Basic Design and Pipe Drafting

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1) Introduction to design concept, engineering design process, how to do design, conceptual design, design cases, design software.
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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

Chapter 5 Valves

This chapter introduces different types of valves and drawings. The valve is one of the most basic and indispensable components of our modern technological society.

Videos: Types of valves

Valve symbols

Chapter 5 Valves- What is a Valve?

Each time you turn on a water faucet, use your dishwasher, turn on a gas range, or step on the accelerator in your car, you operate a valve. Without modern valve systems, there would be no fresh, pure water in your home, no modern appliances, and no gasoline waiting at the corner service station.

One of the most widely observed, but least recognized, type of valve is the fire hydrant. Fire hydrants are connected to municipal water supply systems. They are specialized in that they are underground valves that can be opened and closed from an aboveground location when needed in emergency situations.

Chapter 5 Valves- What is a Valve?

By definition, a valve is a device that controls the flow of a fluid. But today's valves can control not only the flow but also the rate, the volume, the pressure, and the direction of a fluid. They can control liquids, gases, vapors, slurries, or dry materials. Valves can turn on or off, regulate, modulate, or isolate. They can range in size from a fraction of an inch to as large as 30 ft in D and can vary in complexity from a simple brass valve to a highly sophisticated coolant system control valve used in a nuclear reactor. Valves can also control the flow of all types of commodities from gas to highly corrosive chemicals, from superheated steam to toxic gases, from abrasive slurries to radioactive materials. They can handle temperatures from the cryogenic region to molten metal exceeding 1,500 °F, and valves can contain pressures ranging from vacuum to 20,000 pounds per square inch.

Chapter 5 Valves- Common Valve Types

Valves are manufactured in numerous sizes, body styles, and pound ratings to meet a wide variety of application needs. Valves are also manufactured with varying types of end preparations that allow them to be readily mated to flanges or pipes of the same size and rating. Valve end preparations can be screwed, socket-weld, beveled, or flanged. Flanged valves are manufactured to have either raised, flat, or ring-type joint faces.

Chapter 5 Valves- Common Valve Types

Gate Valves
Globe Valves
Angle Valves
Check Valves
Ball Valve
Plug Valve
Butterfly Valve
Relief Valves
Control Valve

