A Guide to Types of Valves

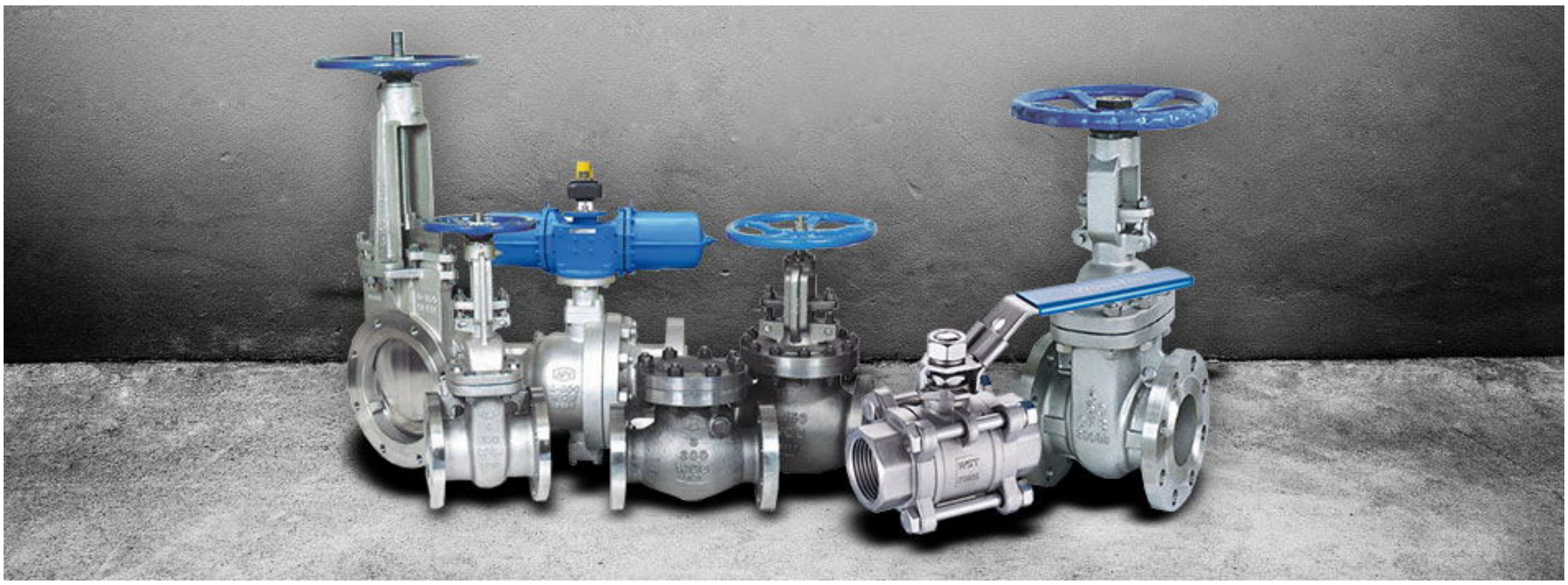
Introduction

A Valve is a device that regulates the flow of gases, liquids or loose materials through an aperture, such as a pipe, by opening, closing or obstructing a port or passageway. A valve controls system or process fluid flow and pressure by performing any of the following functions:

- Stopping and starting fluid flow
- Varying (throttling) the amount of fluid flow
- Controlling the direction of fluid flow
- Regulating downstream system or process pressure
- Relieving component or piping over pressure

There are many valve designs and types that satisfy one or more of the functions identified above. A multitude of valve types and designs safely accommodate a wide variety of industrial applications.

Introduction to the Types of Valves



Because of the diversity of the types of systems, fluids, and environments in which valves must operate, a vast array of valve types have been developed. Examples of the common types are the ball valve, butterfly valve, globe valve, gate valve, plug valve, diaphragm valve, reducing valve, needle vave, check valve and safety/relief valve. Each type of valve has been designed to meet specific needs. Some valves are capable of throttling flow, other valve types can only stop flow, others work well in corrosive systems, and others handle high pressure fluids. Each valve type has certain inherent advantages and disadvantages. Understanding these differences and how they affect the valve's application or operation is necessary for the successful operation of a facility.

Although all valves have the same basic components and function to control flow in some fashion, the method of controlling the flow can vary dramatically. In general, there are four methods of controlling flow through a valve.

