Valves

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OBJECTIVE

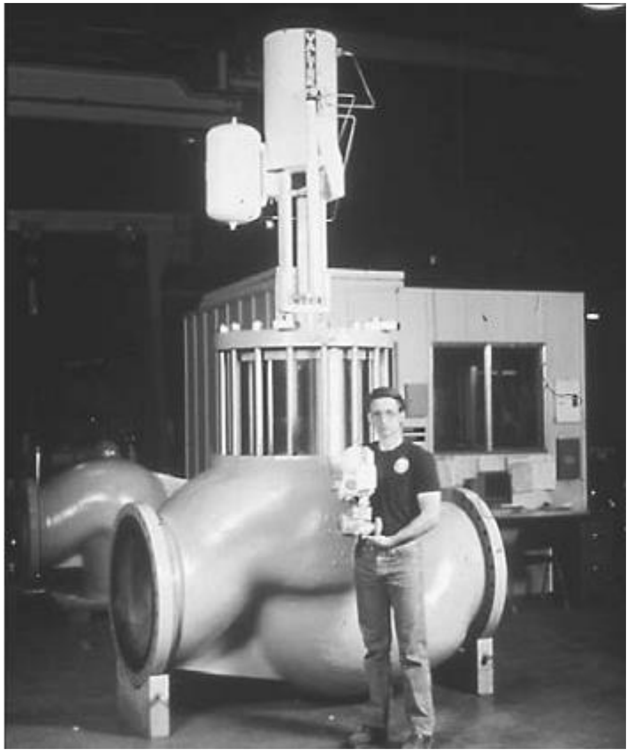
Upon completion of this Subject, trainees will be able to:

- Know what valves means.
- Know how it works.
- Basic part of valve.
- Valve selection
- Know Classification of valves.
- Know about valves actuators.
- Know about valves flanges.

Introduction

- Any fluid (liquid or gas) is carry through up by a piping systems.

Introduction



- This fluid is controlled by valves.

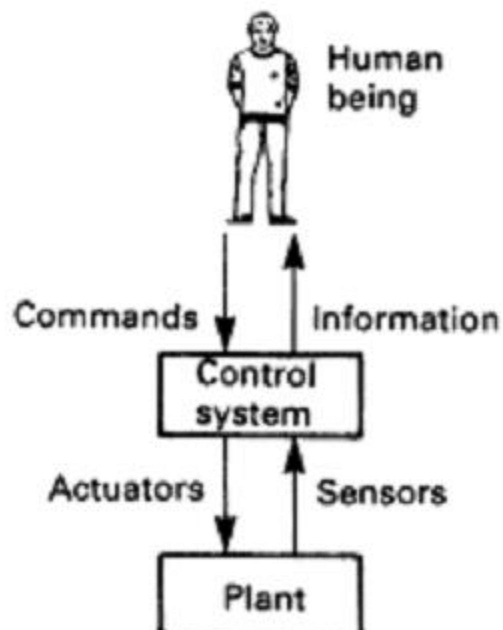
Introduction

- A valve is a mechanical device that controls the flow of fluid and pressure within a system or process.

Introduction

- Functions of a Control Valves.

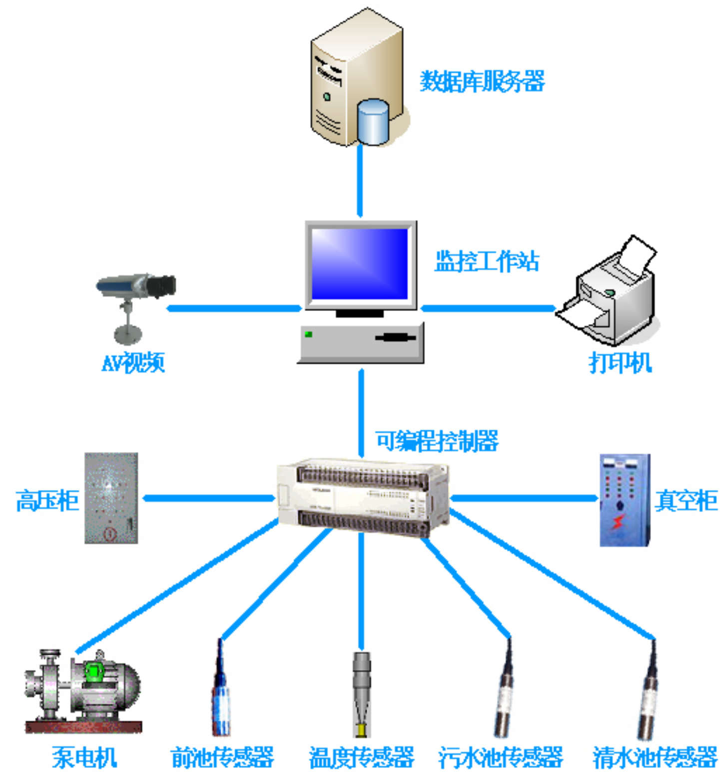
Very few industrial plants can be left to run themselves, and most need some form of control system to ensure safe and economical operation.



Introduction

These sub-processes can generally be considered to fall into three distinct areas.

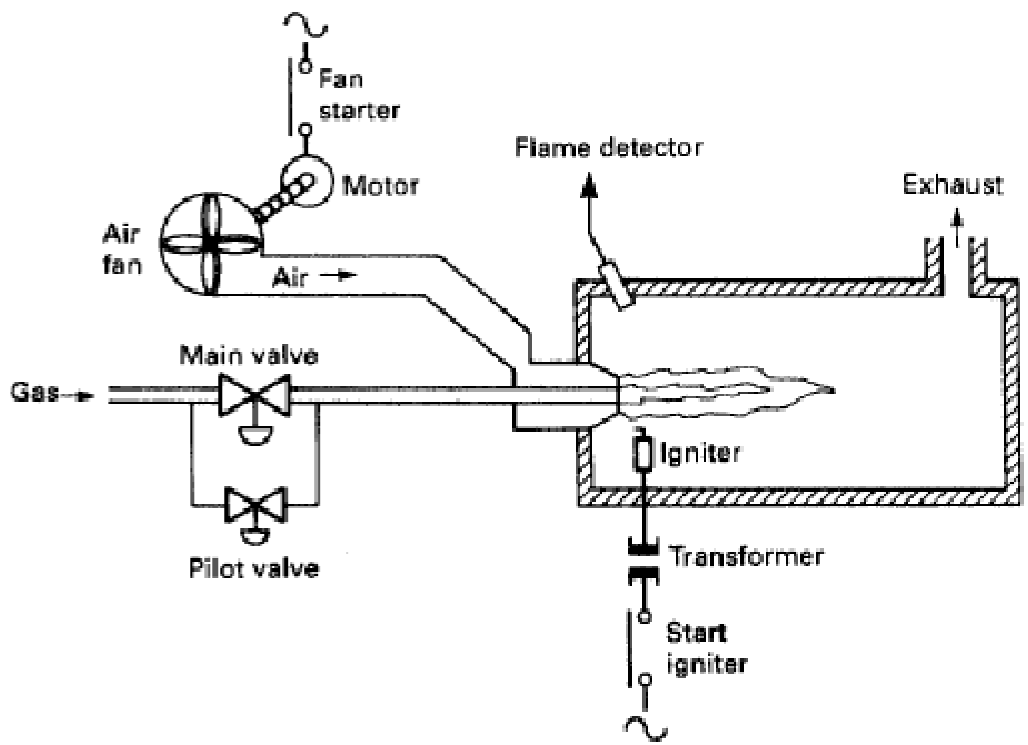
1-Monitoring subsystems.



Introduction

These sub-processes can generally be considered to fall into three distinct areas.

2- Sequencing subsystems.



Introduction

These sub-processes can generally be considered to fall into three distinct areas.

2- Sequencing subsystems.

(a) Start button pressed; if sensors are showing sensible states (no air flow and no flame) then sequence starts.

(b) Energize air fan starter. If starter operates (checked by contact on starter) and air flow is established (checked by flow switch).

(c) Wait two minutes (for air to clear out any un-burnt gas) and then

(d) Open gas pilot valve and operate igniter. Wait two seconds and then stop igniter and

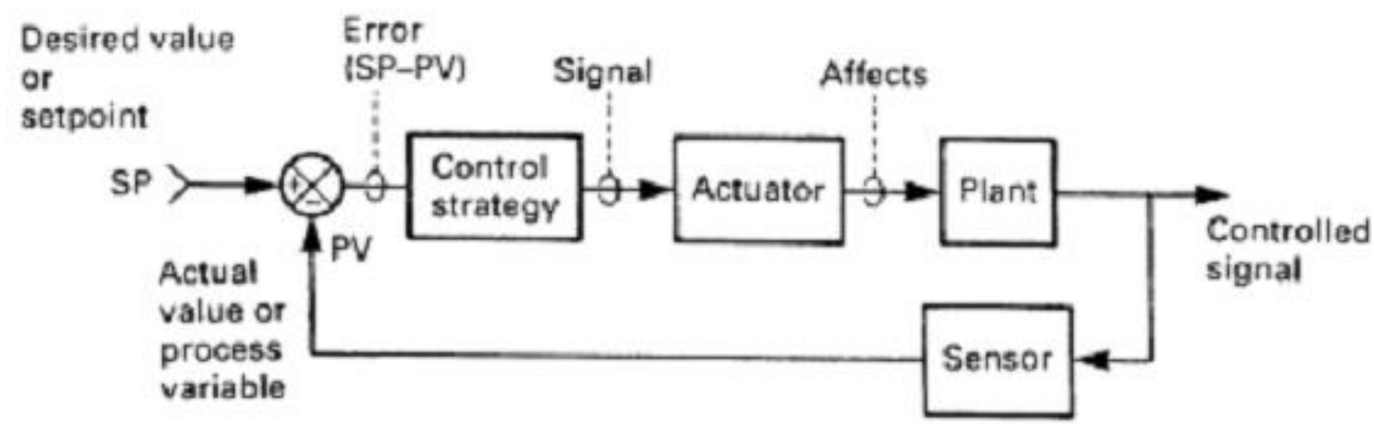
(e) If flame present (checked by flame failure sensor) open main gas valve.

(f) Sequence complete. Burner running. Stays on until stop button pressed, or air flow stops, or flame failure.

Introduction

These sub-processes can generally be considered to fall into three distinct areas.

3- Closed loop control subsystems.



Introduction

These sub-processes can generally be considered to fall into three distinct areas.

3- Closed loop control subsystems.

PV (for process variable)

SP (for set point)

$$\textbf{Error} = \textbf{SP} - \textbf{PV}$$

Introduction

- Manufactured from **various materials**, mostly made from steel, iron, plastic, brass, bronze and special alloys.

Introduction

- A valve controls system or process fluid flow and pressure by performing any of the following functions:

1. Stopping and starting fluid flow.

Introduction

- When the valve open the flow will start.

Introduction

- When the valve closed the flow will stop.


On/Off Valves

Introduction

- A valve controls system or process fluid flow and pressure by performing any of the following functions:

2.Varying (throttling) the amount of fluid flow.

Introduction

- Some valves design to throttle (regulate) flow by partially open or close valves.


Throttling Valves
STOCKHAM
DISC

Introduction

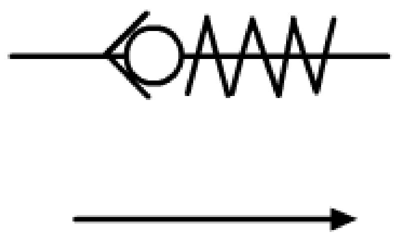
- A valve controls system or process fluid flow and pressure by performing any of the following functions:

3.Controlling the direction of fluid flow.


One-way
or
Check
Valves

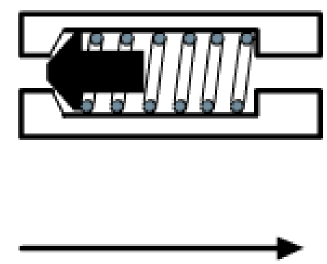
Introduction

Schematic Symbol



Free Flow

Check Valve



Free Flow

Introduction

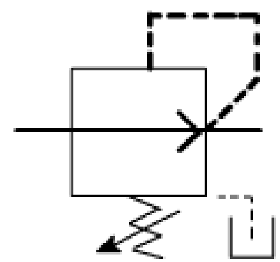
- A valve controls system or process fluid flow and pressure by performing any of the following functions:

4. Regulating downstream system or process pressure.

Introduction

Is a normal open pressure control valve.
Use to limit pressure downstream.

Reducing Valve



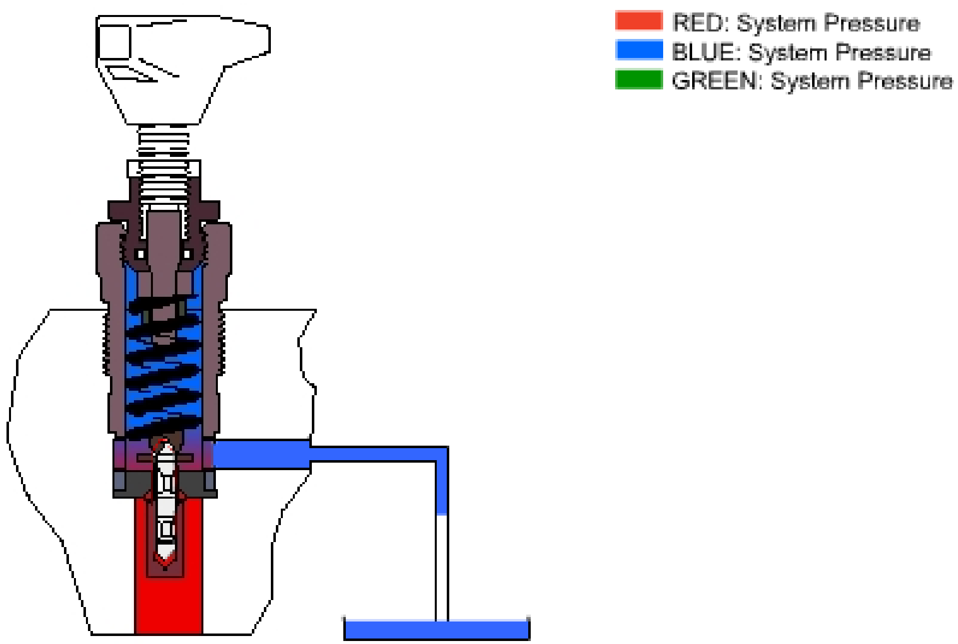
Introduction

- A valve controls system or process fluid flow and pressure by performing any of the following functions:

5. Relieving component or piping over pressure

Introduction

Is a normal open pressure control valve.
Use to limit pressure downstream.




Relief or Safety Valves

Introduction

Introduction

- Although there are many types, shapes, and sizes of valves, they all have the same basic parts.

