



Introduction to Valves

Course Number: CH-02-210

PDH: 4

Approved for: AK, AL, AR, DE, FL, GA, IA, ID, IL, IN, KS, KY, LA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, SC, SD, TN, TX, UT, VA, VT, WI, WV, and WY

State Board Approvals

Florida Provider # 0009553 License #868

Indiana Continuing Education Provider #CE21800088

Maryland Approved Provider of Continuing Professional Competency

New Jersey Professional Competency Approval #24GP00025600

North Carolina Approved Sponsor #S-0695

NYSED Sponsor #274

How Our Written Courses Work

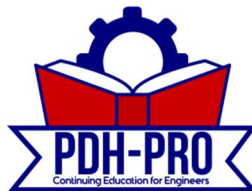
This document is the course text. You may review this material at your leisure before or after you purchase the course.

After the course has been purchased, review the technical material and then complete the quiz at your convenience.

A Certificate of Completion is available once you pass the exam (70% or greater).

If a passing grade is not obtained, you may take the quiz as many times as necessary until a passing grade is obtained).

If you have any questions or technical difficulties, please call (508) 298-4787 or email us at admin@PDH Pro.com.





Valve Functions and Basic Parts

Learning Objectives

By the end of this section, you will be able to:

1. **Identify** the primary functions performed by valves in fluid systems.
2. **Describe** the basic parts common to most valves, including the body, bonnet, trim, actuator, packing, disk, seat, and stem.
3. **Distinguish** between valve parts that commonly form pressure boundaries and parts that normally do not.
4. **Explain** the four basic flow-control methods used in valve design.

Technical Content

Valves are among the most common individual components in process, utility, and industrial fluid systems. They appear in many types, shapes, materials, pressure classes, and sizes, but most valves share a common group of parts and perform a common set of system functions. This section introduces the basic functions of valves, the principal parts common to most valve assemblies, and the four basic ways that valve designs control flow.

Executive Summary: A valve is a pressure-containing mechanical device that controls fluid flow, pressure, or flow direction. Regardless of valve type, engineers should understand which parts form the pressure boundary, how the disk and seat establish shutoff or throttling performance, and how the actuator, stem, and packing affect operation and leakage control.

Valve Functions

A valve controls the flow of fluid and pressure within a system or process. Depending on the service, the same valve may perform one function, or it may contribute to several system functions. The common valve functions are:

1. **Stopping and starting fluid flow**
2. **Varying, or throttling, the amount of fluid flow**
3. **Controlling the direction of fluid flow**
4. **Regulating downstream system or process pressure**
5. **Relieving component or piping overpressure**

These functions explain why a single piping system often contains several valve types. An isolation valve, throttling valve, check valve, pressure-reducing valve, and relief valve are not interchangeable simply

because each is a valve. Each design uses specific internal geometry and motion to perform its intended function safely and reliably.

Basic Parts Common to Most Valves

Regardless of type, most valves include the following basic parts: **body**, **bonnet**, **trim**, **actuator**, and **packing**. The trim includes internal elements such as the **disk**, **seat**, **stem**, and guide sleeves. These parts contribute to pressure containment, shutoff, throttling, positioning, and leakage control.