1. Move a disc, or plug into or against an orifice (for example, globe or needle or some types of check valves).

2. Slide a flat, cylindrical, or spherical surface across an orifice (for example, gate and plug valves).

3. Rotate a disc or ellipse about a shaft extending across the diameter of an orifice(for example, a butterfly or ball or some types of check valves).

4. Move a flexible material into the flow passage (for example, diaphragm valves).

Each method of controlling flow has characteristics that makes it the best choice for a given application of function.

Types of valves

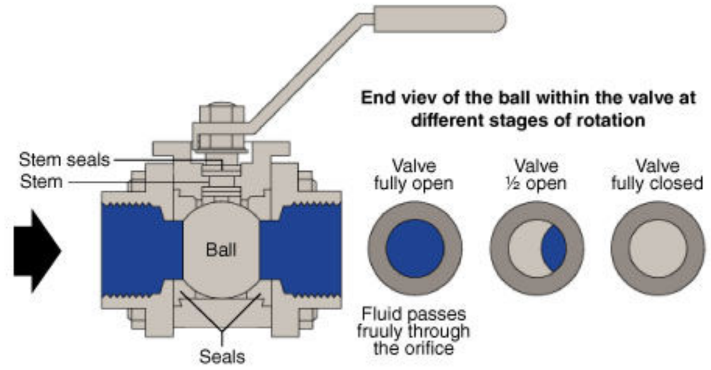
Due to the various environments, system fluids, and system conditions in which flow must be controlled, a large number of valve designs have been developed. A basic understanding of the differences between the various types of valves, and how these differences affect valve function, will help ensure the proper application of each valve type during design and the proper use of each valve type during operation.

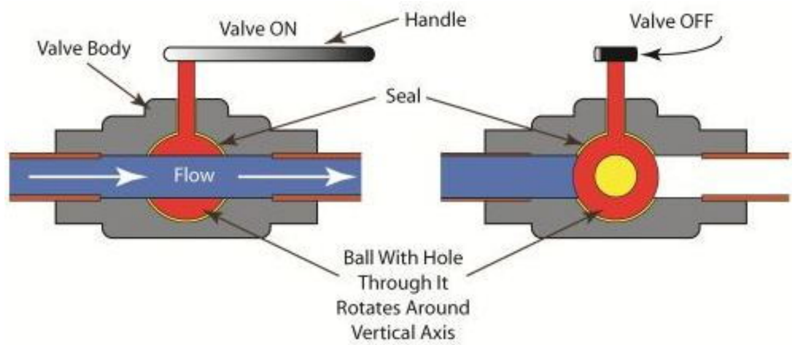
Ball Valves

Ball valves offer very good shut-off capabilities. A simple quarter-turn (90°) completely opens or closes the valve. This characteristic minimizes valve operation time and decreases the likelihood of leakage due to wear from the gland seal.

Ball valves can be divided into two categories: reduced bore and full bore. In reduced bore valves, the valve opening is smaller than the diameter of the piping; in full bore valves, the valve opening is the same size as the diameter of the piping. Full bore ball valves are often valued because they minimize the pressure drop across the valve.

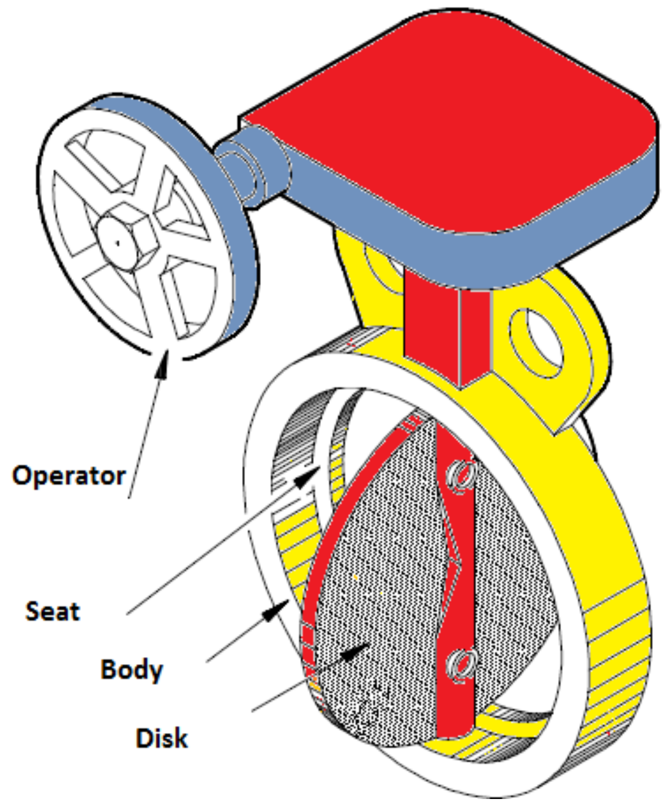
Ball valves are usually only recommended for use in the fully open or fully closed position. They are not suited to regulate flow by being kept partially open because ball valves make use of a ring-shaped soft valve seat.When used in the partially open position, pressure is applied to only a portion of the valve seat, which can cause it to deform. If the valve seat deforms, its sealing properties are impaired and it will leak as a result.