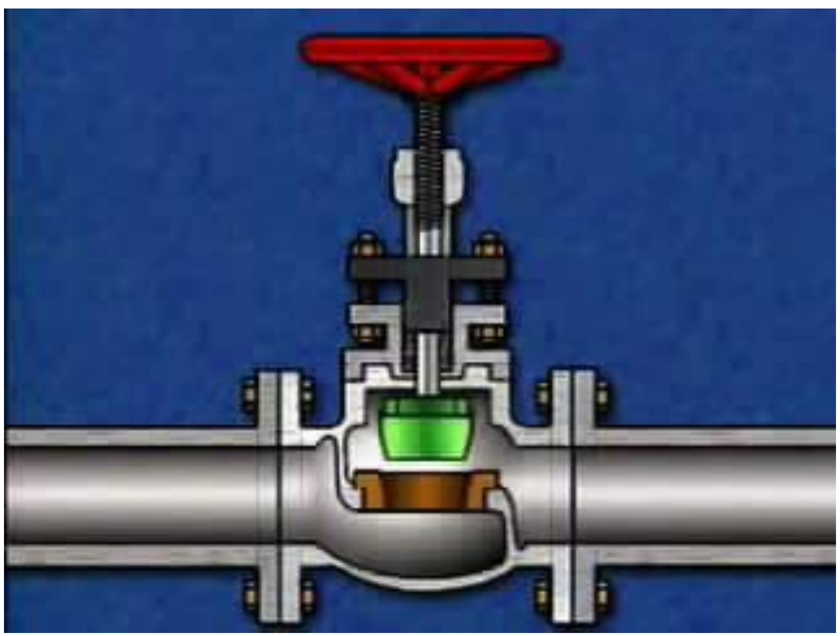
Introduction

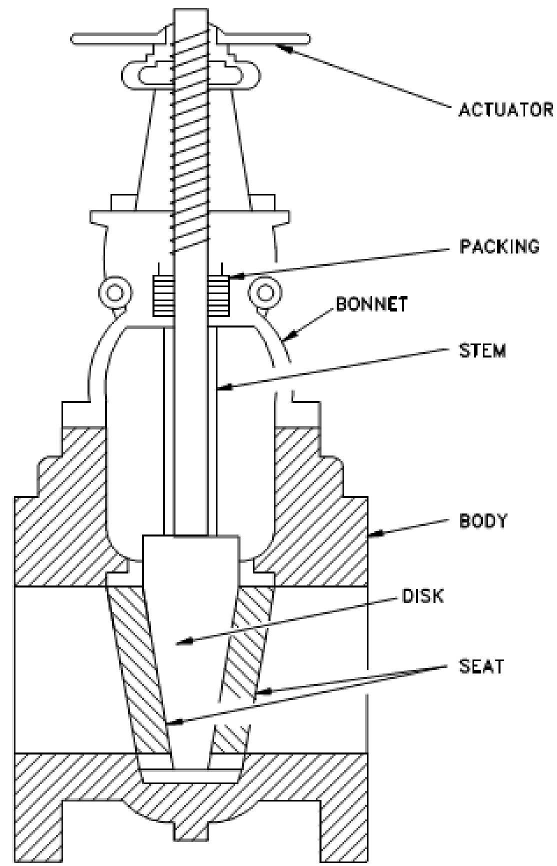
- All valves have the following basic parts:

1. The body.
2. Bonnet.
3. Trim (internal elements).
4. Actuator and;
5. Packing.

Introduction

- All valves have the following basic parts:





Introduction

1. The body.

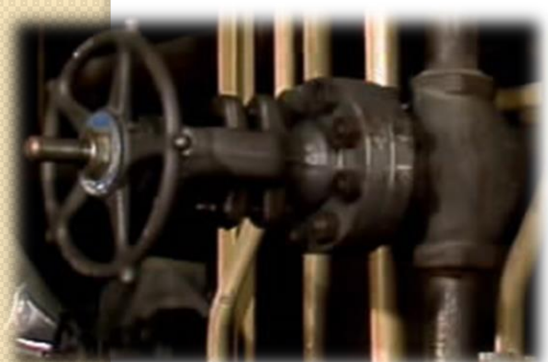
sometimes called the **shell**, is the primary **pressure** boundary of a valve.

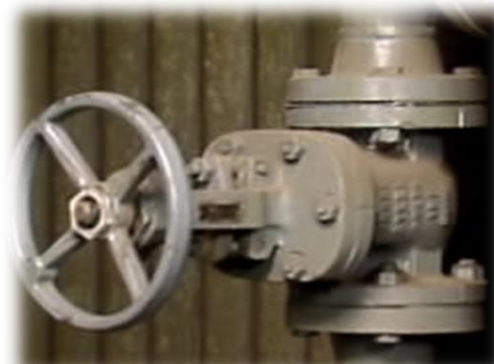
Introduction

1.The body.

It serves as the principal element of a valve assembly because it is the framework that **holds everything together.**

It receives inlet and outlet piping through **threaded, bolted, or welded** joints

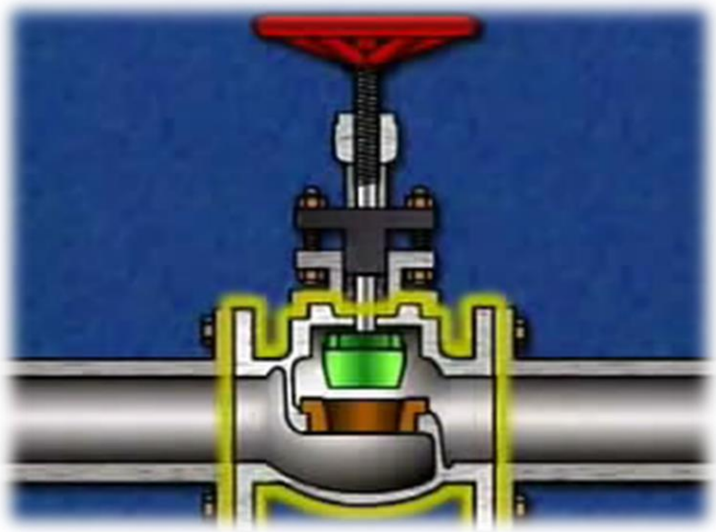




Introduction

1.The body.

The largest component of the valve is the body.



Introduction

1.The body.

The body can be made by different material such as:

a) Bronze.
b) Cast iron.
c) Stainless steel.

The material are used depends on valves applications.

Introduction

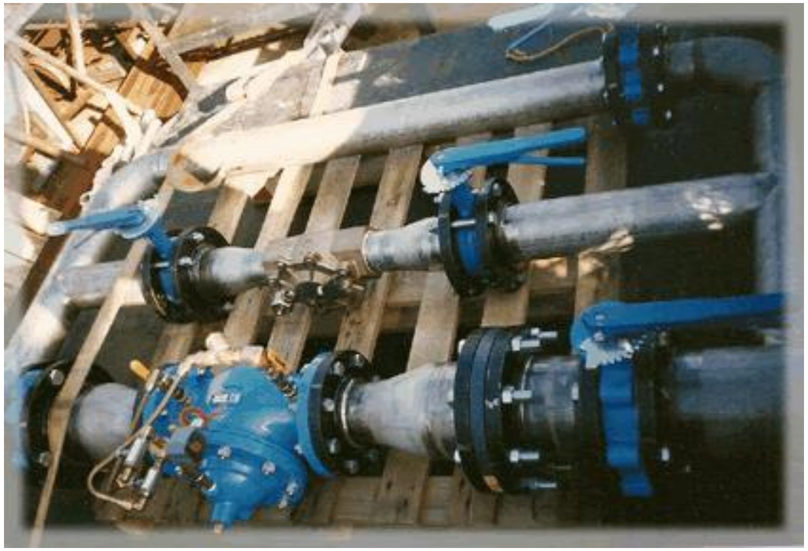
1. The body.

Valve bodies are **cast or forged** into a variety of shapes.
Although a **sphere or a cylinder** would theoretically be the most economical shape to resist fluid pressure when a valve is open.

Introduction

1. The body.

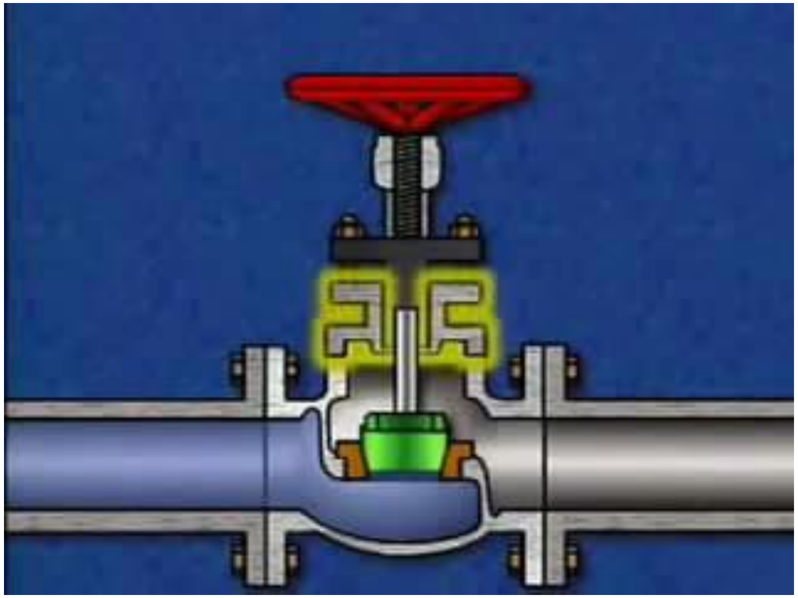
Narrowing of the fluid passage (venturi effect) is also a common method for **reducing the overall size and cost** of a valve.
In other instances, large ends are added to the valve for connection into a larger line.



Introduction

2.Valve Bonnet

- Consider access point



Introduction

2. Valve Bonnet

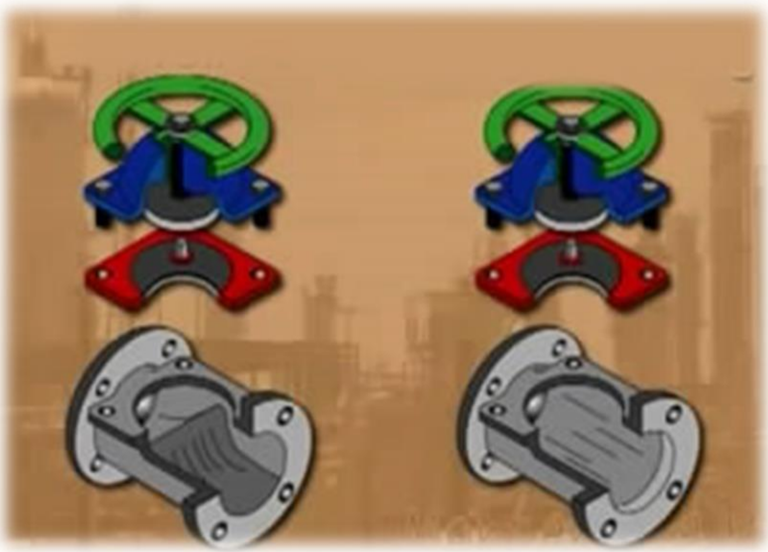
The **cover** for the opening in the valve body is the bonnet.

In some designs, the body itself is split into two sections that bolt together.

Introduction

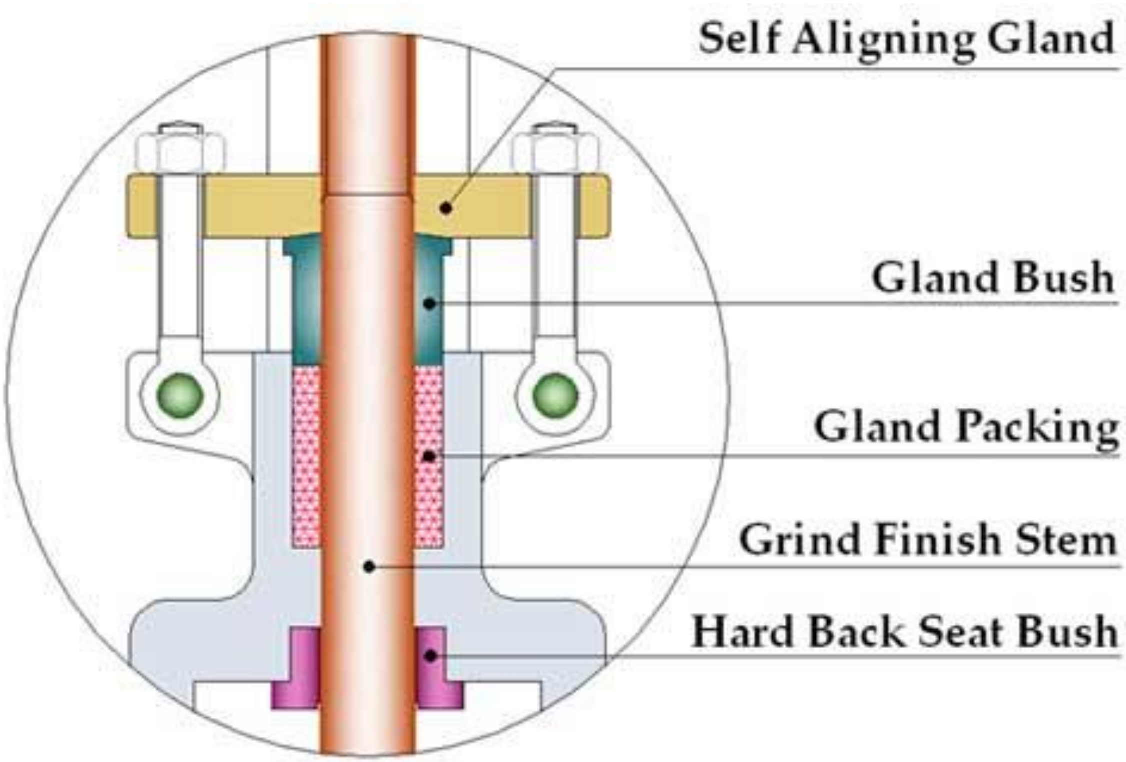
2.Valve Bonnet

Like valve bodies, bonnets vary in design.
Some bonnets function simply as valve covers, while others **support valve internals** and accessories such as the stem, disk, and actuator.



Introduction

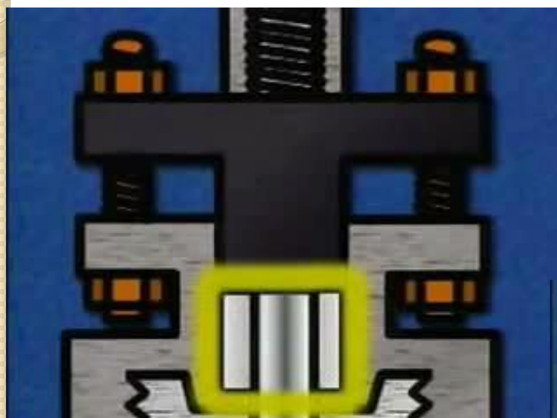
2.Valve Bonnet

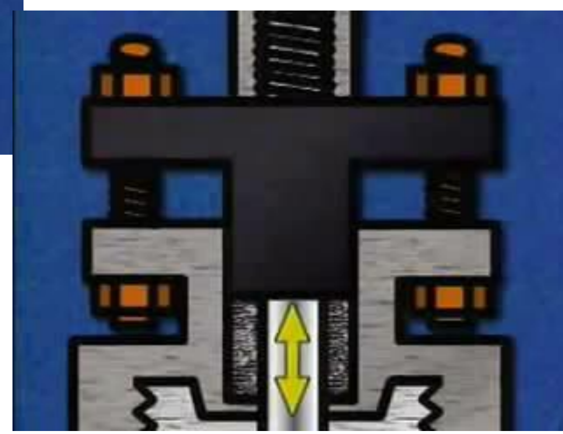


Bonnet Assembly

Introduction

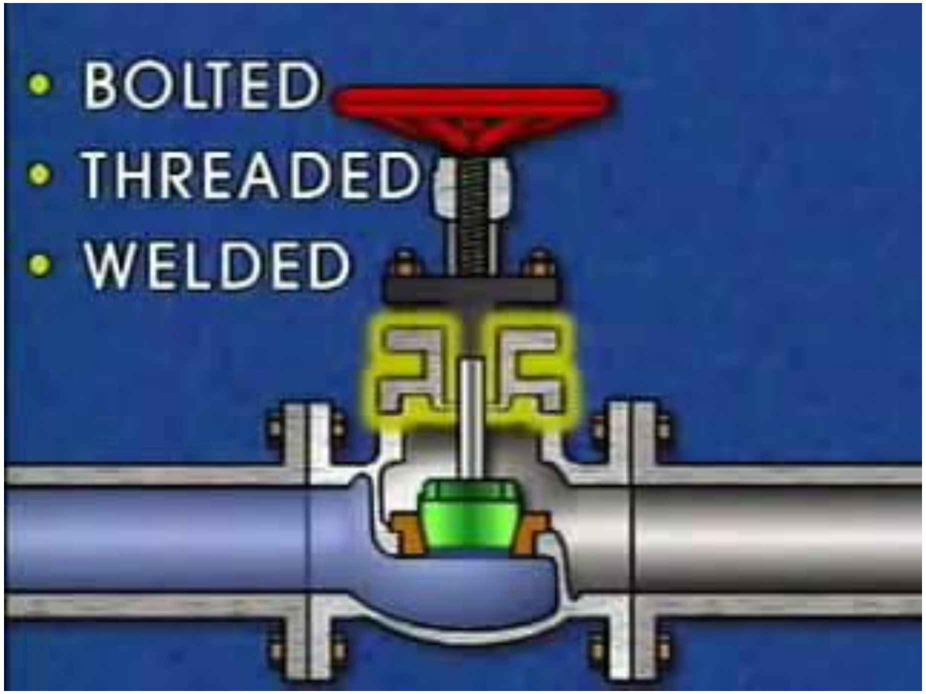
2.Valve Bonnet





Introduction

2.Valve Bonnet



Introduction

2.Valve Bonnet

The bonnet is the second principal **pressure boundary** of a valve.