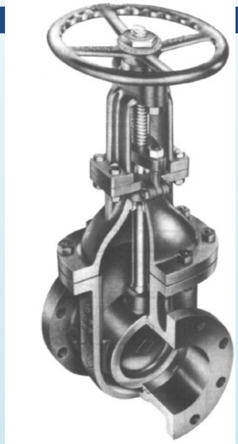


FIGURE 5.1 Gate valve. *Courtesy of Jenkins Bros.*

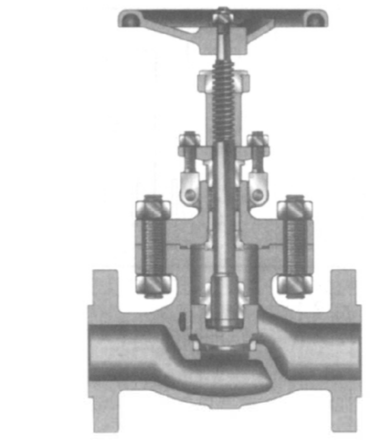


FIGURE 5.7 Globe valve. *Courtesy of VELAN.*

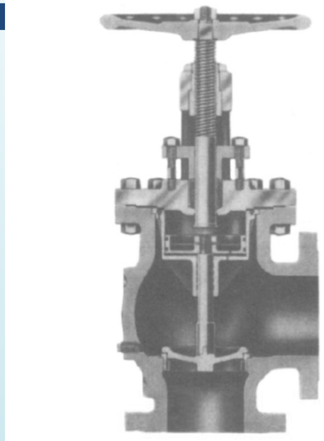


FIGURE 5.9 Angle valve. *Courtesy of Jenkins Bros.*

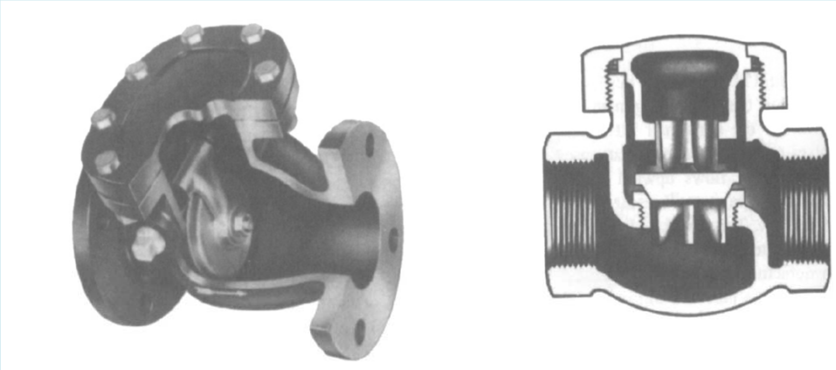


FIGURE 5.11 Swing and lift check valves. *Courtesy of Crane Co.*

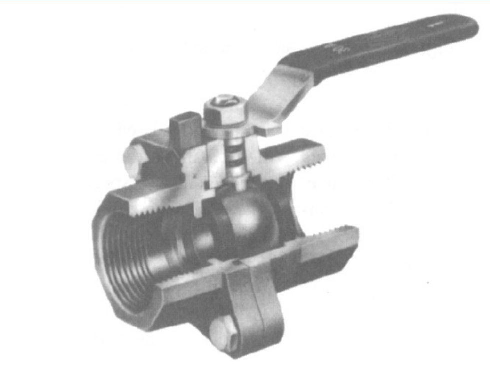


FIGURE 5.13 Ball valve. *Courtesy of Jenkins Bros.*

FIGURE 5.15 Plug valve. *Courtesy of Stockham Valves.*

FIGURE 5.17 Butterfly valve. *Courtesy of Crane Co.*

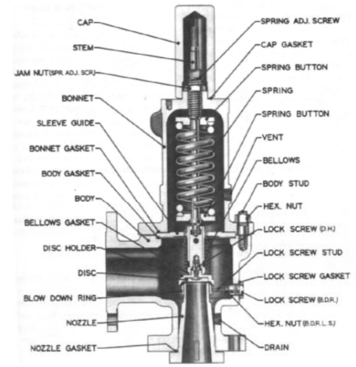
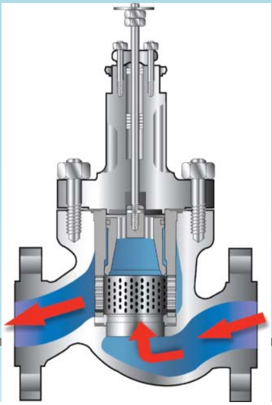


FIGURE 5.19 Relief valve. *Courtesy of Farris Safety-Relief Valves.*



Gate Valves

The gate valve is the most frequently used valve in piping systems. It is a general service valve that is used primarily for on-off, non-throttling applications. When fully opened, the gate valve creates minimal obstruction to the flow. Gate valves control the commodity flowing through the pipe with a gate, that slides up or down as the valve's handwheel is turned.

Designed to be either fully opened or closed, the gate valve should not be operated in a partially opened/closed position. A partially opened gate valve will hasten erosion. Turbulence from the commodity will also cause the wedge to vibrate, creating a "chattering" noise when the valve is partially opened.

Gate Valves

Figure 5.1 depicts the external and internal views of a typical gate valve.

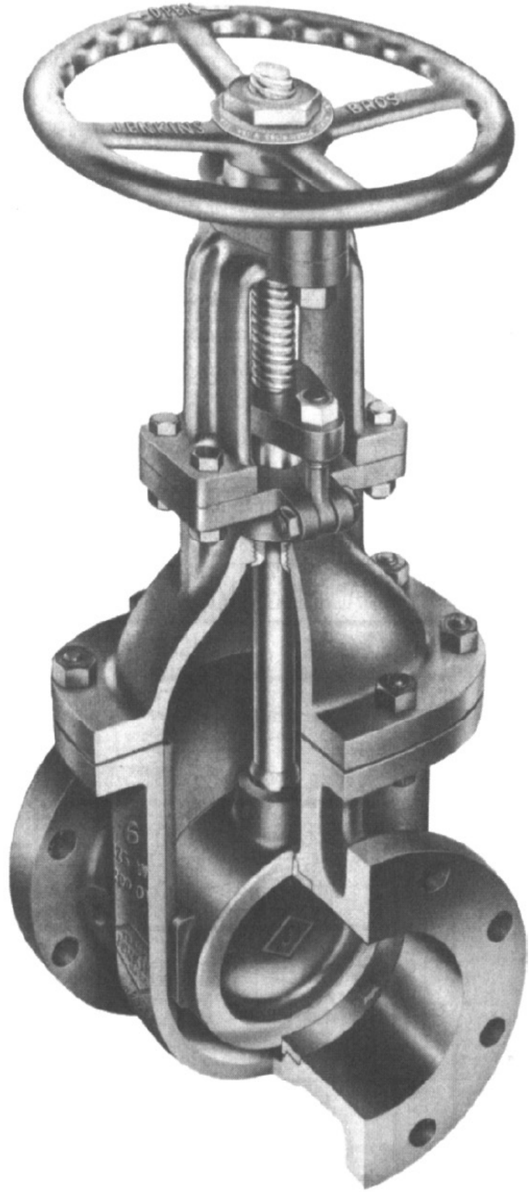
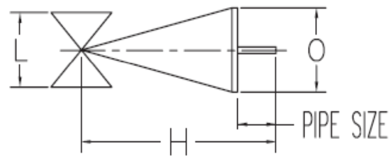
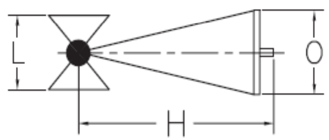
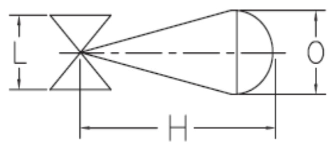
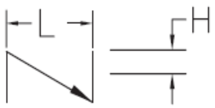