Advantages. A ball valve is generally the least expensive of any valve configuration and has low maintenance costs. In addition to quick, quarter turn on-off operation, ball valves are compact, require no lubrication, and give tight sealing with low torque.

Disadvantages. Conventional ball valves have relatively poor throttling characteristics. In a throttling position, the partially exposed seat rapidly erodes because of the impingement of high velocity flow.



Butterfly Valves

In butterfly valves, the flow is regulated through a disc-type element held in place in the center of the valve by a rod. Similar to ball valves, valve operation time is short because the valving element is simply rotated a quarter turn (90°) to open or close the passageway.

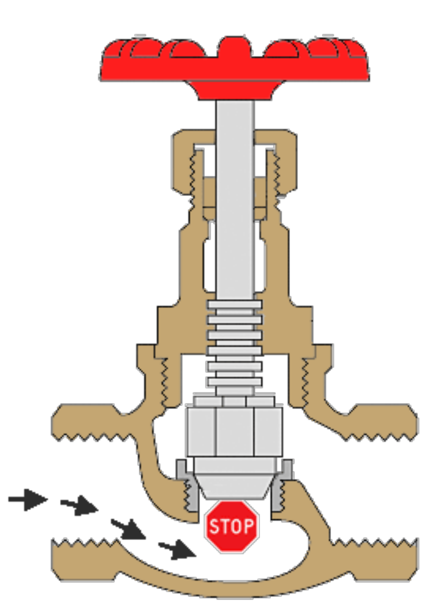
Butterfly valves are characterized by their simple construction, lightness in weight, and compact design. Their face-to-face dimension is often extremely small, making the pressure drop across a butterfly valve much smaller than globe valves (see below). Materials used for the valving element and sealing can limit their applications at higher temperatures or with certain types of fluids. Butterfly valves are often used on applications for water and air, and in applications with large pipe diameters.

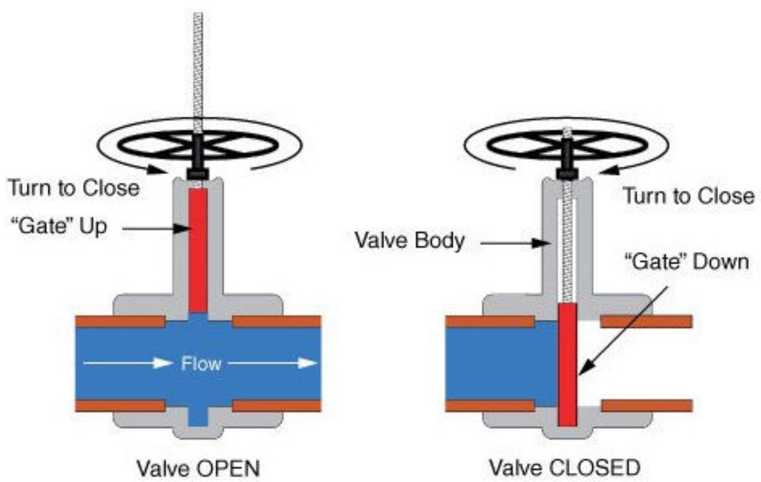
Globe Valves

The globe valve is suitable for use on a wide variety of applications, from flow rate control to open/close operation.

In this type of valve, flow rate control is determined not by the size of the opening in the valve seat, but rather by the lift of the valve plug (the distance the valve plug is from the valve seat). One feature of globe valves is that even if used in the partially open position, there is less risk of damage to the valve seat or valve plug by the fluid than with other types of manual valves. Among the various configurations available, needle type globe valves are particularly well suited for flow rate control.

