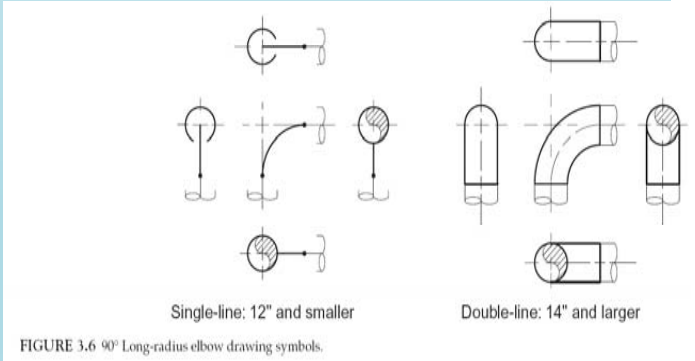


FIGURE 3.6 90° Long-radius elbow drawing symbols.

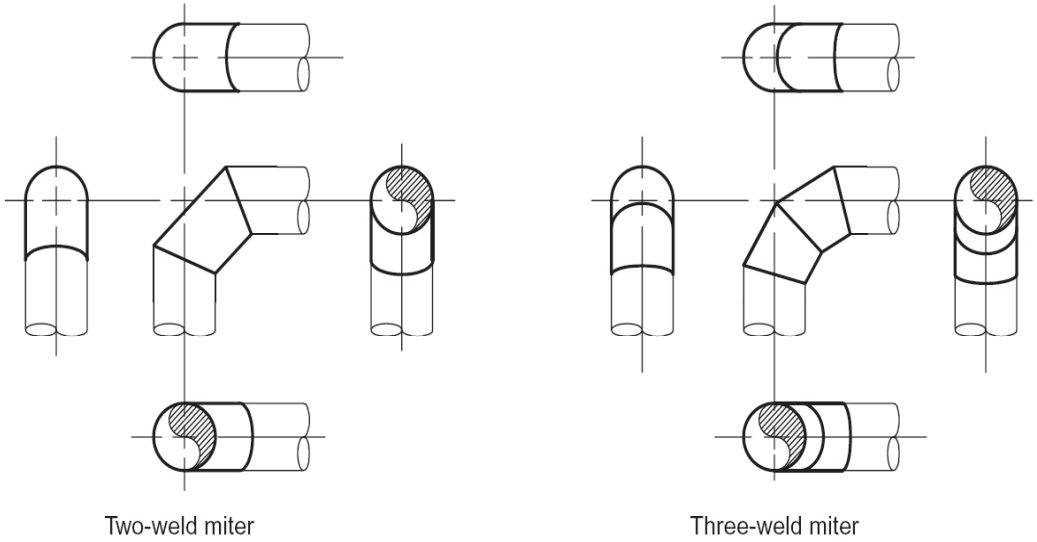


FIGURE 3.14 Mitered elbows drawing symbols.

Pipe Fittings - 45° Elbows

This important elbow is also used to make changes in direction within the piping configuration. The obvious difference between the 90° and 45° elbows is the angle formed by the turn. Because the 45° elbow is one-half of a 90° elbow, as shown in Figure 3.15, it is obviously shorter.