In all cases, the attachment of the bonnet to the body is considered a pressure boundary.
This means that the weld joint or bolts that connect the bonnet to the body are pressure retaining parts.

Introduction

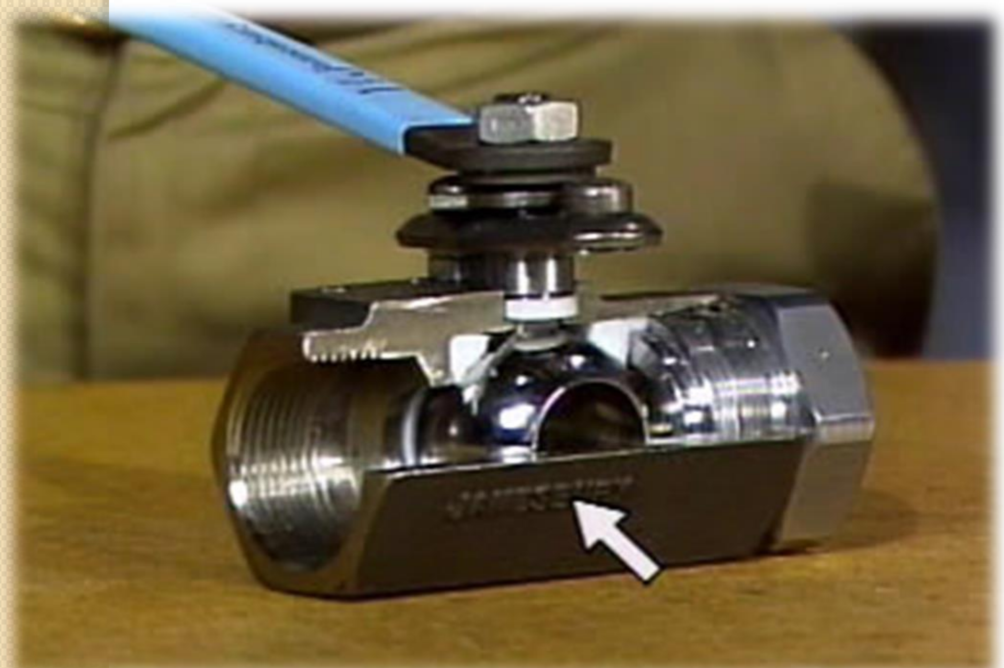
2. Valve Bonnet

It is cast or forged of the same material as the body and is connected to the body by a **threaded, bolted, or welded** joint.

Introduction

2. Valve Bonnet

Valve bonnets, although a necessity for most valves, represent a cause for concern. Bonnets **can complicate** the manufacture of valves, **increase valve size**, represent a significant cost portion of valve cost, and are a source for potential leakage.



Introduction

3. Valve Trim

The internal elements of a valve are collectively referred to as a valve's trim.
The trim typically includes :

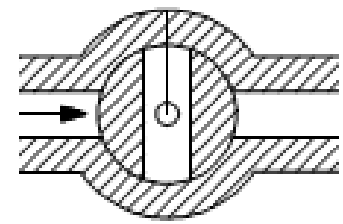
- a disk,
- seat,
- stem,
- and sleeves needed to guide the stem.

Introduction

3. Valve Trim

A valve's performance is determined by the disk and seat interface and the relation of the disk position to the seat.
Because of the trim, basic motions and flow control are possible.

Introduction



3. Valve Trim

In rotational motion trim designs, the disk slides closely past the seat to produce a change in flow opening.
In linear motion trim designs, the disk lifts perpendicularly away from the seat so that an annular orifice appears.

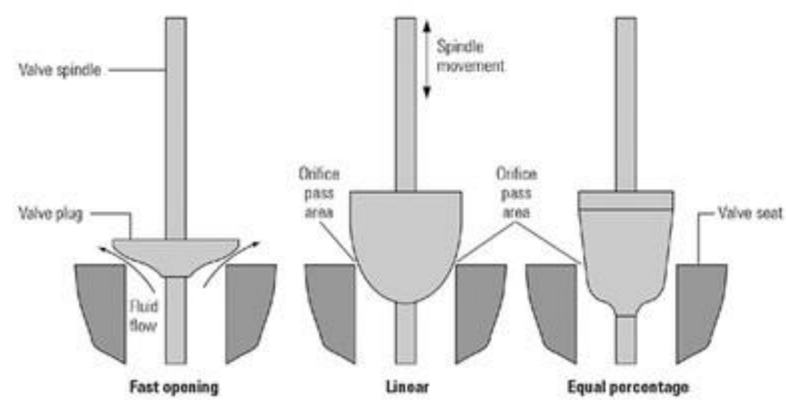
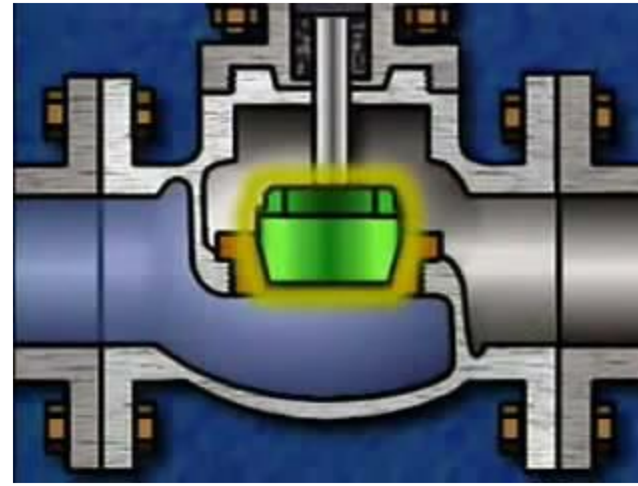


Fig. 6.5.1 The shape of the trim determines the valve characteristic

Introduction

3. Valve Trim

Disk and Seat



The disk is the third primary principal pressure boundary.
With the disk closed, full system pressure is applied across the disk if the outlet side is depressurized.
For this reason, the disk is a pressure-retaining part.

Introduction

3.Valve Trim

Disk and Seat

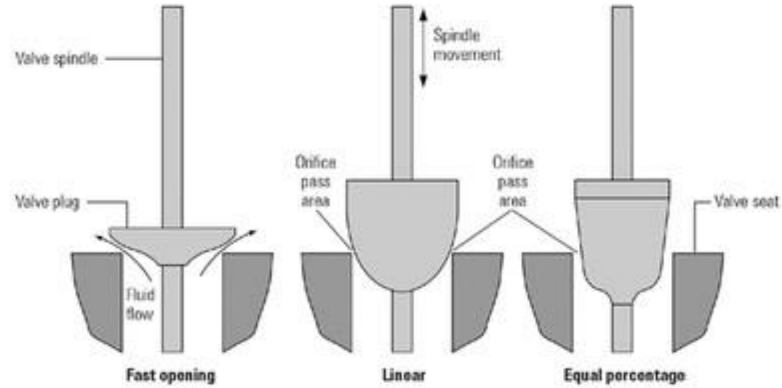


Fig. 6.5.1 The shape of the trim determines the valve characteristic

Disks are typically forged and, in some designs, hard-surfaced to provide good wear characteristics.

A fine surface finish of the seating area of a disk is necessary for good sealing when the valve is closed.

Most valves are named, in part, according to the design of their disks.

Introduction

3. Valve Trim

Disk and Seat

The seat or seal rings provide the seating surface for the disk.

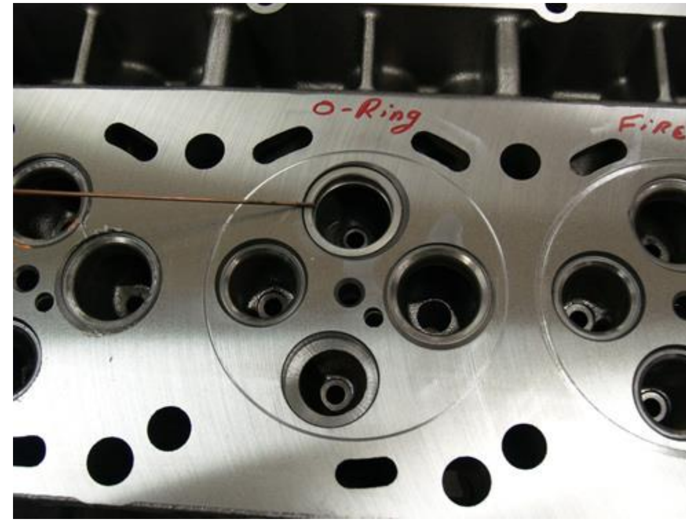
In some designs, the body is machined to serve as the seating surface and seal rings are not used.

In other designs, forged seal rings are threaded or welded to the body to provide the seating surface.

Introduction

3.Valve Trim

Disk and Seat



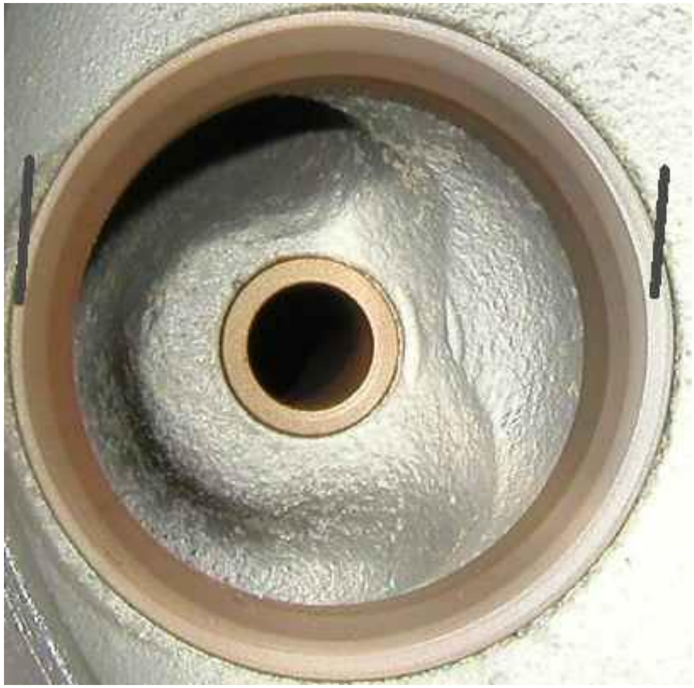
To improve the wear-resistance of the seal rings, the surface is often hard-faced by welding and then machining the contact surface of the seal ring.

A fine surface finish of the seating area is necessary for good sealing when the valve is closed.

Introduction

3. Valve Trim

Disk and Seat



Seal rings are not usually considered pressure boundary parts because the body has sufficient wall thickness to withstand design pressure without relying upon the thickness of the seal rings.

Introduction

3. Valve Trim

Disk and Seat

The seat conceder internal component which may be:

- threaded

Introduction

3. Valve Trim

Disk and Seat

The seat conceder internal component which may be:

- Squeezed through

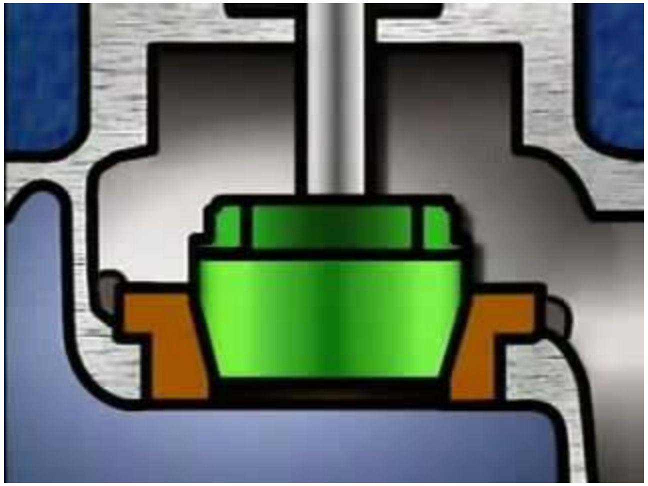
Introduction

3. Valve Trim

Disk and Seat

The seat conceder internal component which may be:

- threaded And welded.



Introduction

3. Valve Trim

Disk and Seat

The seat conceder internal component which may be:

- Squeezed through

And welded.

In high pressure high temperature application.

Introduction

3. Valve Trim

Disk and Seat

The seat conceder internal component which may be:

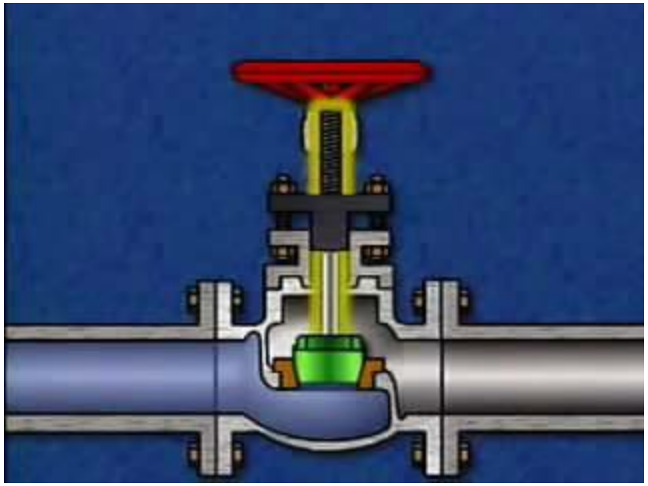
- casted.

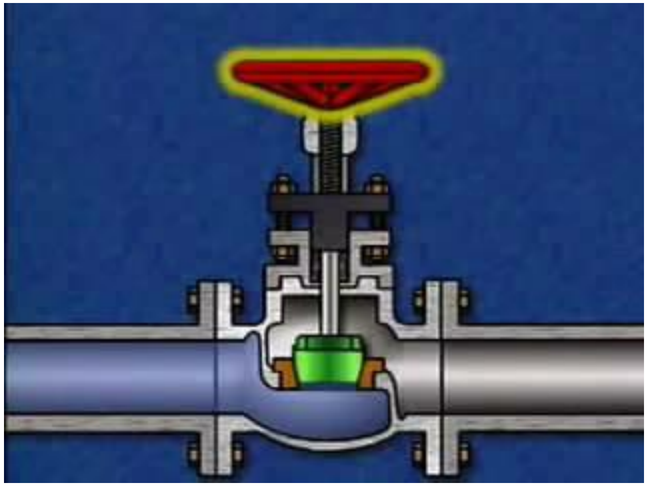
Introduction

3. Valve Trim

Stem

The stem, which connects the actuator and disk, is responsible for positioning the disk.