Other points to consider about globe valves is that the pressure drop across the valve is greater than that of many other types of valves because the passageway is S-shaped. Valve operation time is also longer because the valve stem must be turned several times in order to open and close the valve, and this may eventually cause leakage of the gland seal (packing). Furthermore, care must be taken not to turn the valve shaft too far because there is a possibility it could damage the seating surface.





Gate Valves

The gate valve is the type of valve most often used in industrial piping. The significant feature of the gate valve is less obstruction to flow, with less turbulence within the valve and very little pressure drop. When the valve is wide open, the wedge is lined entirely out of the waterway. providing a straightway flow area through the valve. The gate valve should be specified when pressure drop is to be avoided. Also, gate valves should never be used for throttling purposes; only in the fully open or closed positions. If kept in an intermediate or partially open position, the bottom of the wedge and the seat will become badly eroded in a short time. Also, the wedge will tend to chatter and cause noise in the line.

A gate valve can be used for a wide variety of fluids and provides a tight seal when closed. The major disadvantages to the use of a gate valve are:

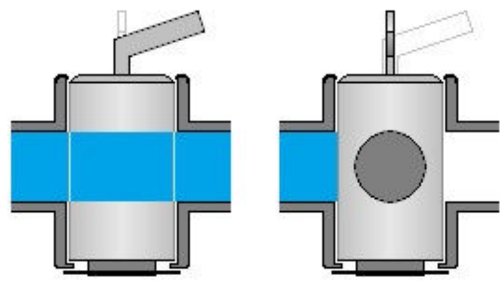
- It is not suitable for throttling applications.
- It is prone to vibration in the partially open state.
- It is more subject to seat and disk wear than a globe valve.
- Repairs, such as lapping and grinding, are generally more difficult to

accomplish.