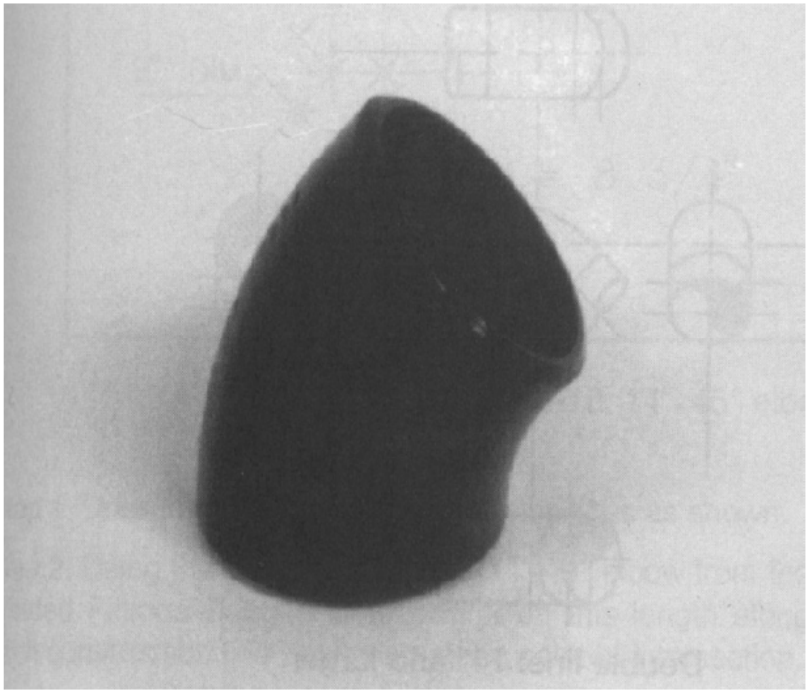


FIGURE 3.15 45° Elbow.

Pipe Fittings - 45° Elbows

A design using two 45° elbows to make a directional change, instead of two 90° elbows, would result in considerable savings. Savings not only related to the cost of the fittings themselves, but savings in the physical space needed to route the pipe (Figure 3.16).

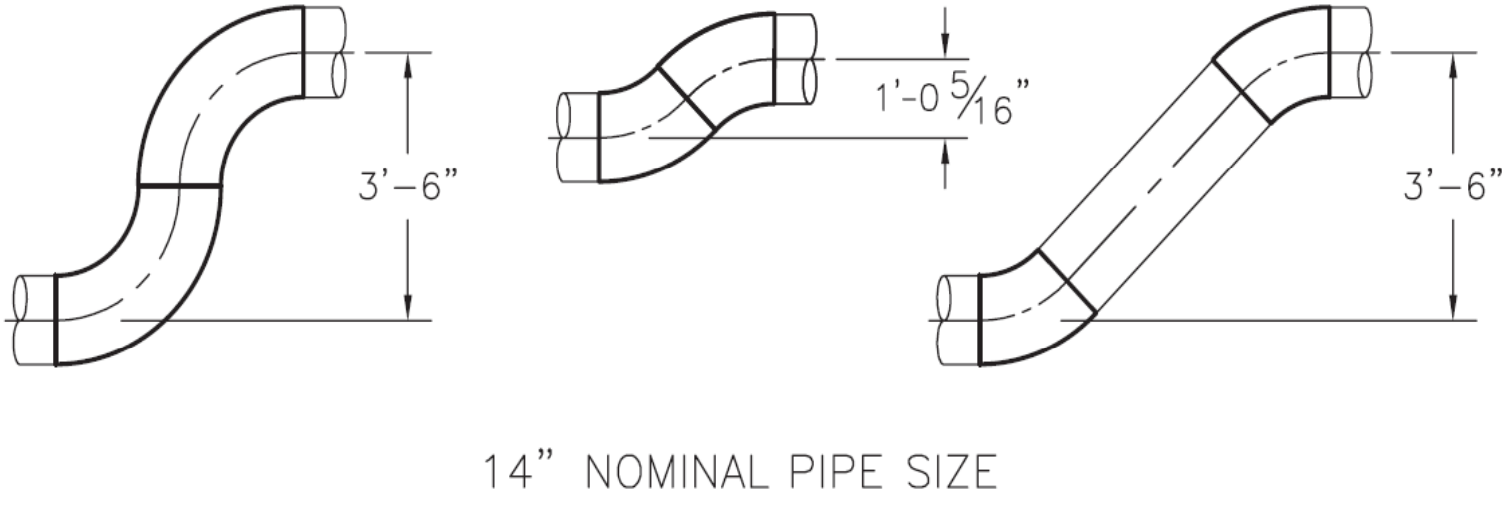
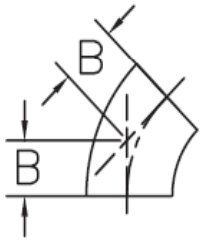


FIGURE 3.16 90° Ell versus 45° elbow.

Pipe Fittings - 45° Elbows

One can multiply the nominal pipe size times 0.625 (5/8") to determine the elbow's length, but that only works for elbows 4–24" in size. To avoid confusion, it is recommended to use the Welded Fittings–Flanges Dimensioning Chart to get the length of a 45° elbow (see Figure 3.17).



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
45°L.R. ELL	B	$1\frac{3}{8}$	2	$2\frac{1}{2}$	$3\frac{3}{4}$	5	$6\frac{1}{4}$	$7\frac{1}{2}$	$8\frac{3}{4}$

FIGURE 3.17 Welded Fittings–Flanges Chart.