FIGURE 5.1 Gate valve. *Courtesy of Jenkins Bros.*

Gate Valves

As with pipe, fittings, and flanges, valves are represented by symbols on piping drawings. These symbols are developed in such a manner as to describe the valve’s body style, end type, and handwheel orientation. Symbol sizes are established from dimensions provided in manufacturers’ catalogs or data sheets. Three dimensions are crucial when drawing a valve symbol: face-to-face (length), handwheel height, and handwheel diameter (see Figure 5.2).

Gate Valves

VALVES												150#
NOMINAL PIPE SIZES -(INCHES)			2	3	4	6	8	10	12	14	16	18
PIPE (OUTSIDE DIAMETER)			2 3/8	3 1/2	4 1/2	6 5/8	8 5/8	10 3/4	12 3/4	14	16	18
VALVES	GATE	 L	7	8	9	10 1/2	11 1/2	13	14	15	16	17
		H	15 3/4	20 3/4	25 3/4	35 1/4	44	52 1/2	60 1/2	70 1/2	79 3/4	89
		O	8	9	10	14	16	18	18	22	24	27
	GLOBE	 L	8	9 1/2	11 1/2	16	19 1/2	*	*	*	*	*
		H	13 3/4	16 1/2	19 3/4	24 1/2	26	*	*	*	*	*
		O	8	9	10	12	16	*	*	*	*	*
	CONTROL	 L	10	11 3/4	13 7/8	17 3/4	21 3/8	26 1/2	*	*	*	*
		H	27 7/8	28 7/16	29 7/16	38	39 1/4	46 1/4	*	*	*	*
		O	13 1/8	13 1/8	13 1/8	16	16	21 1/8	*	*	*	*
	CHECK	 L	8	9 1/2	11 1/2	14	19 1/2	24 1/2	27 1/2	35	39	*
		H	5	6	7	9	10 1/4	12 1/8	13 3/4	18	20 1/2	*

NOTE: ALL DIMENSIONS ARE IN INCHES
* REFER TO VENDOR'S CATALOG

150# RF

FIGURE 5.2 Flanged valve dimensioning chart.

Chapter 5 Valves- Common Valve Types

The length of a valve is represented on most dimensioning charts as the face-to-face dimension. The face-to-face dimension is a length that defines the length of a valve from one end to the other. Also important are the height and diameter of a valve's handwheel. Of particular importance is the valve's open handwheel height. This dimension defines the maximum height of the valve when it is in the full-open position. The open handwheel height is measured from the centerline of the valve body to the tip of the valve stem.

Chapter 5 Valves- Common Valve Types

The valve stem is a threaded rod that connects the valve's wedge or gate to the handwheel. Valve stems fall into one of two categories: rising or nonrising.

A rising stem is one in which the stem rises and lowers as the handwheel is rotated. The handwheel remains in a stationary position as the stem passes through it. On valves having a nonrising stem, the handwheel is attached to the end of the stem and moves up and down with the stem as the valve is opened or closed.

The length of a rising stem must be determined before the handwheel is represented on a drawing. When the valve is fully opened, the stem is at its highest point. The maximum distance the stem will extend above the handwheel is approximately equal to the nominal size of the pipe. Knowing the length of the stem allows a piping designer to draw the valve symbol with the handwheel located at the proper distance from the end of the stem which ultimately aids in determining when interference problems may occur.

Chapter 5 Valves- Common Valve Types

Another important dimension is the diameter of the flanged faces on flanged valves. When representing flanged valves, the diameter of the valve’s flanges must be drawn to match the size and pound rating of the flange or nozzle to which the valve is being bolted. Because most valve dimensioning charts do not provide this information, a drafter must refer to the flange dimensioning chart to find the proper flange OD measurements.