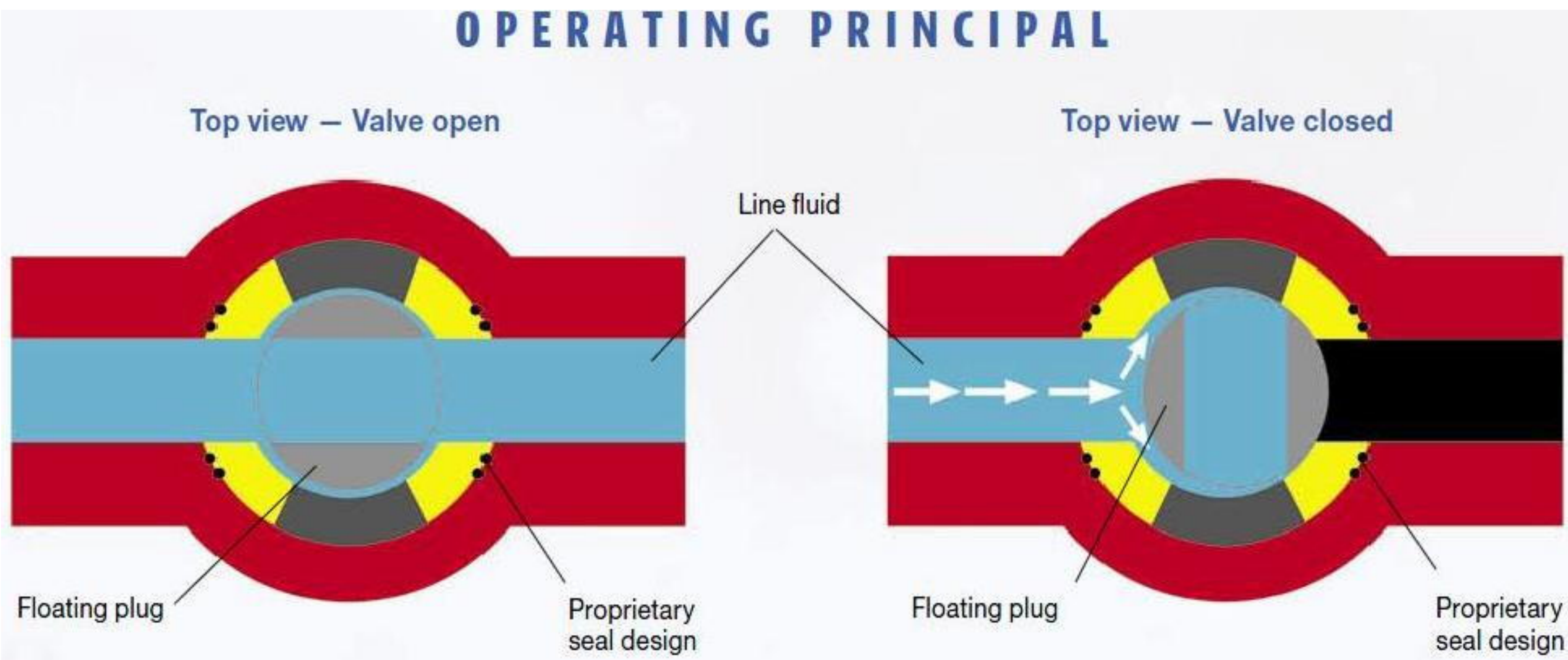
Plug Valves

A plug valve is a rotational motion valve used to stop or start fluid flow. The name is derived from the shape of the disk, which resembles a plug. The simplest form of a plug valve is the petcock. The body of a plug valve is machined to receive the tapered or cylindrical plug. The disk is a solid plug with a bored passage at a right angle to the longitudinal axis of the plug.

In the open position, the passage in the plug lines up with the inlet and outlet ports of the valve body. When the plug is turned 90° from the open position, the solid part of the plug blocks the ports and stops fluid flow.



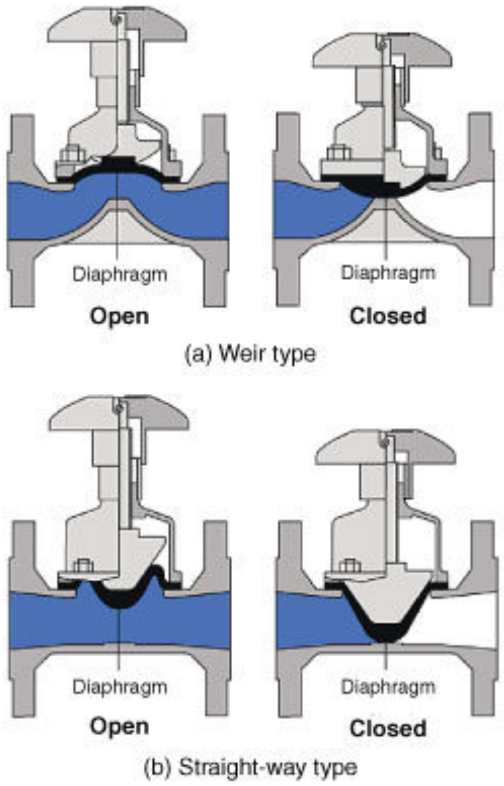
Cylindrical plug valve



Plug valves are available in either a lubricated or non-lubricated design and with a variety of styles of port openings through the plug as well as a number of plug designs.

Diaphragm Valves

Diaphragm valves use a 'pinching' method to stop



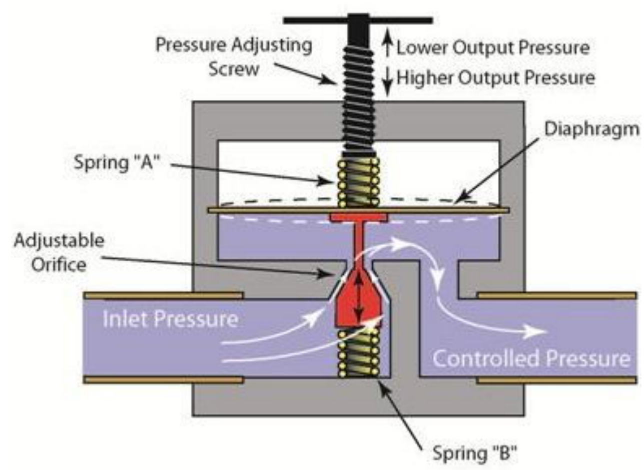
the valve flow using a flexible diaphragm. They are available in two types: weir and straight-way. The most commonly seen of the two is the weir-type. This is because the straight-way type requires additional stretching of the diaphragm, which can shorten the diaphragm's life-span.

One of the major advantages of using diaphragm valves is that the valve components can be isolated from the process fluid. Similarly, this construction helps prevent leakage of the fluid without the use of a gland seal (packing) as seen in other types of valves. One the other hand, the diaphragm becomes worn more easily and regular maintenance is necessary if the valve is used on a regular basis. These types of valves are generally not suited for very high temperature fluids and are mainly used on liquid systems.