Introduction

3. Valve Trim

Stem

Stems are typically forged and connected to the disk by threaded or welded joints.

For valve designs requiring stem packing or sealing to prevent leakage, a fine surface finish of the stem in the area of the seal is necessary.

Typically, a stem is not considered a pressure boundary part.

Introduction

3.Valve Trim

Stem

Connection of the disk to the stem can allow some rocking or rotation to ease the positioning of the disk on the seat.
Alternately, the stem may be flexible enough to let the disk position itself against the seat.
However, constant fluttering or rotation of a flexible or loosely connected disk can destroy the disk or its connection to the stem.

Introduction

3. Valve Trim

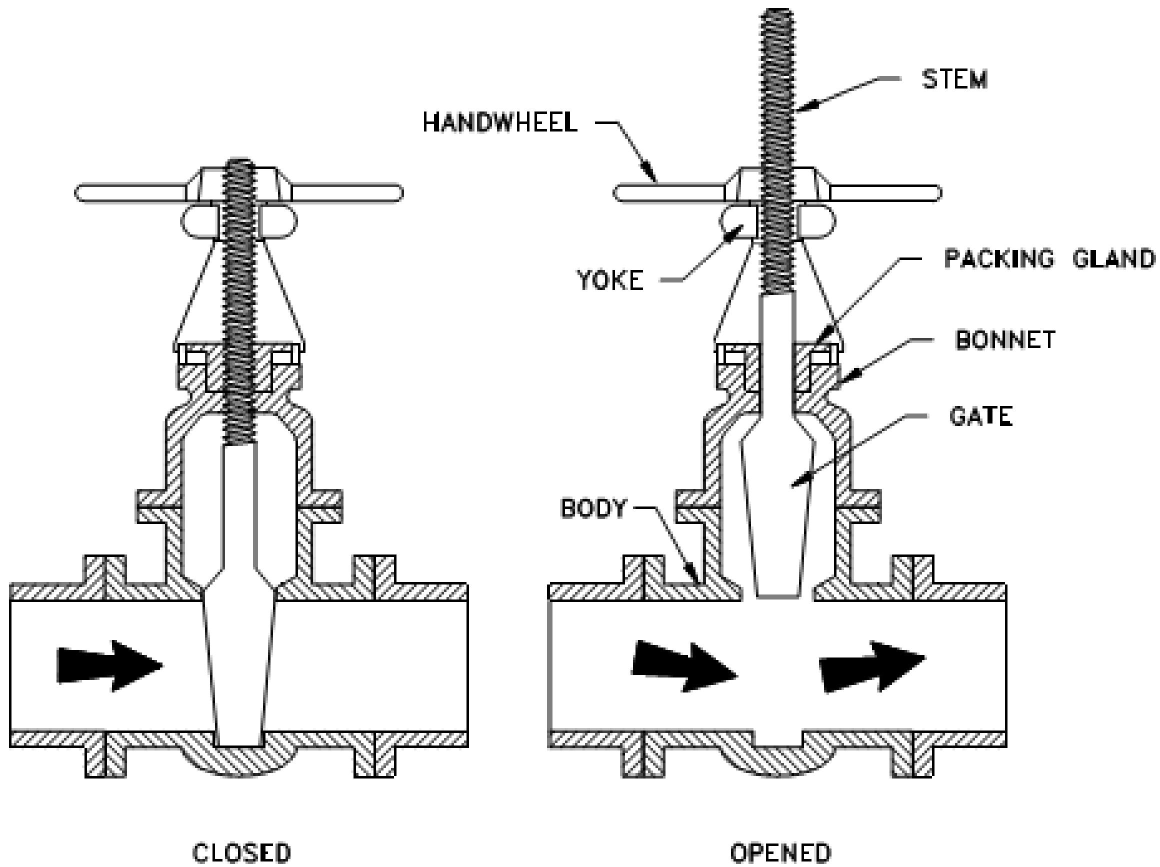
Stem

Two types of valve stems are rising stems and non-rising stems.
For a rising stem valve, the stem will rise above the actuator as the valve is opened. This occurs because the stem is threaded and mated with the bushing threads of a yoke that is an integral part of, or is mounted to, the bonnet.

Introduction

3. Valve Trim

Stem



rising stems

Introduction

3. Valve Trim

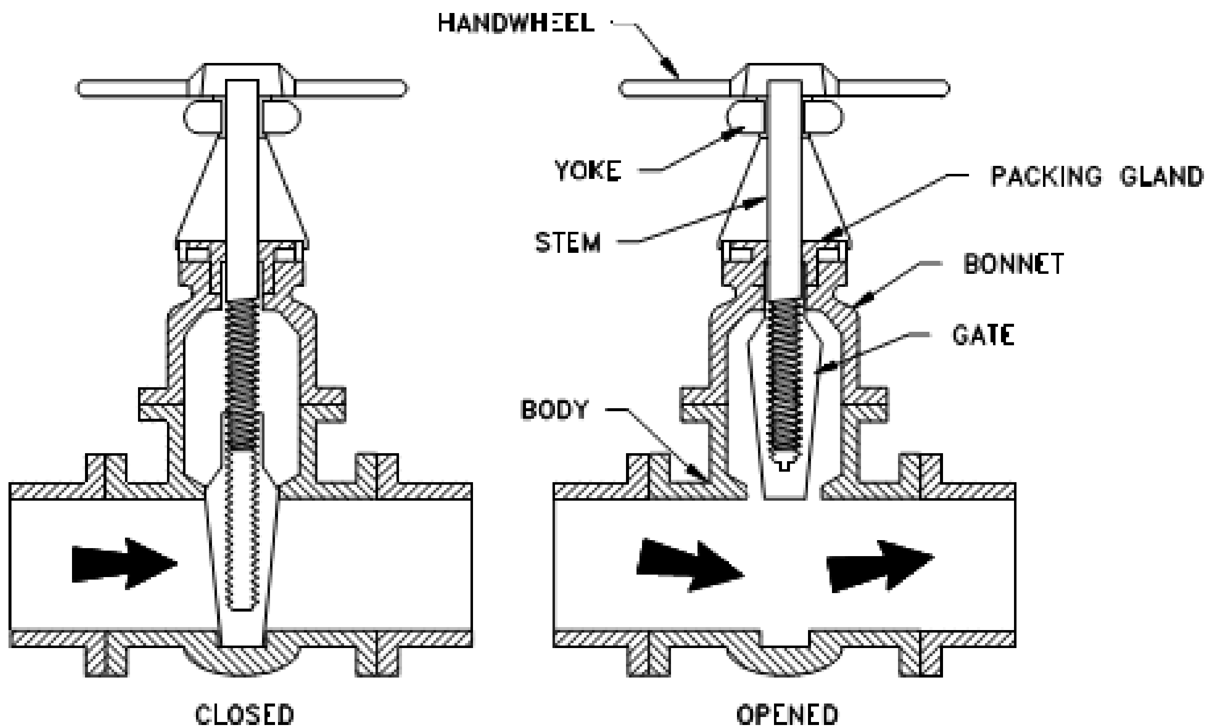
Stem

There is no upward stem movement from outside the valve for a non-rising stem design. For the non-rising stem design, the valve disk is threaded internally and mates with the stem threads.

Introduction

3. Valve Trim

Stem



non-rising stem

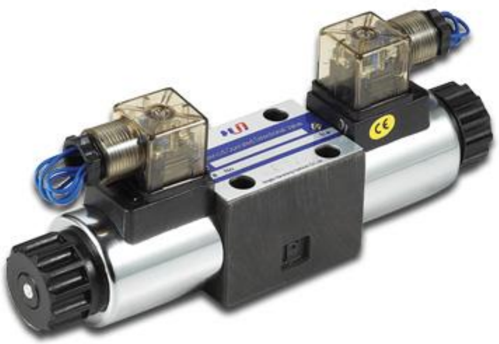
Introduction

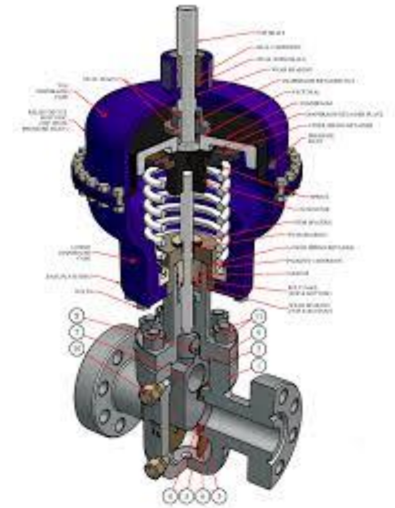
4.Valve Actuator

The actuator operates the stem and disk assembly. An actuator may be a manually operated hand-wheel, manual lever, motor operator, solenoid operator, pneumatic operator, or hydraulic ram. In some designs, the actuator is supported by the bonnet. In other designs, a yoke mounted to the bonnet supports the actuator.

Introduction

4.Valve Actuator





Introduction

4.Valve Actuator

Introduction

4. Valve Actuator

Except for certain hydraulically controlled valves, actuators are outside of the pressure boundary. Yokes, when used, are always outside of the pressure boundary

Introduction

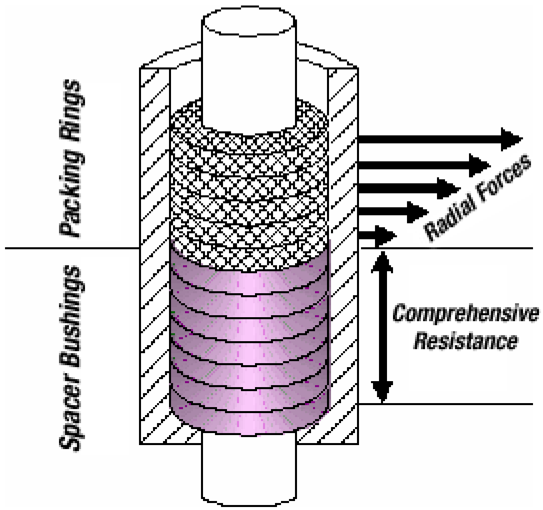
5.Valve Packing

Most valves use some form of packing to prevent leakage from the space between the stem and the bonnet.

Packing is commonly a fibrous material (such as flax) or another compound (such as Teflon) that forms a seal between the internal parts of a valve and the outside where the stem extends through the body.

Introduction

5.Valve Packing



Valve packing must be properly compressed to prevent fluid loss and damage to the valve's stem.
If a valve's packing is too loose, the valve will leak, which is a safety hazard.
If the packing is too tight, it will impair the movement and possibly damage the stem.

Introduction

5.Valve Packing

Introduction

5.Valve Packing

Packing System	Maximum Pressure and Temperature Limits for 100 PPM Service(1)		Application Guideline for Nonenvironmental Service(1)		Seal Performance Index	Service Life Index	Packing Friction (2)
	Metric	Imperial	Metric	Imperial			
Single PTFE V-Ring	20.7 bar -18 to 93 °C	300 psi 0 to 200 °F	See figure 3 -46 to 232 °C	See figure 3 -50 to 450 °F	Better	Long	Very low
Double PTFE V-Ring	- - -	- - -	See figure 3 -46 to 232°C	See figure 3 -50 to 450°F	Better	Long	Low
ENVIRO-SEAL PTFE	See figure 2 -46 to 232 °C	See figure 2 -50 to 450 °F	See figure 3 -46 to 232 °C	See figure 3 -50 to 450 °F	Best	Very long	Low
ENVIRO-SEAL Duplex	51.7 bar -46 to 232 °C	750 psi -50 to 450 °F	See figure 3 -46 to 232 °C	See figure 3 -50 to 450 °F	Best	Very long	Low
KALREZ® with Vespel® CR-6100 (KVSP 500)(3)	24.1 bar 4 to 260°C	350 psig 40 to 500°F	See figure 3 -40 to 260°C	See figure 3 -40 to 500°F	Best	Long	Low
ENVIRO-SEAL Graphite ULF	103 bar -7 to 315°C	1500 psi 20 to 600°F	207 bar -198 to 371 °C	3000 psi -325 to 700°F	Best	Very long	Medium
HIGH-SEAL Graphite ULF	103 bar -7 to 315°C	1500 psi 20 to 600°F	290 bar(4) -198 to 538 °C	4200 psi(4) -325 to 1000°F	Best	Very long	Medium
Graphite Composite / HIGH-SEAL Graphite	- - -	- - -	290 bar(4) -198 to 649°C(5)	4200 psi(4) -325 to 1200°F(5)	Better	Very long	Very high
Braided Graphite Filament	- - -	- - -	290 bar -198 to 538°C(5)	4200 psi -325 to 1000°F(5)	Good	Moderate	High
Graphite ULF	- - -	- - -	290 bar -198 to 538 °C	4200 psi -325 to 1000°F	Better	Very long	Medium

An emission-reducing packing system

quiz

1. Stem is consider pressure boundary part.

- True.
- False.

2. Valve stem leakage is usually controlled by properly compressing the packing around the valve stem.

- True.
- False.

quiz

3.Valve bonnet consider not from main valve part.

- True.
- False.

4.----------is machine to serve as the seating surface.

- a)valve body b)valve bonnet.
- c)valve stem. d)valve package.

Valve Selection

Valve Selection Considerations

- 1. Pressure.
- 2. Temperature.
- 3. Type of fluid.
  - A. Liquid.
  - B. Gas, i.e., steam or air.
  - C. Dirty or abrasive (erosive)
  - D. Corrosive.
- 4. Flow Considerations
  - A. On-off or Throttling.
  - C. Is the valve needed to prevent
  - backflow.
  - D. Concern for pressure drop.
  - E. Velocity.
- 5. Operating conditions
  - A. Frequency of operation.
  - B. Accessibility.
  - C. Overall space/size available.
  - D. Manual or automated control.
  - E. Need for bubble-tight shut-off.
  - F. Concerns about body joint leaks.
  - G. Fire safe design.
  - H. Speed of closure.

Material Selection

- There are factors govern the basic materials selection
  - Corrosion-resistance requirements.
  - Thermal shock.
  - Piping stress.
  - Fire hazard.
- Types of materials typically available include,
  - Ductile iron.
  - Carbon steel.
  - Cast iron.
  - Stainless steels.
  - Brass.
  - Bronze.
  - Polyvinyl chloride (PVC) plastic.
- Body Materials
  - For small valves are usually brass, bronze, or forged steel
  - For larger valves, cast iron, cast ductile iron or cast steel as required for the pressure and service.

Material Selection

- Seat and Valve Disk Materials
- The valve seat and valve disk are sometimes referred to as the valve trim and are usually constructed of the same material selected to meet the service requirements.

- Valve stem material should be selected to meet service conditions. Stainless steel is commonly used for most HVAC applications, and bronze is commonly used in ball valve construction.

Table 2.9 Temperature Limits for Body Materials†

Material	Upper Limit (°F)	Upper Limit (°C)	Lower Limit (°F)	Lower Limit (°C)
Cast Iron	410	210	-20	-5
Ductile Iron	650	345	-20	-5
*Carbon Steel (Grade WCB)	1000	535	-20	-5
Carbon Steel (Grade LCB)	650	345	-50	-10
Carbon Moly	850	455	-20	-5
1-1/4 Cr - 1/2 Mo (Grade WC6)	1000	535	-20	-5
2-1/4 Cr - 1/2 Mo (Grade WC9)	1050	565	-20	-5
5 Cr - 1/2 Mo (Grade C5)	1100	595	-20	-5
9 Cr - 1 Mo (Grade C12)	1100	595	-20	-5
Type 304 (Grade CF 8)	1500	815	-425	-220
Type 347 (Grade CF8C)	1500	815	-425	-220
Type 316 (Grade CF8M)	1500	815	-425	-220
3-1/2 Ni (Grade LC3)	650	345	-150	-65
Aluminum	400	205	-325	-160
Bronze	550	285	-325	-160
Inconel 600	1200	650	-325	-160
Monel 400	900	480	-325	-160
Hastelloy B	700	370	-325	-160
Hastelloy C	1000	535	-325	-160
Titanium	600	315	N/A	N/A
Nickel	500	260	-325	-160
Alloy 20	300	150	-50	-10

†*Courtesy of Valtek International.*

*The carbon phase of carbon steel may be converted to graphite upon long exposure to temperatures above 775°F (415°C). Check applicable codes for maximum temperature ratings of various materials. Other specific data available in ANSI B16.34.