Valve symbols vary from company to company and client to client. It is therefore imperative that a drafter be familiar with the symbols being used on a project before work begins on that new project. The symbols shown in this text are typical of those found on many piping drawings. They should not be considered standard for all applications, however. The symbols shown in Figure 5.3 represent screwed, socket-weld, and flanged gate valves. Notice also the two methods of representing handwheels.

Chapter 5 Valves- Common Valve Types

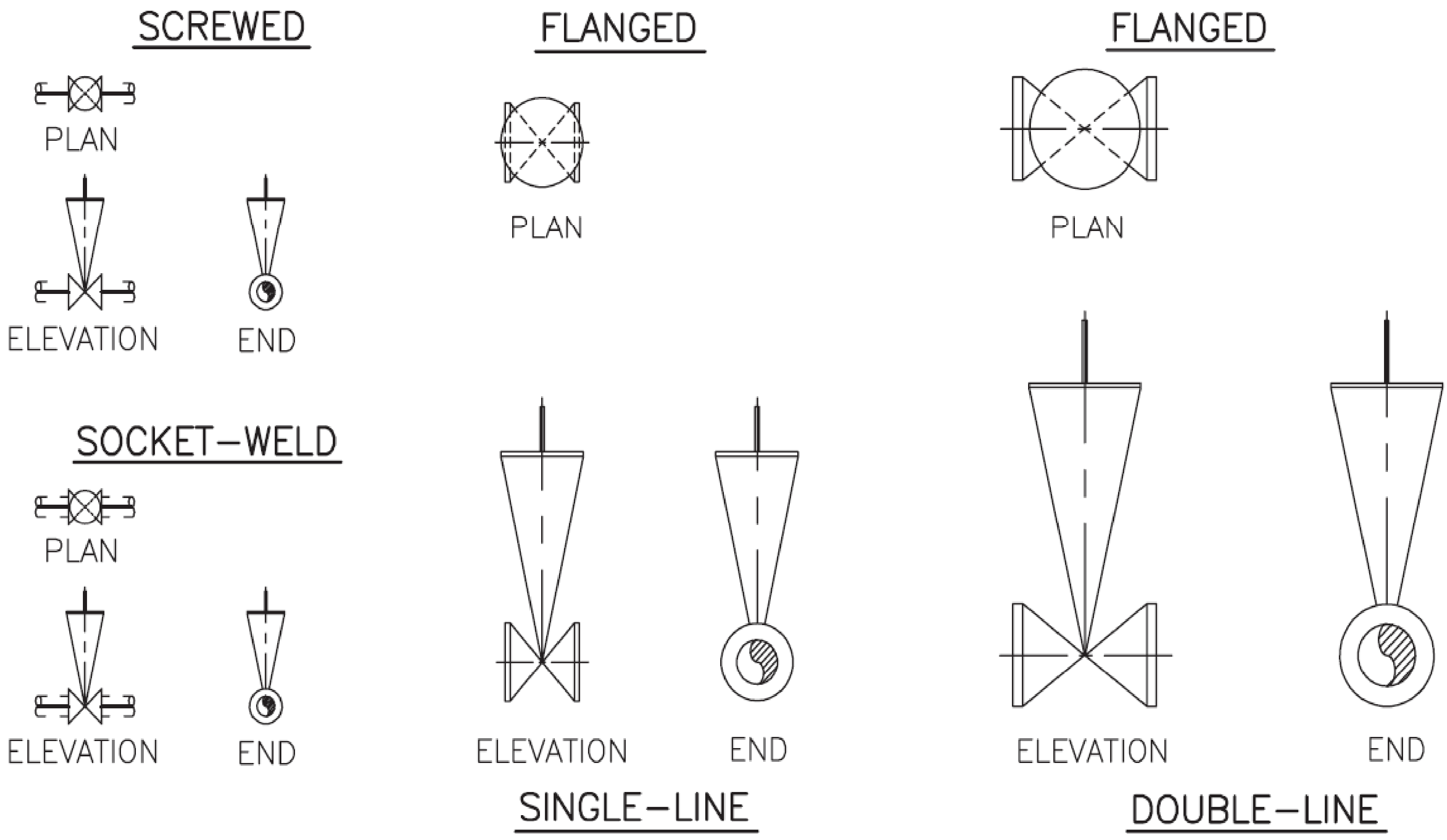


FIGURE 5.3 Gate valve drawing symbols.

Chapter 5 Valves- Common Valve Types

The valve rotations represented in Figure 5.4 depict the possible rotations in which valves may appear on drawings. Therefore, angular rotation of valves becomes imperative and the rotations shown in Figure 5.4 indicate how those valve rotations would appear on piping drawings.