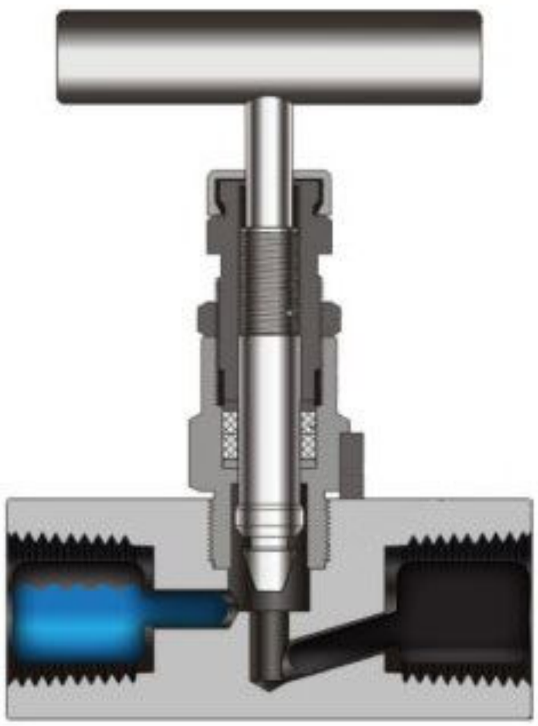
NOTE: There exists a valve for steam systems that goes by a similar name. It is an automated valve with a diaphragm type actuator. This is often shortened to just 'diaphragm valve', so when a valve is referred to by this name, care must be taken to verify which type of valve it is.

Reducing Valves

Reducing valves automatically reduce supply pressure to a preselected pressure as long as the supply pressure is at least as high as the selected pressure. The Principle parts of the reducing valve are the main valve; an upward-seating valve that has a piston on top of its valve stem, an upward-seating auxiliary (or controlling) valve, a controlling diaphragm, and an adjusting spring and screw.



Reducing valve operation is controlled by high pressure at the valve inlet and the adjusting screw on top of the valve assembly. The pressure entering the main valve assists the main valve spring in keeping the reducing valve closed by pushing upward on the main valve disk. However, some of the high pressure is bled to an auxiliary valve on top of the main valve. The auxiliary valve controls the admission of high pressure to the piston on top of the main valve. The piston has a larger surface area than the main valve disk, resulting in a net downward force to open the main valve. The auxiliary valve is controlled by a controlling diaphragm located directly over the auxiliary valve.



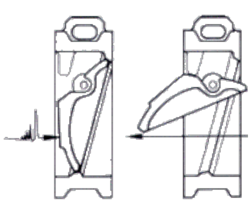
Needle Valves

A needle valve is used to make relatively fine adjustments in the amount of fluid flow. The distinguishing characteristic of a needle valve is the long, tapered, needle-like point on the end of the valve stem. This "needle" acts as a disk. The longer part of the needle is smaller than the orifice in the valve seat and passes through the orifice before the needle seats. This arrangement permits a very gradual increase or decrease in the size of the opening. Needle valves are often used as component parts of other, more complicated valves. For example, they are used in some types of reducing valves.

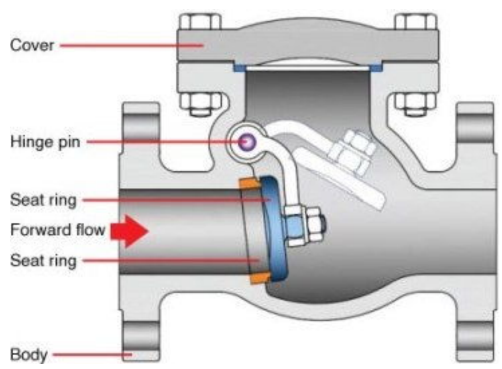
Needle Valve Applications: Most constant pressure pump governors have needle valves to minimize the effects of fluctuations in pump discharge pressure. Needle valves are also used in some components of automatic combustion control systems where very precise flow regulation is necessary.