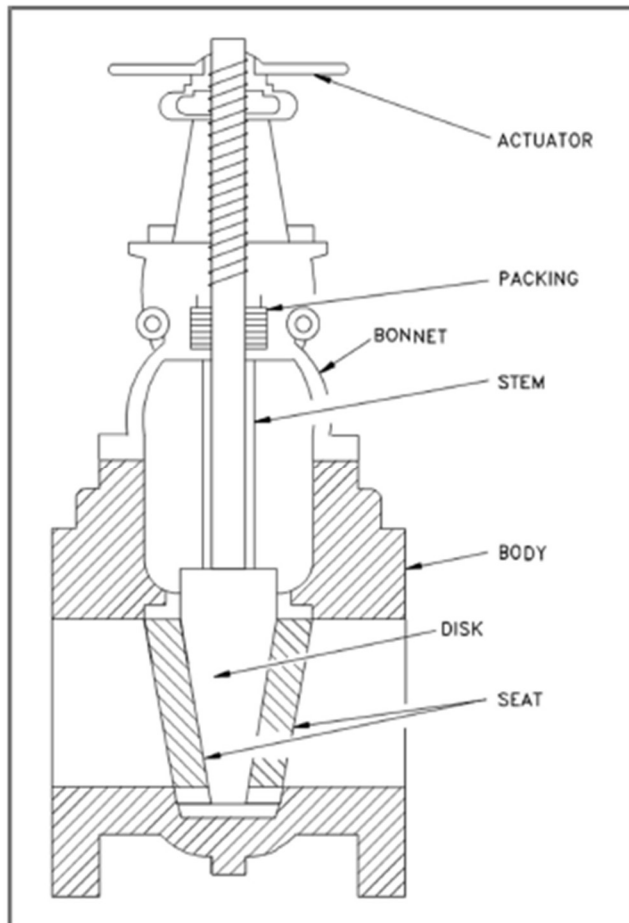


Figure 1 Basic Parts of a Valve

Valve Body

The **valve body**, sometimes called the shell, is the primary pressure boundary of the valve. It is the principal structural element of the valve assembly because it provides the framework that holds the internal parts and end connections together.

The body is the first pressure boundary exposed to fluid pressure loads transmitted from connecting piping. It receives inlet and outlet piping through threaded, bolted, or welded joints. Because these

joints connect the valve to the piping system, their integrity is part of the overall pressure-containing function of the installation.

Valve bodies are cast or forged into many shapes. In theory, a sphere or cylinder would be an efficient shape for resisting internal pressure when the valve is open. In practice, a valve body must do more than contain pressure. Many valves require an internal partition across the body to support the seat opening, which forms the throttling or shutoff orifice. When the valve is closed, the pressure loading on the body can be difficult to idealize because flow is stopped or redirected and differential pressure may be present.

Manufacturing, assembly, maintenance, and cost also affect valve body geometry. For these reasons, valve bodies range from simple block-like configurations to complex pressure-retaining shapes. In some valves, the bonnet forms part of the pressure-resisting assembly and is removable to allow assembly and maintenance of internal parts.

A common method for reducing valve size and cost is to narrow the fluid passage through a venturi-type body. In other applications, large end connections are added so the valve can connect to a larger line even when the internal flow passage is smaller.

Design Tip:

Do not evaluate a valve body only by nominal pipe size. Internal flow area, body pattern, end connection type, and pressure class can materially affect pressure drop, maintenance access, and suitability for the intended service.

Valve Bonnet

The **bonnet** covers the opening in the valve body. In some designs, the body itself is split into two bolted sections. Some bonnets function primarily as covers, while others also support valve internals and accessories such as the stem, disk, and actuator.

The bonnet is the second principal pressure boundary of many valves. It is typically cast or forged from the same material as the body and is connected to the body by a threaded, bolted, or welded joint. In all cases, the bonnet-to-body attachment is part of the pressure boundary. The bolts, threads, or welds that connect the bonnet to the body are pressure-retaining elements.

Although a bonnet is necessary for most valves, it also introduces design and maintenance concerns. The bonnet can complicate valve manufacture, increase valve size, represent a significant portion of valve cost, and create a potential leakage location at the bonnet-to-body joint.

Safety Constraint:

Because the bonnet connection is part of the pressure boundary, leakage, improper bolting, damaged threads, or defective welds at this location can compromise pressure containment.



Valve Trim

The **trim** consists of the internal elements of the valve. It typically includes the disk, seat, stem, and sleeves or guides needed to position and guide the stem. Valve performance is controlled largely by the interface between the disk and seat, and by how disk position changes the flow opening.

Trim geometry creates the basic valve motion and flow-control behavior. In rotational-motion trim designs, the disk slides or rotates closely past the seat to change the flow opening. In linear-motion trim designs, the disk lifts perpendicularly away from the seat, creating an annular orifice between the disk and the seating surface.

Disk and Seat

For a valve with a bonnet, the **disk** is the third principal pressure boundary. The disk permits or prohibits fluid flow. When the disk is closed and the outlet side is depressurized, full system pressure can be applied across the disk. For that reason, the disk is considered a pressure-retaining part.

Disks are typically forged, and some are hard-surfaced to improve wear resistance. A fine surface finish at the disk seating area is necessary to obtain good sealing when the valve is closed. Many valves are named, at least in part, according to the shape or design of their disks.

The **seat** or **seal rings** provide the mating surface for the disk. In some designs, the valve body is machined directly to form the seating surface, and separate seal rings are not used. In other designs, forged seal rings are threaded or welded into the body. To improve wear resistance, seal ring surfaces are often hard-faced by welding and then machined to provide a smooth contact surface.

A fine surface finish on the seating area is necessary for good shutoff. Seal rings are not usually considered pressure boundary parts because the valve body has sufficient wall thickness to withstand design pressure without relying on the seal ring thickness.

Stem

The **stem** connects the actuator to the disk and positions the disk. Stems are typically forged and connected to the disk by threaded or welded joints. For valves that use stem packing or another stem seal, the stem surface in the sealing area must have a fine finish to control leakage and prevent damage to the seal. The stem is typically not considered a pressure boundary part.