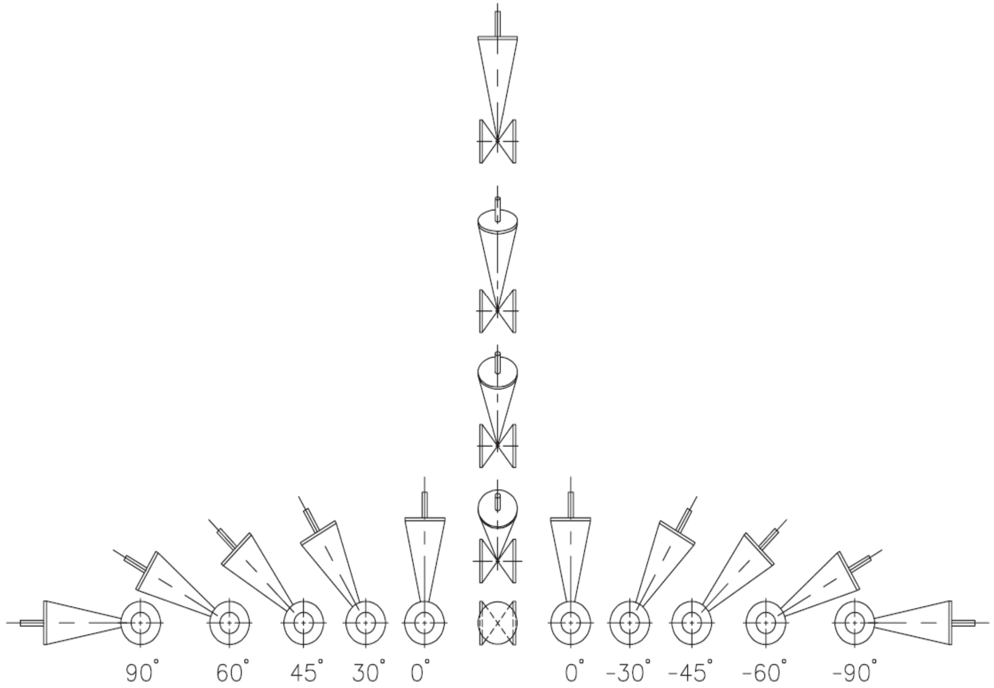


FIGURE 5.4 Gate valve rotation drawing symbols.

Drawing the Gate Valve

Figures 5.5 and 5.6 are pictorial representations of the step-by-step procedures used to draw a 10"-300# RFWN gate valve using manual and AutoCAD methods of construction. Symbols depicting other valve types are developed using similar step-by-step procedures but with minor changes or alterations that would reflect the representation of that particular valve.