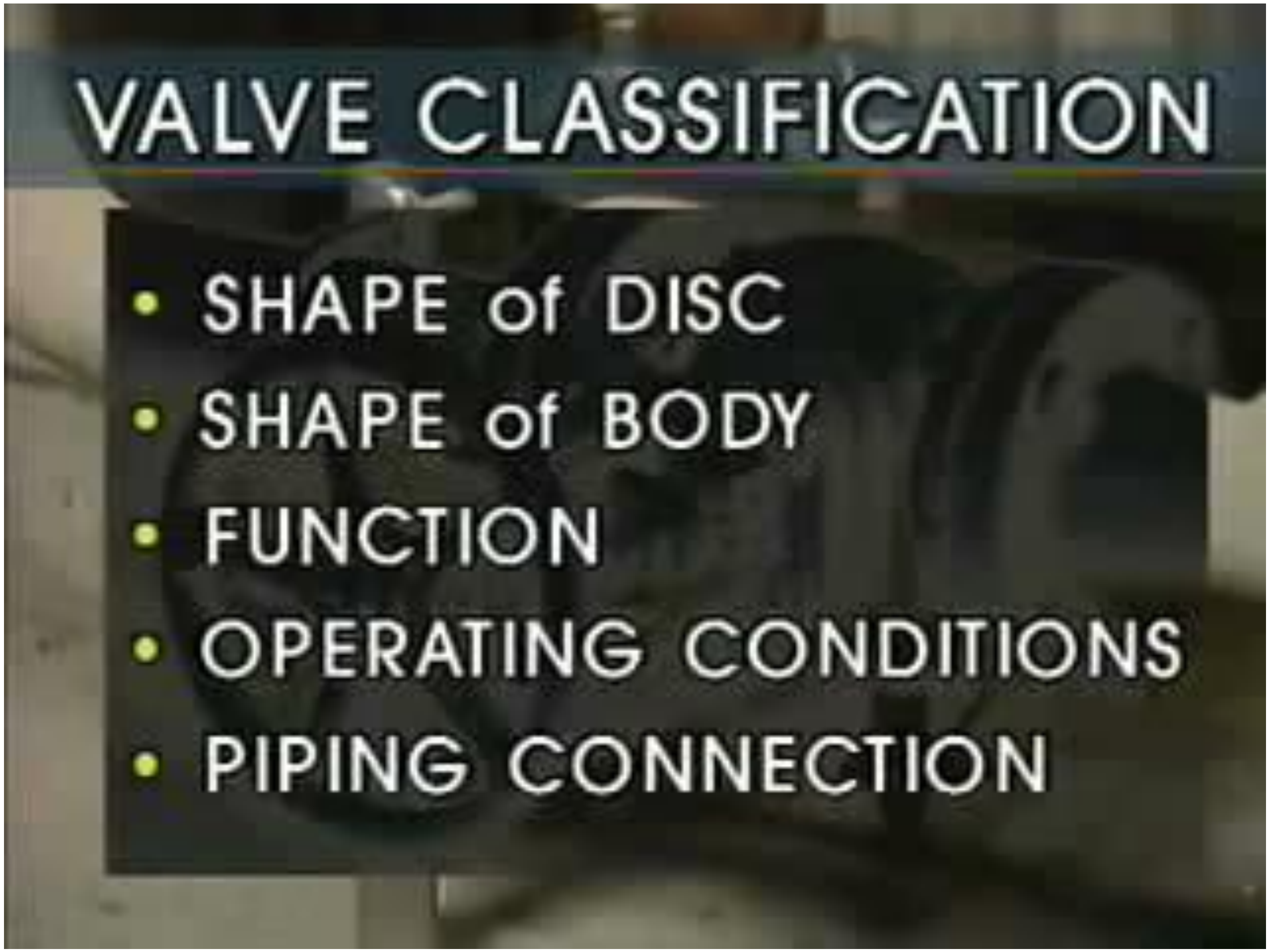
Body Type	Material	Body Standard	Bonnet Standard
Castings	Stainless Steel Carbon Steel Chrome-moly	A351-CF8M A216-WCB A217-WC6 A217-WC9 A217-C5	A479-316 A675-70 A479-316 A479-316 A479-316
Forgings	Stainless Steel Carbon Steel Chrome-moly	A743-CF8M A105 A182-F11 A182-F22 A182-F5a	A479-316 A675-70 A479-316 A479-316 A479-316
Bar	Stainless Steel Carbon Steel Chrome-moly	A182-F316 A479-316 A675-70 See Forgings	A479-316 A479-316 A675-70 See Forgings

Table 2.10 Common ASTM Materials for Bodies and Bonnets

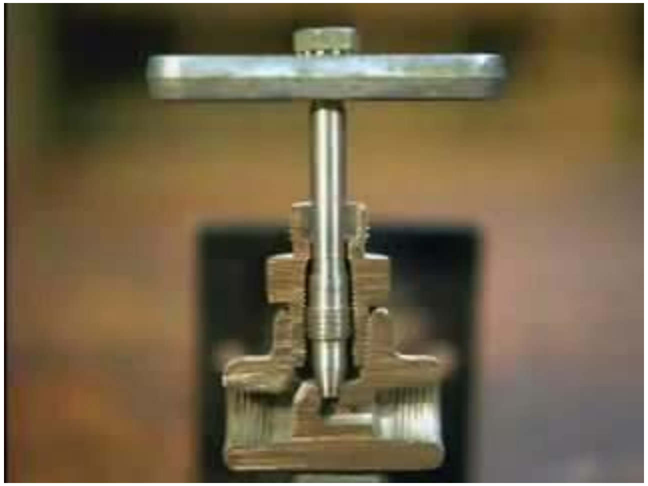
Classification of valves

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.

Classification of valves



Classification of valves

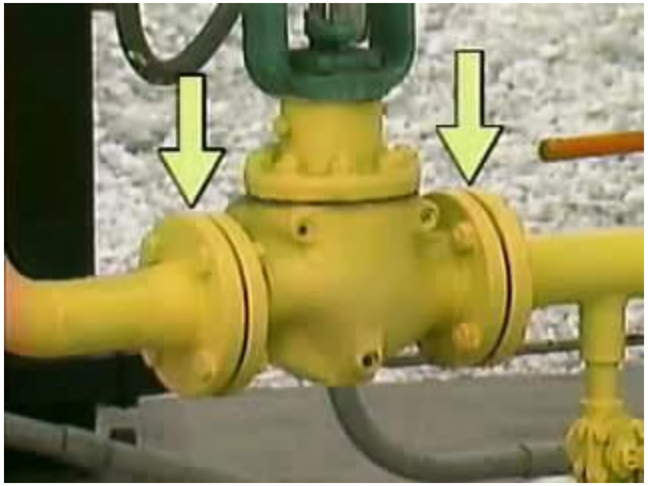


Classification of valves

Classification of valves

Classification of valves






Classification of valves

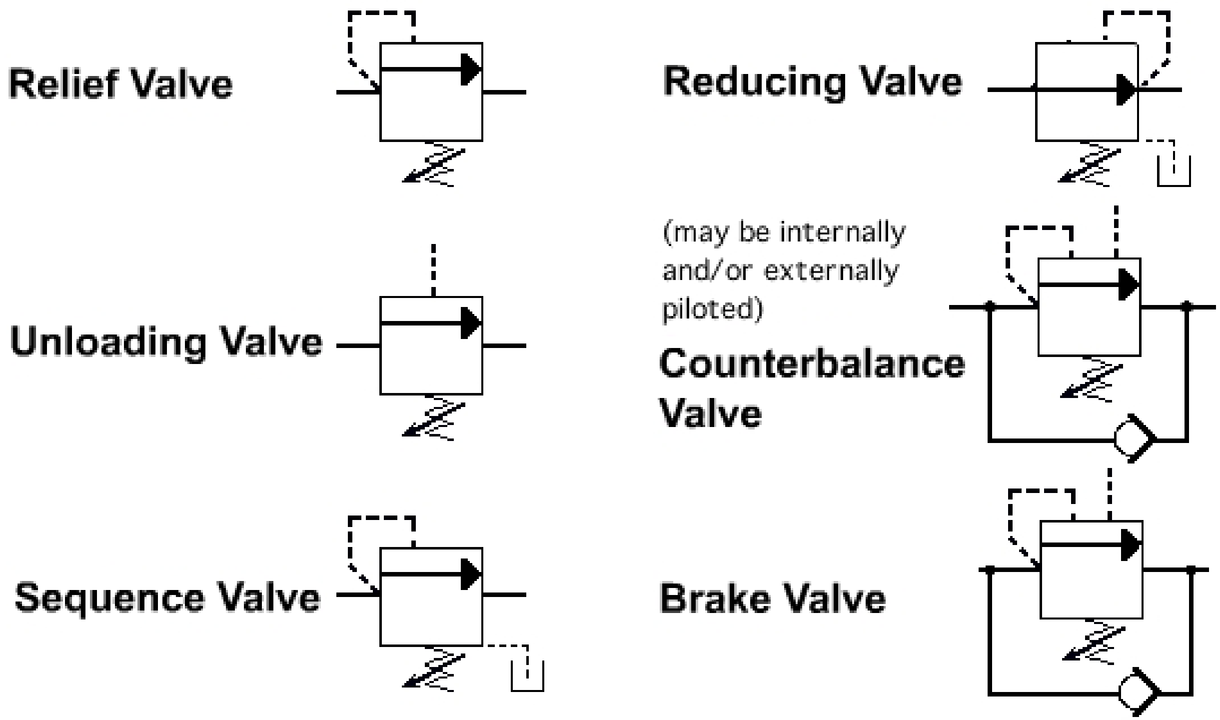
Valves Classification According To:

1) Function
2) Shape of disk
3) Motion
4) Piping conection

Classification of valves

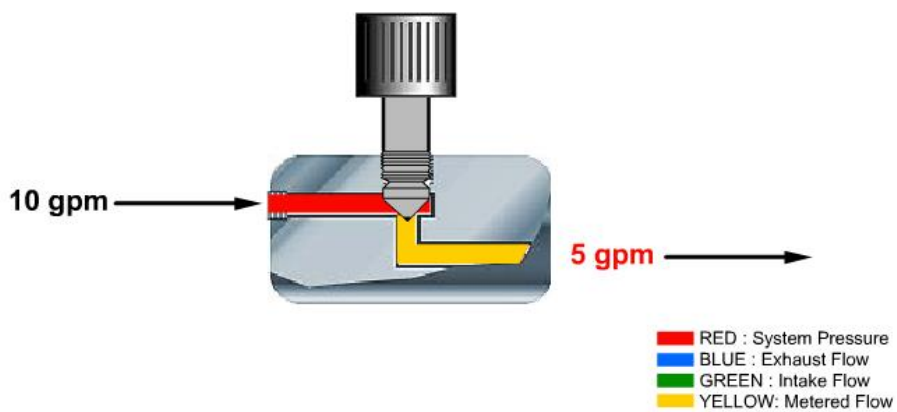
1) Function.

- Pressure control valves.



Classification of valves

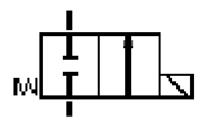
- Function.
- Flow control valves.



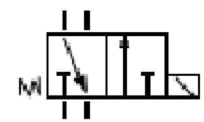
Classification of valves

1) Function.

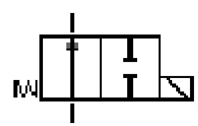
- Direction control valves



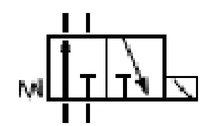
Normally Closed
Spring Offset
Solenoid Operated 2-way



Normally Closed
Spring Offset
Solenoid Operated 3-way



Normally Open
Spring Offset
Solenoid Operated 2-way



Normally Open
Spring Offset
Solenoid Operated 3-way

Classification of Valves

The following are some of the commonly used valve classifications, based on mechanical motion:

·Linear Motion Valves. The valves in which the closure member, as in gate, globe, diaphragm, pinch moves in a straight line to allow, stop, or throttle the flow.

·Rotary Motion Valves. When the valve-closure member travels along an angular or circular path, as in butterfly, ball, plug valves.

·Quarter Turn Valves. Some rotary motion valves require approximately a quarter turn, 0 through 90 , motion of the stem to go to fully open from a fully closed position or vice versa.

Classification of valves based on motion

Valve types	Linear motion	Rotary motion	Quarter turn
Gate Valve	x		
Globe valve	x		
Plug valve		x	x
Ball valve		x	x
Butterfly valve		x	x
Diaphragm valve	x		
Pinch valve	x		

Classification of valves

- Motion

1) Linear-motion Valves

➢Had a **sliding-stem design** that pushes a closure element into an open or closed position.

➢Simple design, easy maintenance, and versatile with various sizes, pressure class and design options.

➢Example: gate, globe, diaphragm, three-way.

Classification of valves

- Motion

1) Linear-motion Valves

Classification of valves

- Motion

2) Rotary-motion Valves

➢Used a **closure element that rotates** through a quarter-turn range to open and block the flow.

➢Limited to certain pressure drops.

➢Prone to **cavitations** and **flashing problems**.

Classification of valves

- Motion

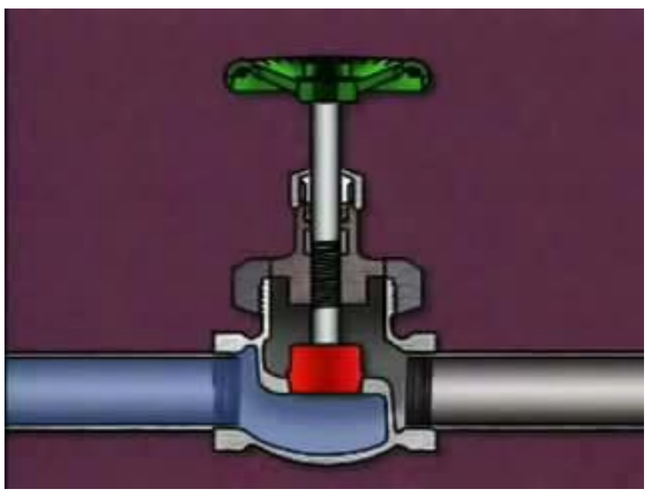
2) Rotary-motion Valves

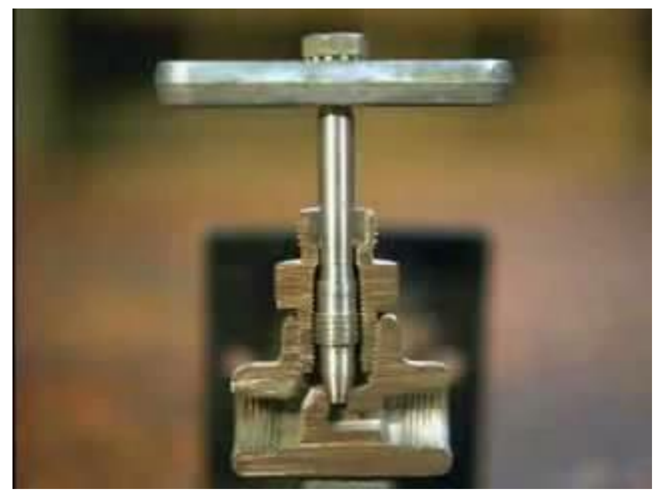
Classification of valves

- Shape of disk

There are four methods of controlling flow through a valve.