The disk-to-stem connection may allow some rocking or rotation so the disk can seat properly. In some designs, the stem itself may have enough flexibility to allow the disk to position itself against the seat. However, constant fluttering or rotation of a flexible or loosely connected disk can damage the disk or the disk-to-stem connection.

Two common stem arrangements are **rising stems** and **nonrising stems**. In a rising-stem valve, the stem rises above the actuator as the valve opens. This movement occurs because the stem is threaded and engages the bushing threads of a yoke that is integral with, or mounted to, the bonnet. In a nonrising-stem design, no upward stem movement is visible from outside the valve. The disk is threaded internally and engages the stem threads, so the disk moves as the stem rotates.

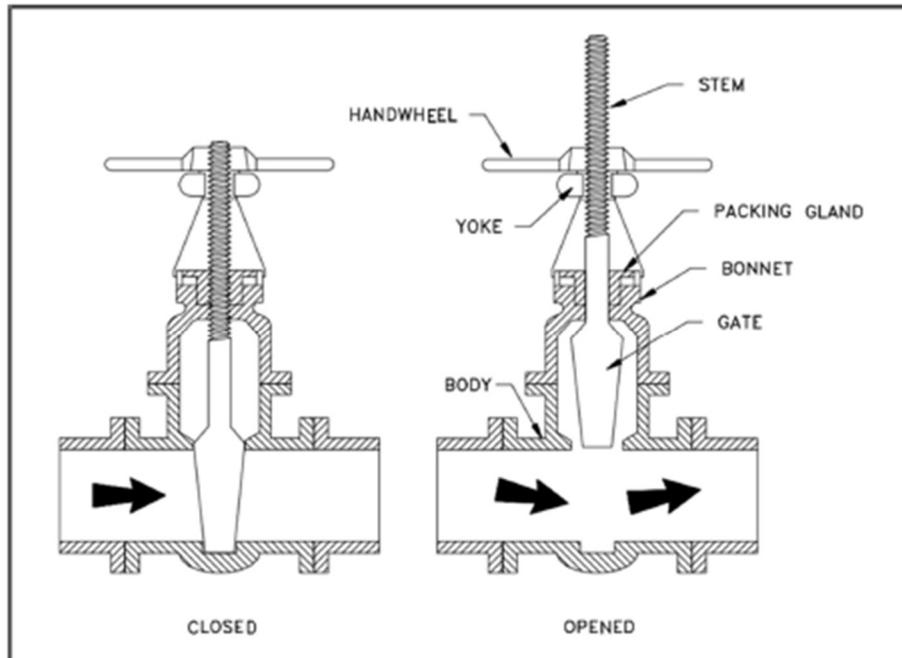


Figure 2 Rising Stems

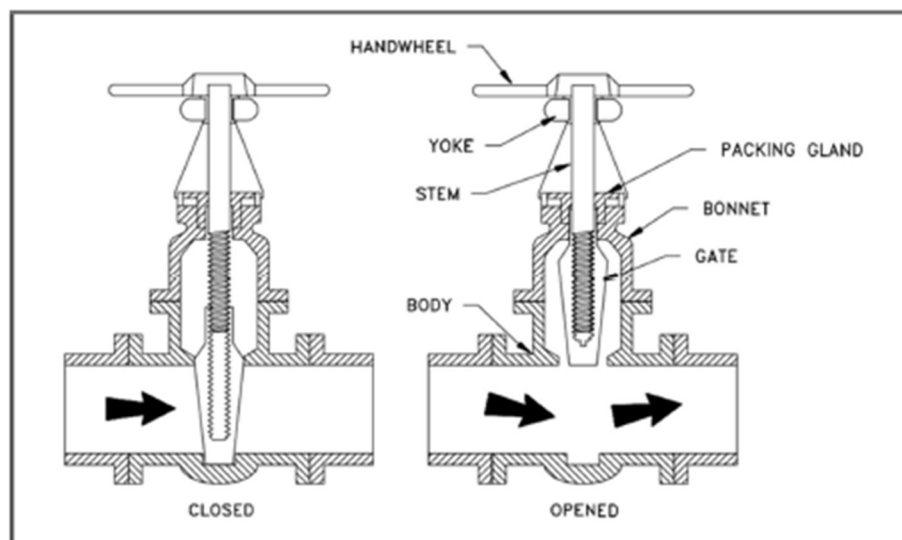


Figure 3 Nonrising Stems



Purchase this course to
see the remainder of
the technical materials.