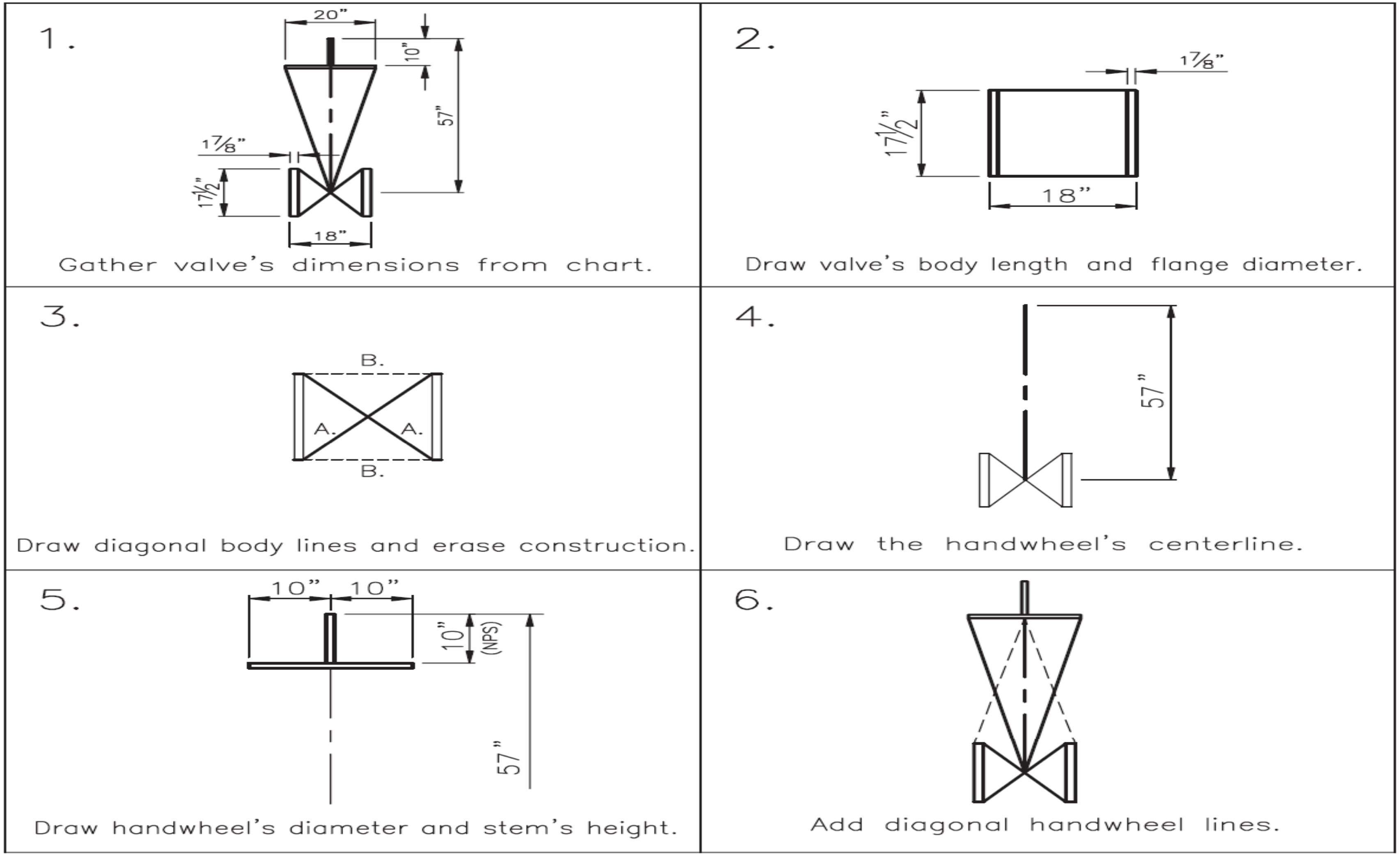


FIGURE 5.5 Gate valve. Manual step-by-step drawing procedures.

Step 1. Use the appropriate vendor's catalog to determine the overall dimensions of a 10″-300# RFWN gate valve. Find the valve's length, ***L*** (face-to-face) (18″); handwheel height, ***H*** (57″); handwheel diameter (handwheel ***O***) (20″); and flange diameter (flange ***O***) (17½″); and flange face thickness (flange T) (1⅞″).

Step 2. Lightly draw a rectangle having the width of the face-to-face (18″) dimension and the height of the flange diameter (17½″). Draw two lines parallel to the vertical ends 1⅞″ away from and toward the center of the rectangle.

Step 3.

A. Draw intersecting, diagonal lines (A) from the ends of the inner vertical lines to create the valve body.

B. Erase the horizontal construction lines (B) between the inner vertical lines that form the valve's flange faces.

Step 4. From the intersection of the diagonal lines (center of valve body), draw a vertical centerline the length of the handwheel's *"open"* height (57″).

Step 5. Measure 10″ (distance equal to NPS) down from the top of the centerline. Draw a construction line perpendicular to the centerline. Measure one-half (10″) of the handwheel's diameter (20″) on either side of the handwheel centerline. Draw a line below and parallel to the handwheel to represent the thickness of the handwheel. Draw lines parallel to the top of the valve centerline, above the handwheel to represent the valve stem. Though not the actual measurement, 1″ can be used for both the handwheel and valve stem thickness.

Step 6. To complete the handwheel representation, draw a line from each end of the handwheel down to the center of the valve body. Lines drawn in the opposite direction can also be used as an alternative.