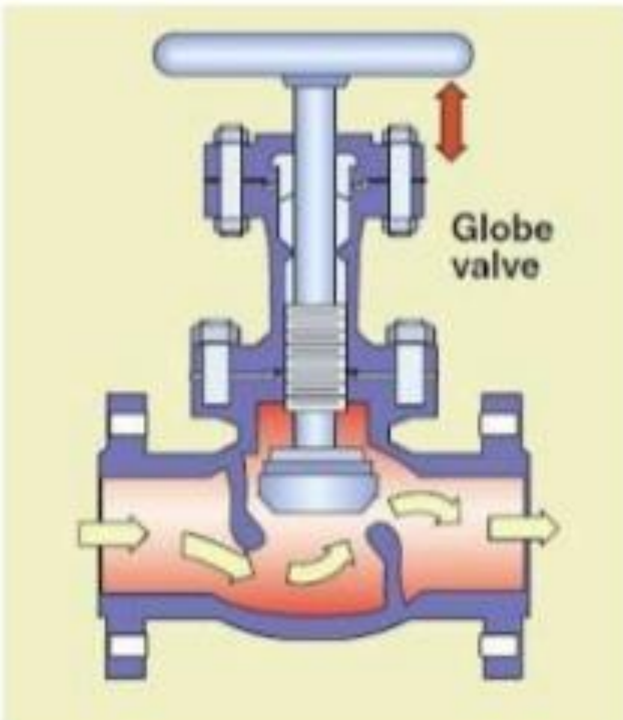
1. Move a disc, or plug into or against an orifice (for example, globe or needle type valve).



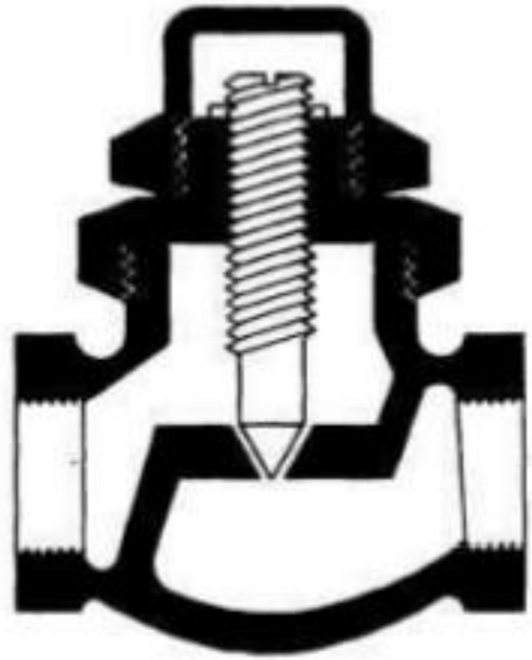


Methods of controlling flow through a valve.

1. Move a disc, or plug into or against an orifice globe or needle type valve)



globe valve



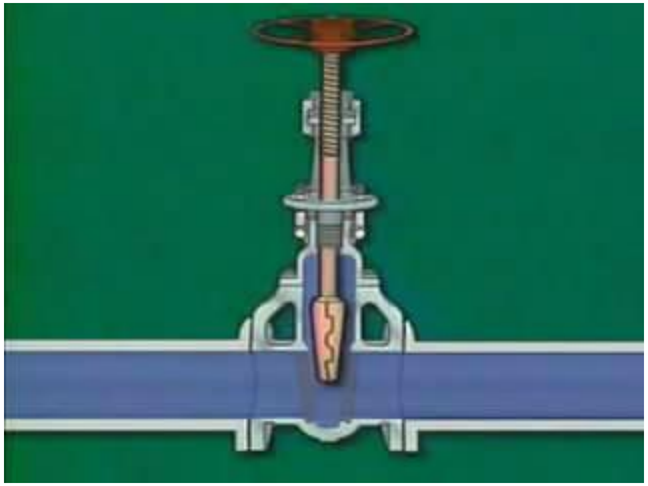
Needle valve

Classification of valves

- Shape of disk

There are four methods of controlling flow through a valve.

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



Methods of controlling flow through a valve.

2. Slide a flat, cylindrical, or spherical surface across the orifice.

plug valve

gate valve

Classification of valves

- Shape of disk

There are four methods of controlling flow through a valve.

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

Methods of controlling flow through a valve.

3. Rotate a disc or ellipse about a shaft extending across the diameter of an orifice.

ball valve

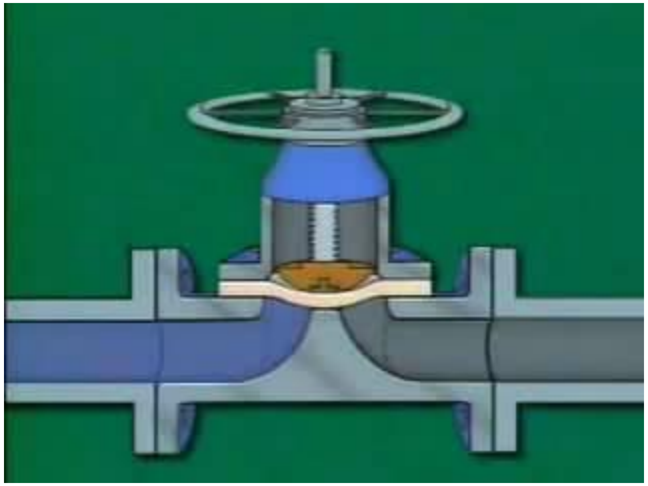
butterfly valve

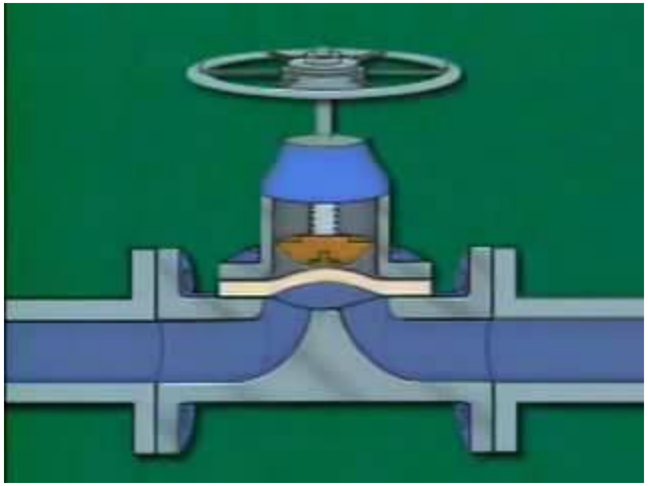
Classification of valves

- Shape of disk

There are four methods of controlling flow through a valve.

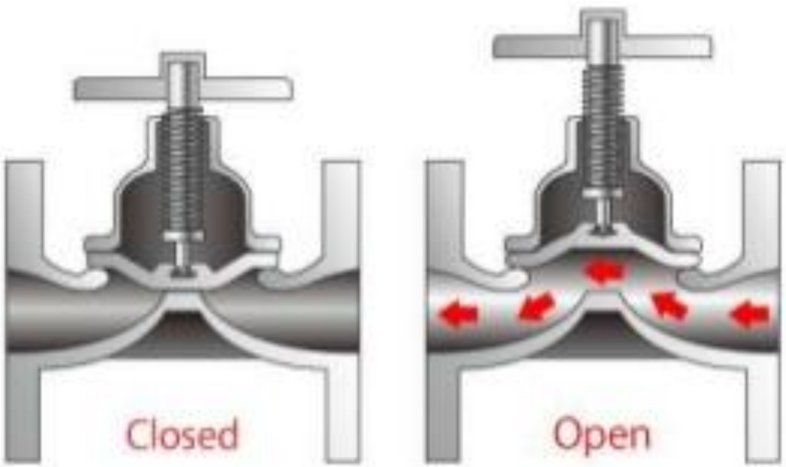
4. Move a flexible material into the flow passage (for example, diaphragm and pinch valves).



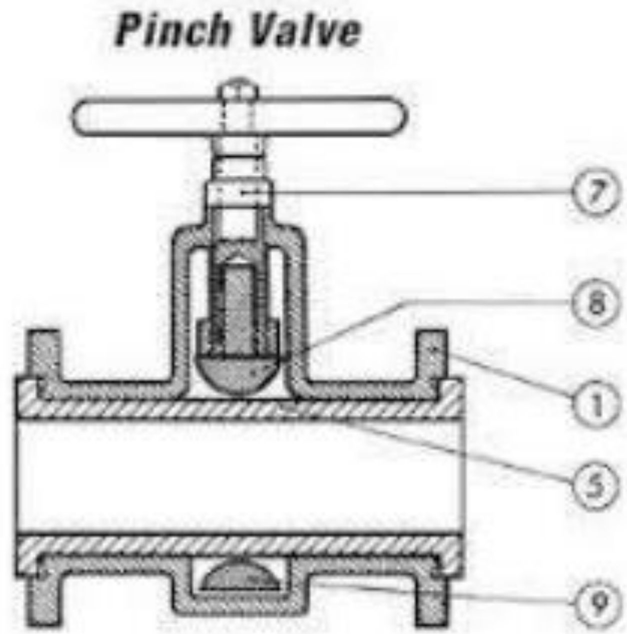


Methods of controlling flow through a valve.

4. Move a flexible material into the flow passage.



diaphragm valve



pinch valve

Classification of valves

- Shape of disk

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

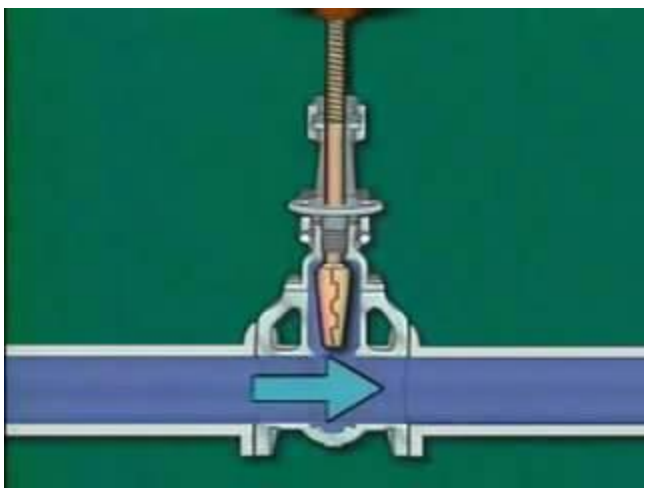
Classification of valves

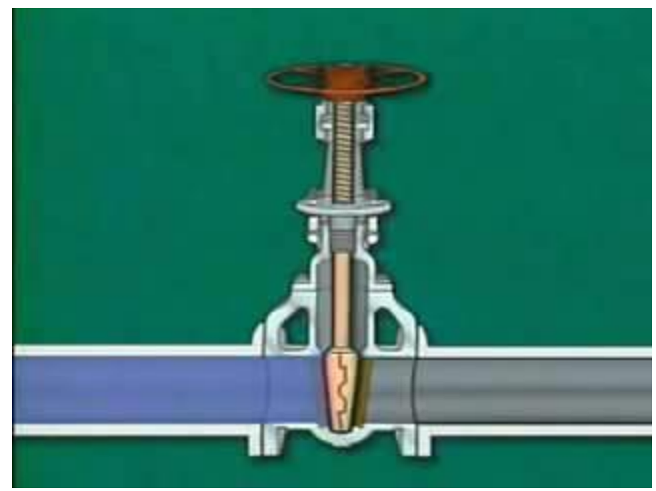
- Gate Valves

Classification of valves

- Gate Valves

A gate-valve is a linear motion valve used to start or stop fluid flow; however, it does not regulate or throttle flow.

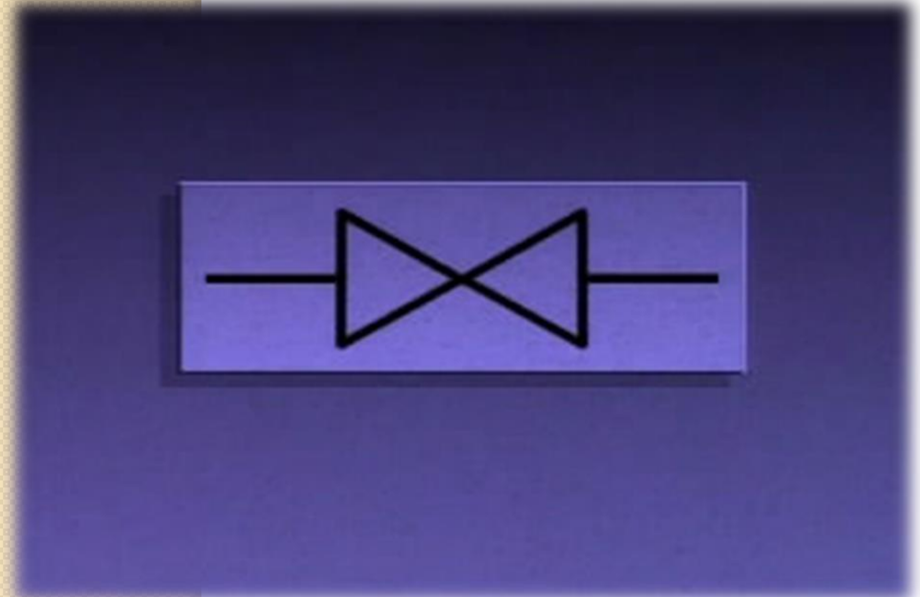




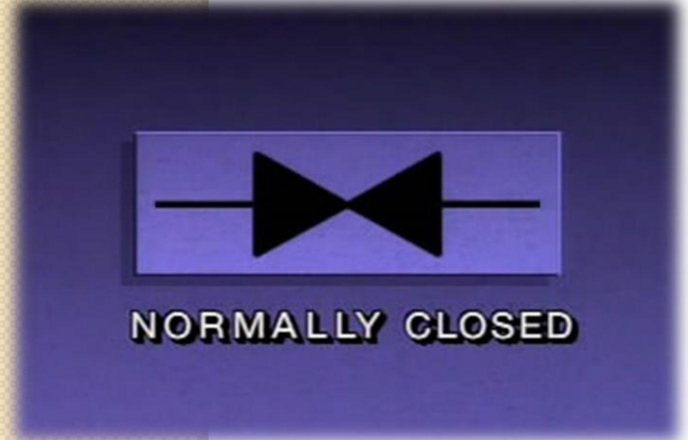
Classification of valves

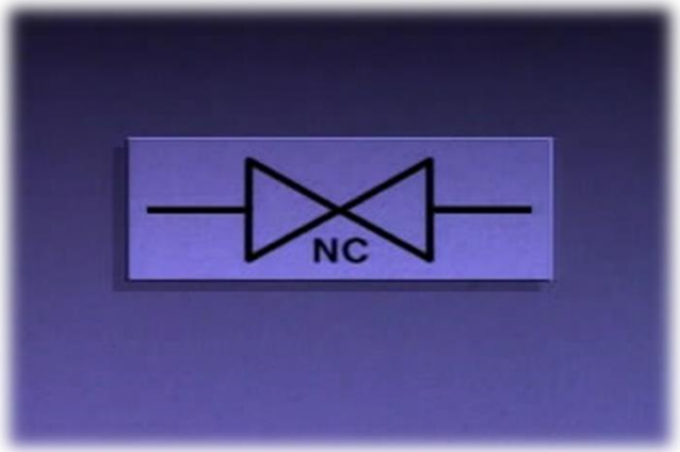
- Gate Valves

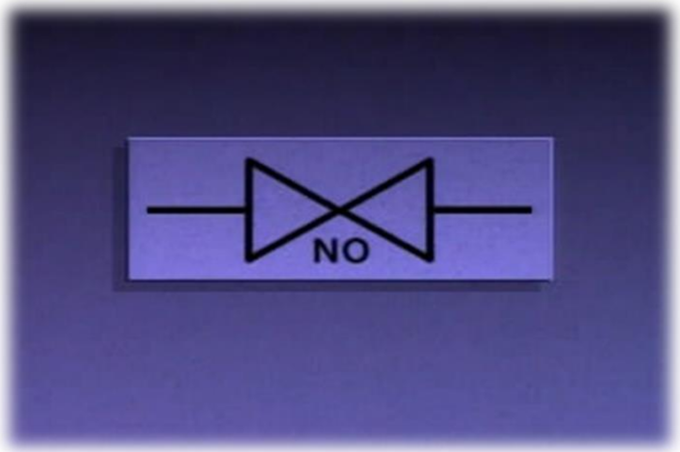
The name gate is derived from the appearance of the disk in the flow stream.