Check Valves

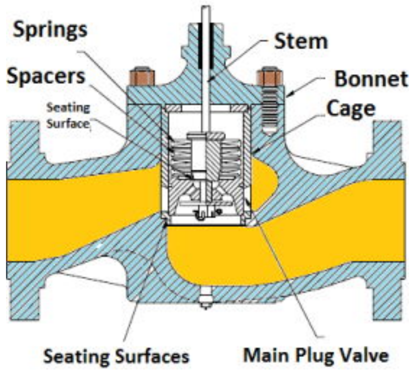
Check valves are designed to prevent the reversal of flow in a piping system. These valves are activated by the flowing material in the pipeline. The pressure of the fluid passing through the system opens the valve, while any reversal of flow will close the valve. Closure is accomplished by the weight of the check mechanism, by back pressure, by a spring, or by a combination of these means.



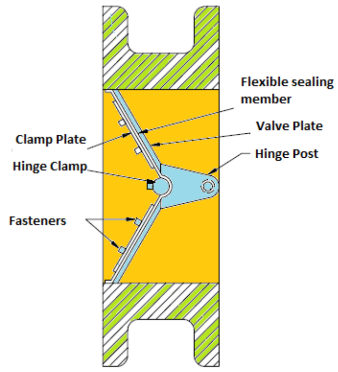
The general types of check valves are swing, tilting-disk, piston, butterfly, and stop.



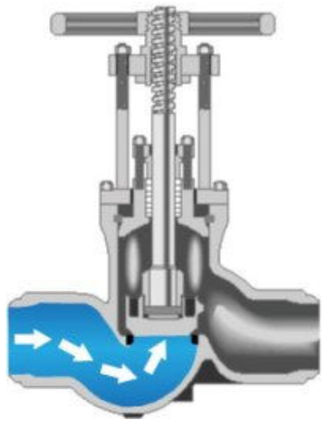
Swing check valve



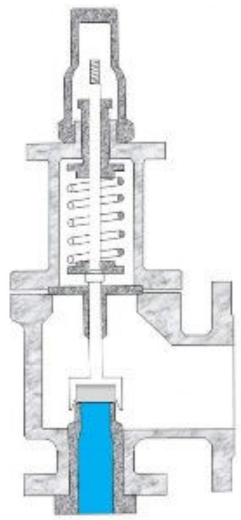
Piston check valve



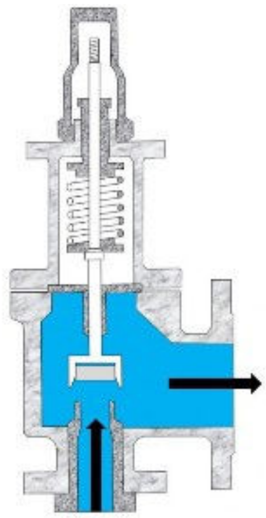
Butterfly check valve



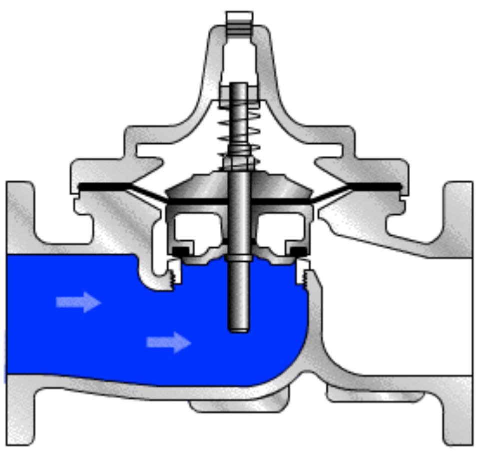
Stop check valve



Relief Valve Closed



Relief Valve Relieving



Relief and Safety Valves

Relief and safety valves prevent equipment damage by relieving accidental over-pressurization of fluid systems. The main difference between a relief valve and a safety valve is the extent of opening at the setpoint pressure.

A relief valve gradually opens as the inlet pressure increases above the setpoint. A relief valve opens only as necessary to relieve the over-pressure condition. A safety valve rapidly pops fully open as soon as the pressure setting is reached. A safety valve will stay fully open until the pressure drops below a reset pressure. The reset pressure is lower than the actuating pressure setpoint. The difference between the actuating pressure setpoint and the pressure at which the safety valve resets is called blowdown. Blowdown is expressed as a percentage of the actuating pressure setpoint.

Relief valves are typically used for incompressible fluids such as water or oil. Safety valves are typically used for compressible fluids such as steam or other gases. Safety valves can often be

		distinguished by the presence of an external lever at the top of the valve body, which is used as an operational check.