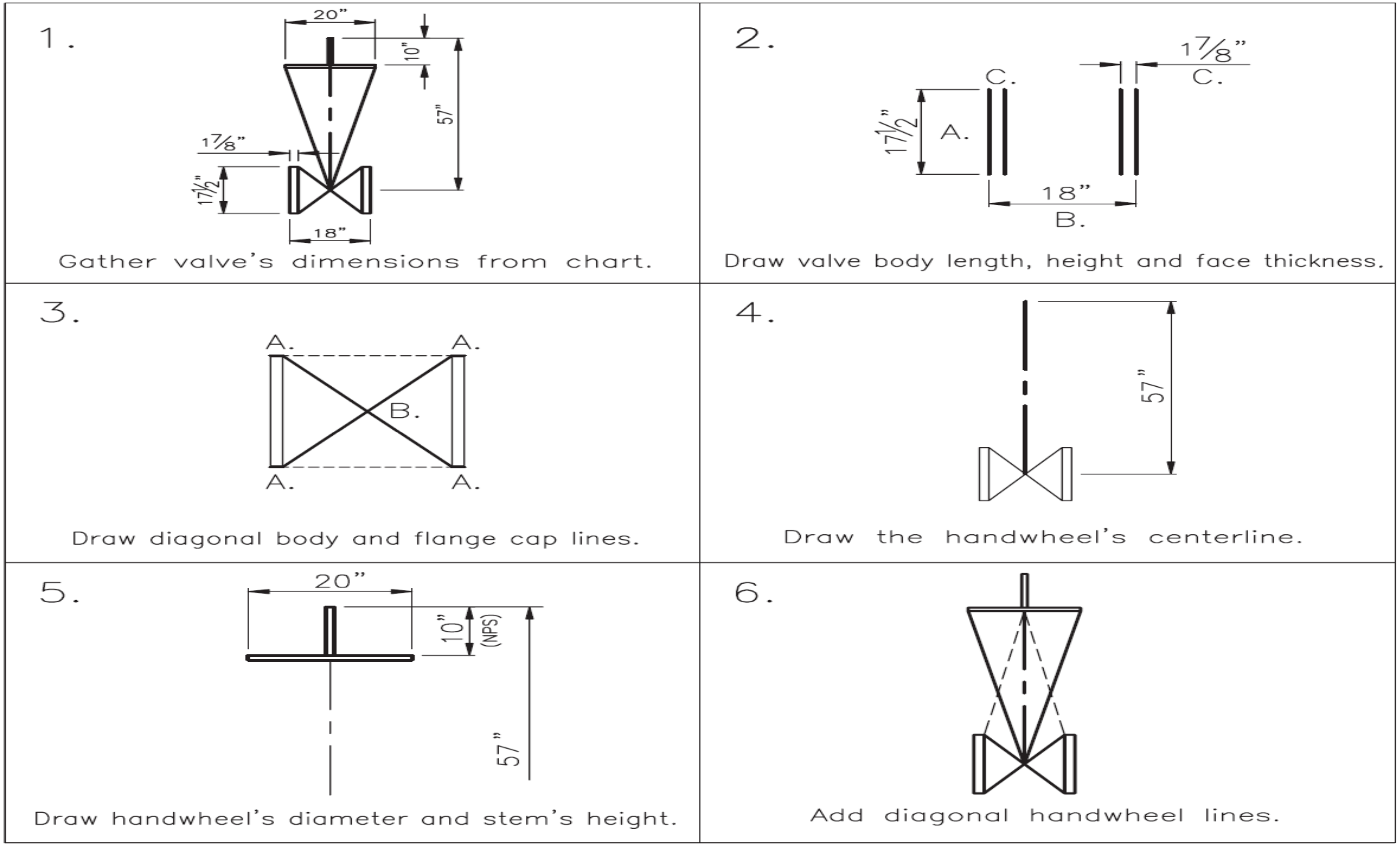


FIGURE 5.6 Gate valve. AutoCAD step-by-step drawing procedures.

Step 1. Use the appropriate vendor's catalog to determine the overall dimensions of a 10″-300# RFWN gate valve. Find the valve's length, ***L*** (face-to-face) (18″); handwheel height, ***H*** (57″); handwheel diameter (handwheel ***O***) (20″); flange diameter (flange ***O***) (17½″); and flange thickness (flange ***T***) (1⅞″).

Step 2.

A. Draw a vertical line 17½″ long to represent the flange diameter of the valve's face.
B. OFFSET the vertical line 18″ (face-to-face dimension) to the right to establish to valve's length.
C. From each end of the valve OFFSET, toward the center, the valve's flange face thickness (1⅞″).

Step 3.

A. Draw horizontal lines (A) to "cap" the ends of the valve's flange face.
B. Draw intersecting, diagonal lines (B) from the ends of the vertical lines to create the valve body.

Step 4. Draw a vertical centerline from the center of the valve's body 57″ long to represent the handwheel's "open" dimension.

Step 5. Draw a 20″ (handwheel's diameter) horizontal line, equally centered on the valve's centerline, 10″ (distance equal to NPS) from the top end of the valve's centerline. Give the valve's handwheel and stem a 0.3 mm lineweight.

Step 6. To complete the handwheel representation, draw a line from each end of the handwheel down to the center of the valve body. Lines drawn in the opposite direction can also be used as an alternative.

Globe Valves

Globe valves are used primarily in situations where throttling of the commodity is required. By simply rotating the handwheel, the rate at which the commodity flows through the valve can be adjusted to any desired level. Having the valve seat parallel to the line of flow is an important feature of the globe valve. This feature makes the globe valve efficient when throttling commodities as well as yielding minimal disk and seat erosion. This configuration, however, creates a large amount of resistance within the valve. The design of the globe valve body forces the flow of the commodity to change direction which creates substantial pressure drop and turbulence. The globe valve is therefore not recommended when flow resistance and pressure drop are to be avoided.