NORMALLY OPEN

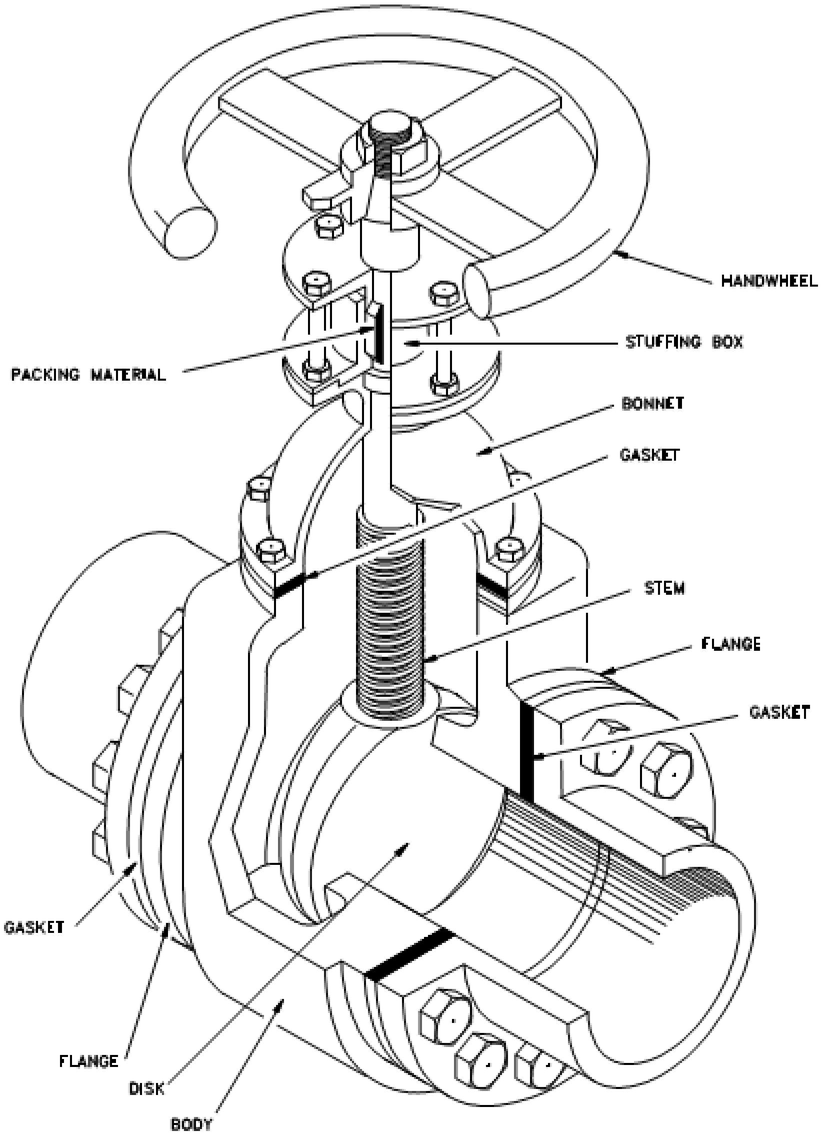

NORMALLY CLOSED


NC


NO

Classification of valves

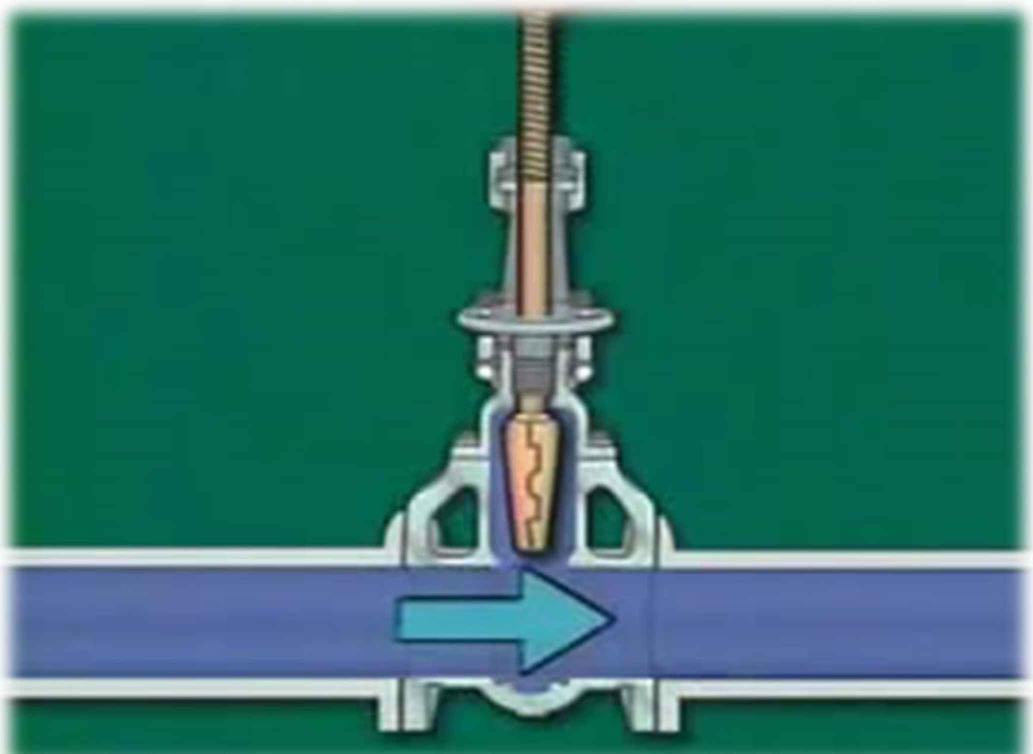
- Gate Valves



Classification of valves

- Gate Valves

•The disk of a gate valve is completely removed from the flow stream when the valve is fully open.

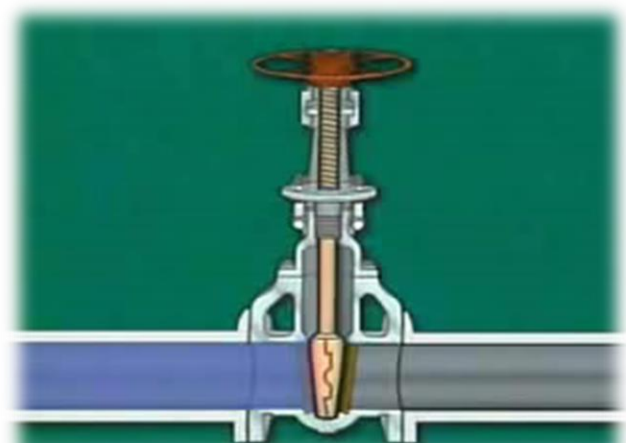


Classification of valves

- Gate Valves

•This characteristic offers virtually no resistance to flow when the valve is open. Hence,
•there is little pressure drop across an open gate valve.

•When the valve is fully closed, a disk-to-seal ring contact surface exists for 360°, and good sealing is provided.



Classification of valves

- Gate Valves

With the proper mating of a disk to the seal ring, very little or no leakage occurs across the disk when the gate valve is closed.

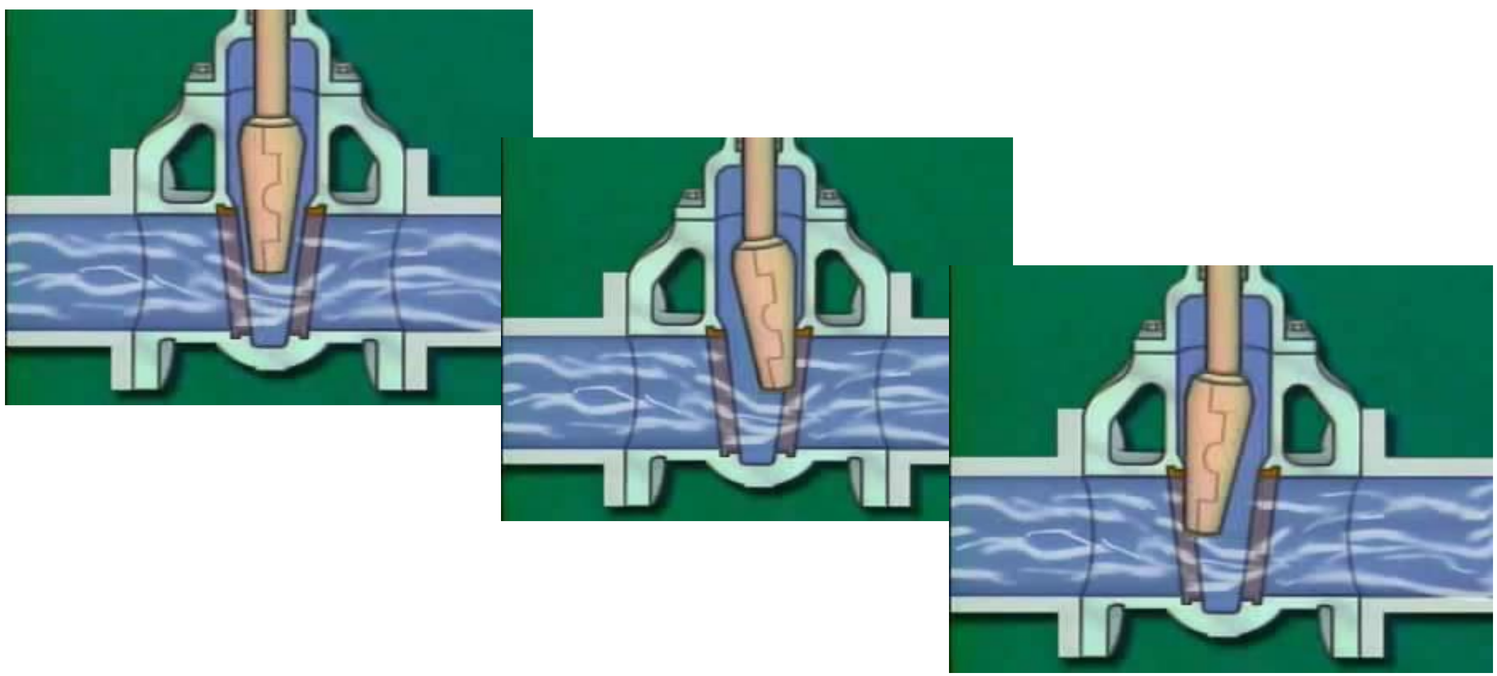
On opening the gate valve, the flow path is enlarged in a highly nonlinear manner with respect to percent of opening.

This means that flow rate does not change evenly with stem travel.

Classification of valves

- Gate Valves

Also, a partially open gate disk tends to vibrate from the fluid flow.

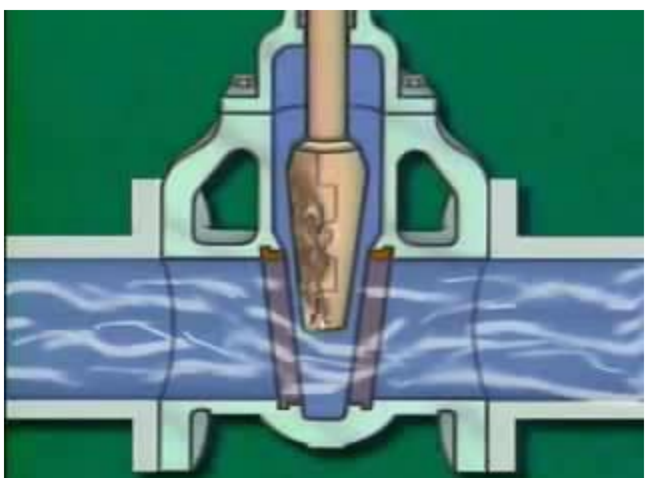


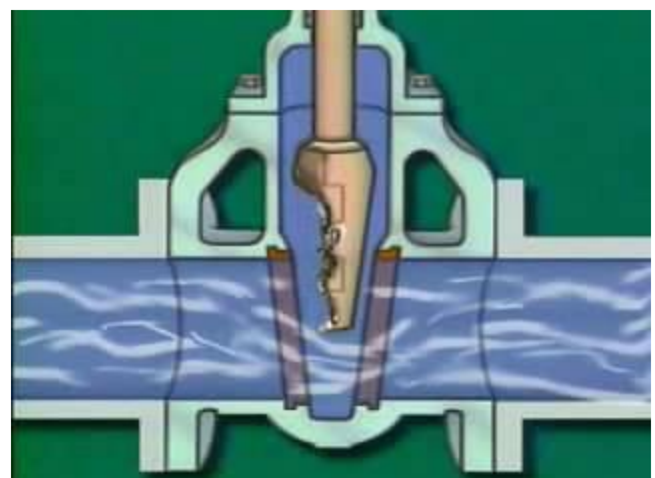
Classification of valves

- Gate Valves

Most of the flow change occurs near shutoff with a relatively high fluid velocity causing disk and seat wear and eventual leakage if used to regulate flow.

For these reasons, gate valves are not used to regulate or throttle flow.





Classification of valves

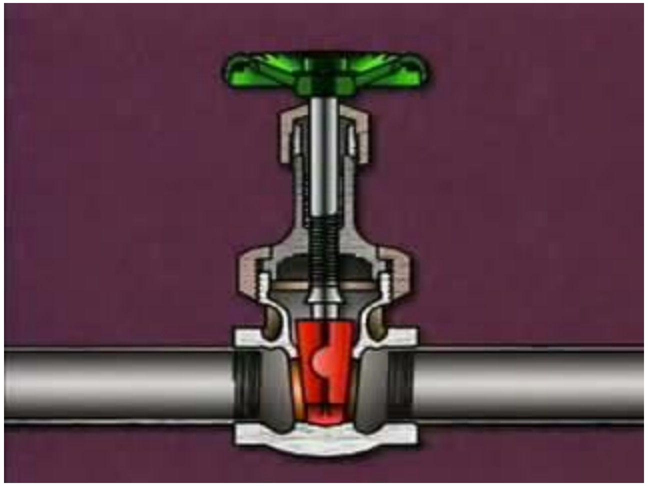
- Gate Valves

Valve open counter c.w

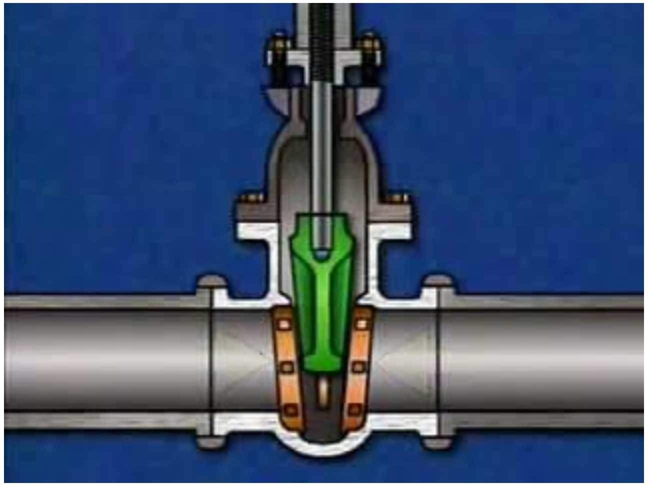
Valve close c.w

Classification of valves

- Gate Valves



Fixed seat for small application



Replacement seat for large valves.