Globe Valves

Figure 5.7 depicts the internal view of a globe valve.

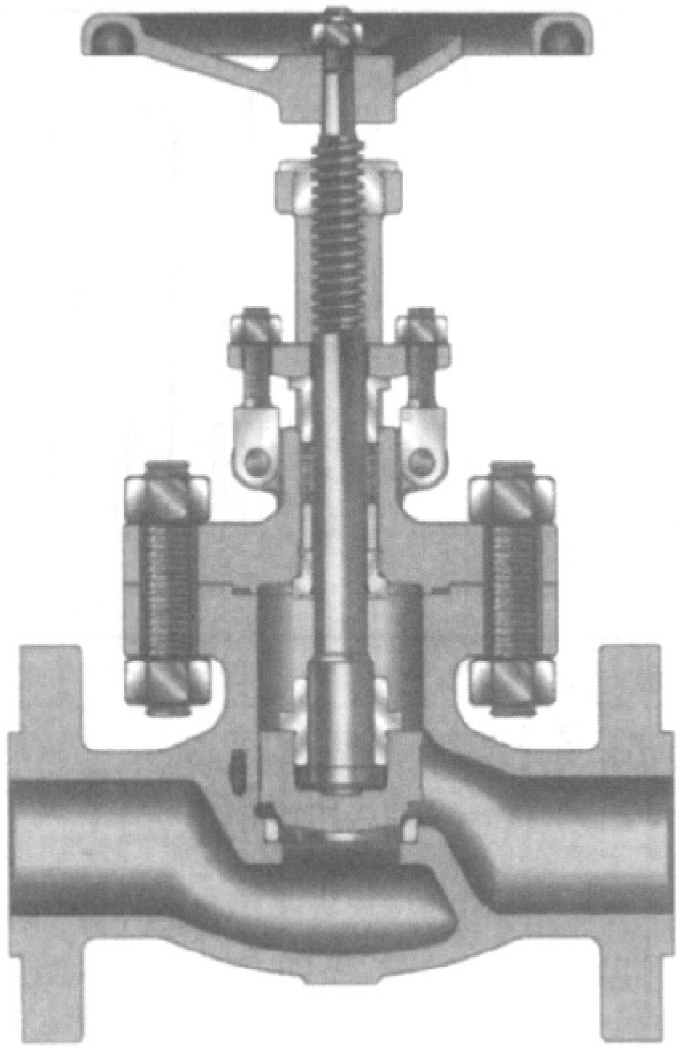


FIGURE 5.7 Globe valve. *Courtesy of VELAN.*

Globe Valves

Drawing symbols of the globe valve are similar to those of the gate valve. Measurements used to draw the valve are found on manufacturers' dimensioning charts. One noticeable difference is the use of a darkened circle positioned at the intersection of the diagonal lines in the valve's body. One other difference is the use of a nonrising stem on globe valves. Drawing symbols for globe valves are shown in Figure 5.8.

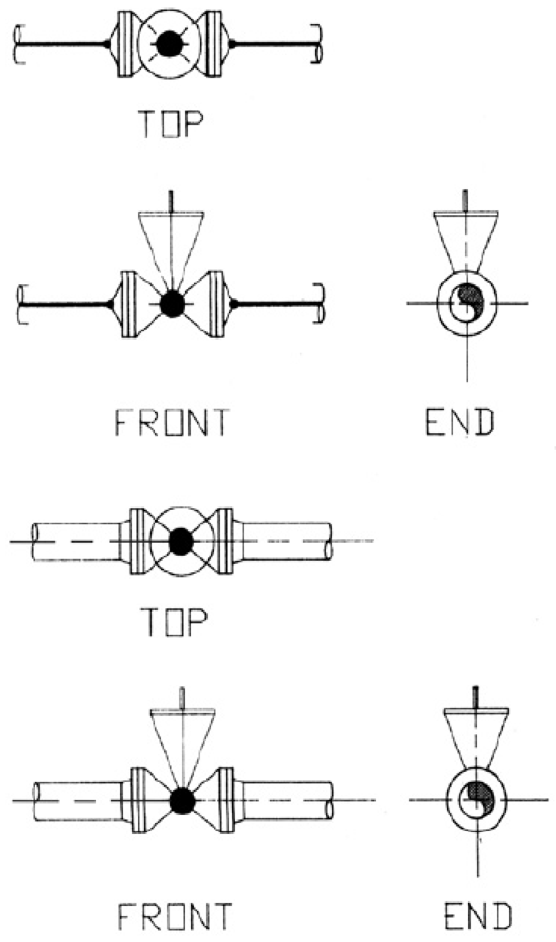


FIGURE 5.8 Globe valve drawing symbols.