Classification of valves

- Gate Valves

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.

Classification of valves

- Gate Valves

Gate Valve Disk Design

Gate valves are available with a variety of disks. Classification of gate valves is usually made by the type disk used:

1. solid wedge,
2. flexible wedge,
3. split wedge,
4. or parallel disk

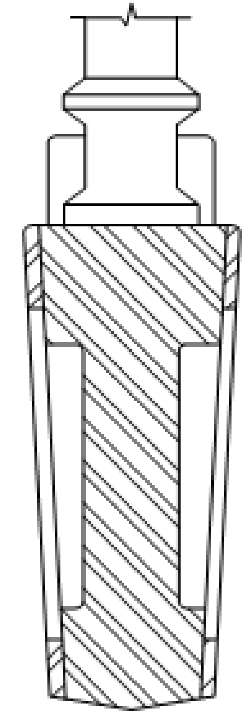
Classification of valves

- Gate Valves

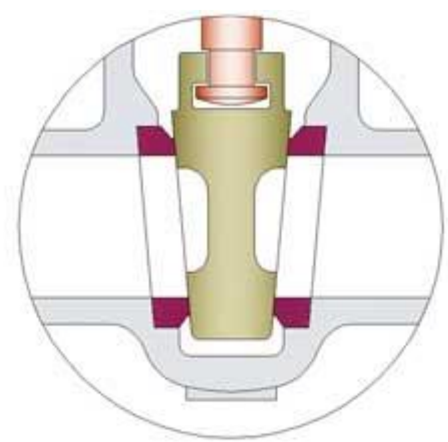
Solid wedges, flexible wedges, and split wedges are used in valves having inclined seats.
Parallel disks are used in valves having parallel seats.
Regardless of the style of wedge or disk used, the disk is usually replaceable.
In services where solids or high velocity may cause rapid erosion of the seat or disk, these components should have a high surface hardness and should have replacement seats as well as disks. If the seats are not replaceable, seat damage requires removal of the valve from the line for re-facing of the seat, or re-facing of the seat in place.
Valves being used in corrosion service should normally be specified with replaceable seats.

Classification of valves

- Gate Valves



<u>Solid Wedge</u>
The solid wedge gate valve shown in
Figure is the most
commonly used disk because of its
simplicity and strength.
A valve with this type of wedge may be
installed in any
position and it is suitable for almost all
fluids. It is practical
for turbulent flow.



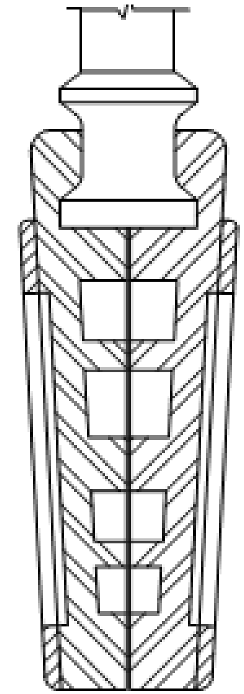
Solid Wedge Gate

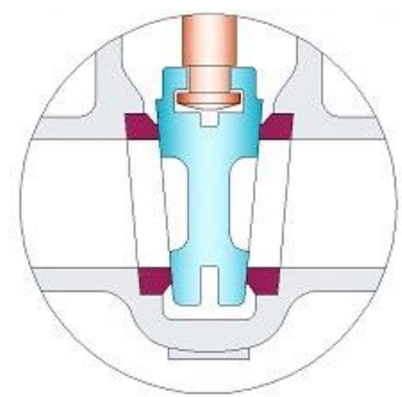
Classification of valves

- Gate Valves

<u>Flexible Wedge</u>

The flexible wedge gate valve is a one-piece disk with a cut around the perimeter to improve the ability to match error or change in the angle between the seats. The cut varies in size, shape, and depth. A shallow, narrow cut gives little flexibility but retains strength. A deeper and wider cut, or cast-in recess, leaves little material at the center, which allows more flexibility but compromises strength.





Flexible Wedge Gate

Classification of valves

- Gate Valves

Flexible Wedge

The flexible-wedge is also made in one piece. It has a groove cut around its perimeter that allows it to bend a little to fit the shape of the seat more easily. These discs may also have recesses cast into them to increase flexibility.

Flexible-wedge discs are used for valves in steam lines. When the temperature of a closed valve rises, solid-wedge discs can expand and stick in their seats. Flexible wedge discs can compress mere easily and are less likely to distort.

Classification of valves

- Gate Valves

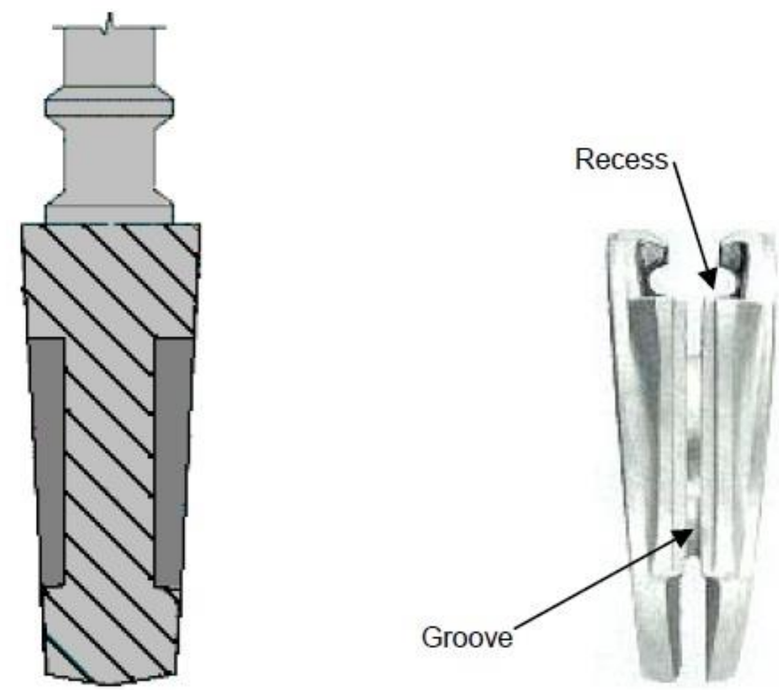
Flexible Wedge

The major problem associated with flexible gates is that water tends to collect in the body neck. Under certain conditions, the admission of steam may cause the valve body neck to rupture, the bonnet to lift off, or the seat ring to collapse. Following correct warming procedures prevent these problems.

Classification of valves

- Gate Valves

<u>Flexible Wedge</u>



(a) Solid-wedge Disc

(b) Flexible-wedge Disc

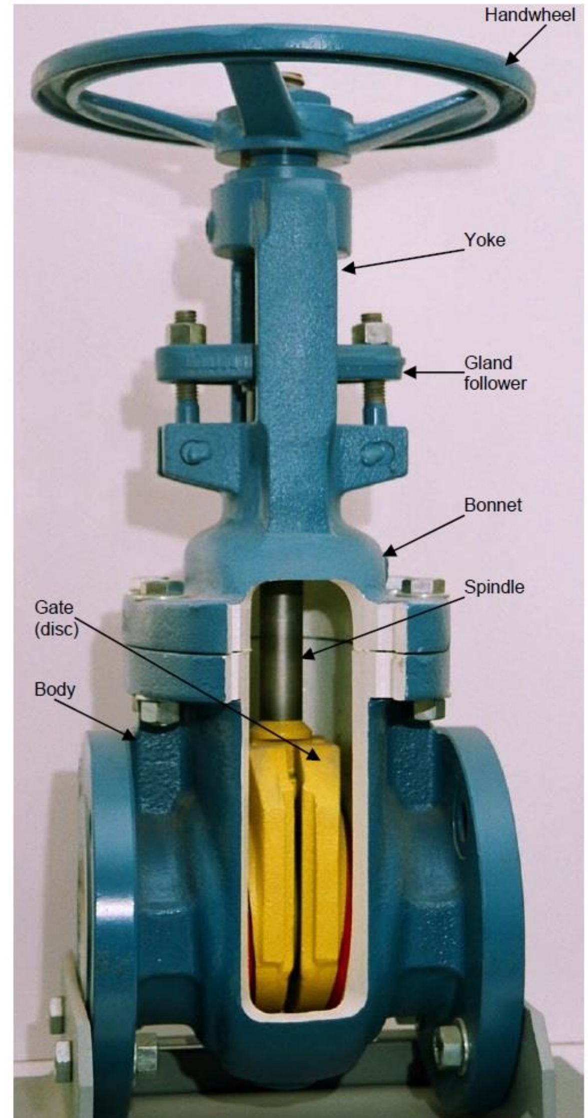
Disc Design

Classification of valves

- Gate Valves

split wedge

Split-wedge discs are made in two separate halves.
This allows the wedge angle between their outer faces to adjust to fit the seat.
This is especially useful if a solid particle is stuck between the disc and its seat.
Split-wedge discs are used for gases, especially corrosive gases.

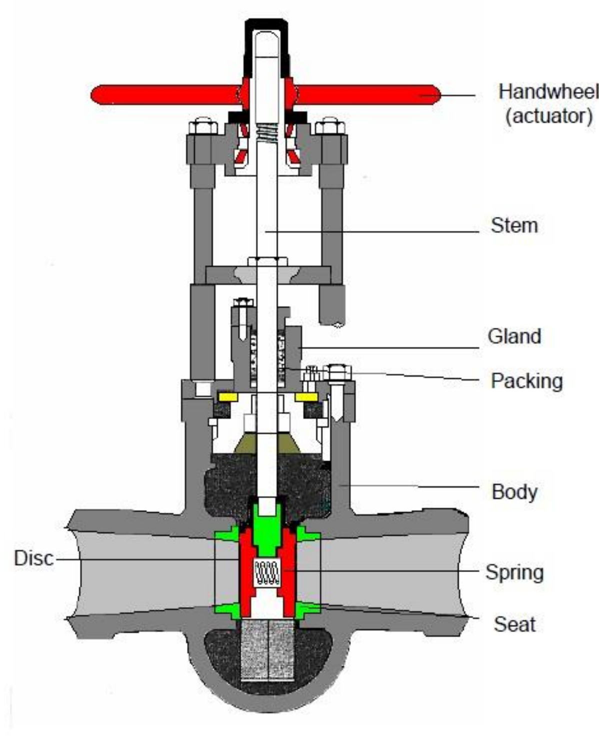


Cutaway Rising-stem, Flexible-wedge Gate Valve

Classification of valves

- Gate Valves

parallel disk
Parallel slide valves also have split discs.
Their faces are parallel, not wedge A spring between the disc halves pushes them against their seats.
When the valve is closed, the disc on the outlet side is also pushed against its seat by the fluid pressure on the inlet side.



Parallel-slide Gate Valve

Classification of valves

- Gate Valves

parallel disk

As the valve opens and closes, the sliding action keeps the disc faces clean but causes wear to discs and seats. When fully open, the discs are completely clear of the bore giving no obstruction to flow through the valve.

Gate valve seats may be integral with the valve body or separate seat rings. Integral seats are cut into the valve body and are part of the body. These seats can not be replaced. They can be repaired by lapping with grinding paste.

Classification of valves

- Gate Valves

parallel disk

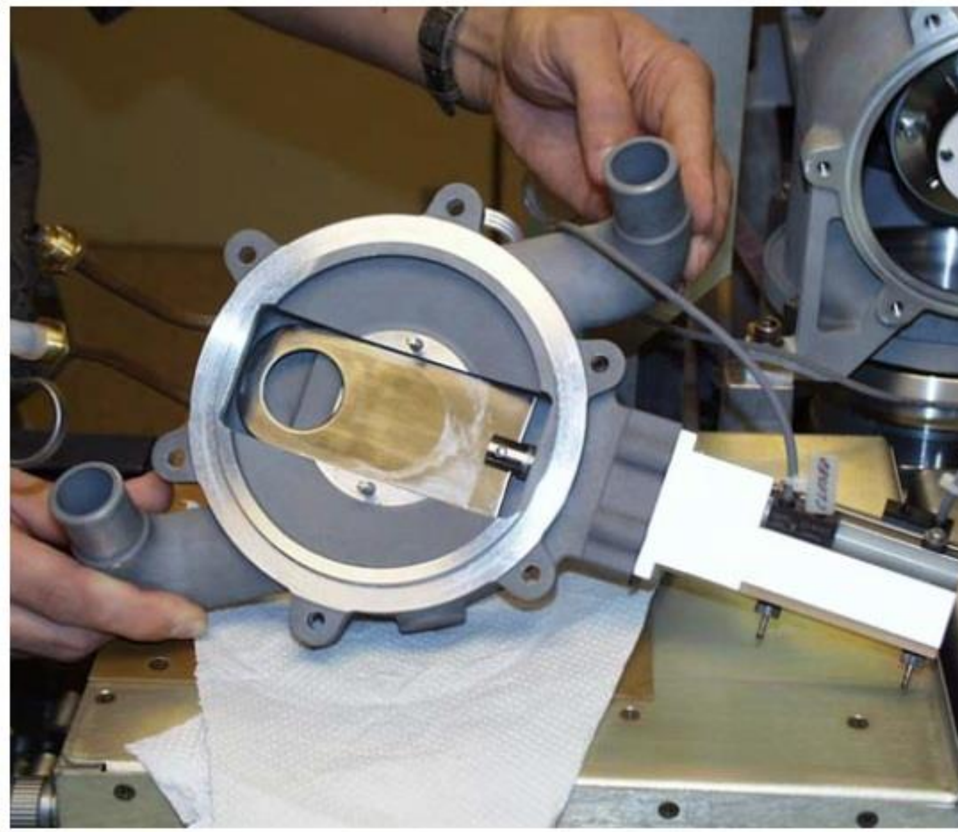
Seat rings may be pressed or screwed into the body. These can be of a different material and can be replaced when worn or damaged.

Knife gate valves, have a simple, one-piece closing element. It is a parallel-sided plate that may move clear of the flow path to open or may have a hole that moves into the flow path.

Classification of valves

- Gate Valves

(a)



(b)

Knife Gate Valves

Classification of valves

- Gate Valves

Advantages

- Gate valves opens or closes slowly, which prevents fluid hammer and subsequent damage to the piping system.
- They need long operation time since setting the valve to the fully open or closed position requires the handle to be turned many times.
- Good choice for on-off service.
- Full flow, low pressure drop.
- Bidirectional.

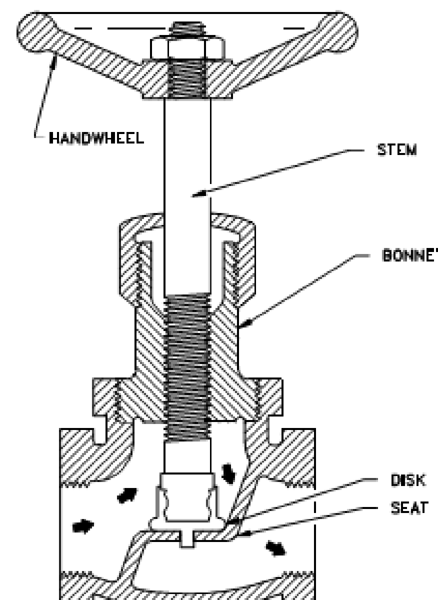
Disadvantages

- 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.
- Repairs, such as lapping and grinding, are generally more difficult to accomplish.

Classification of valves

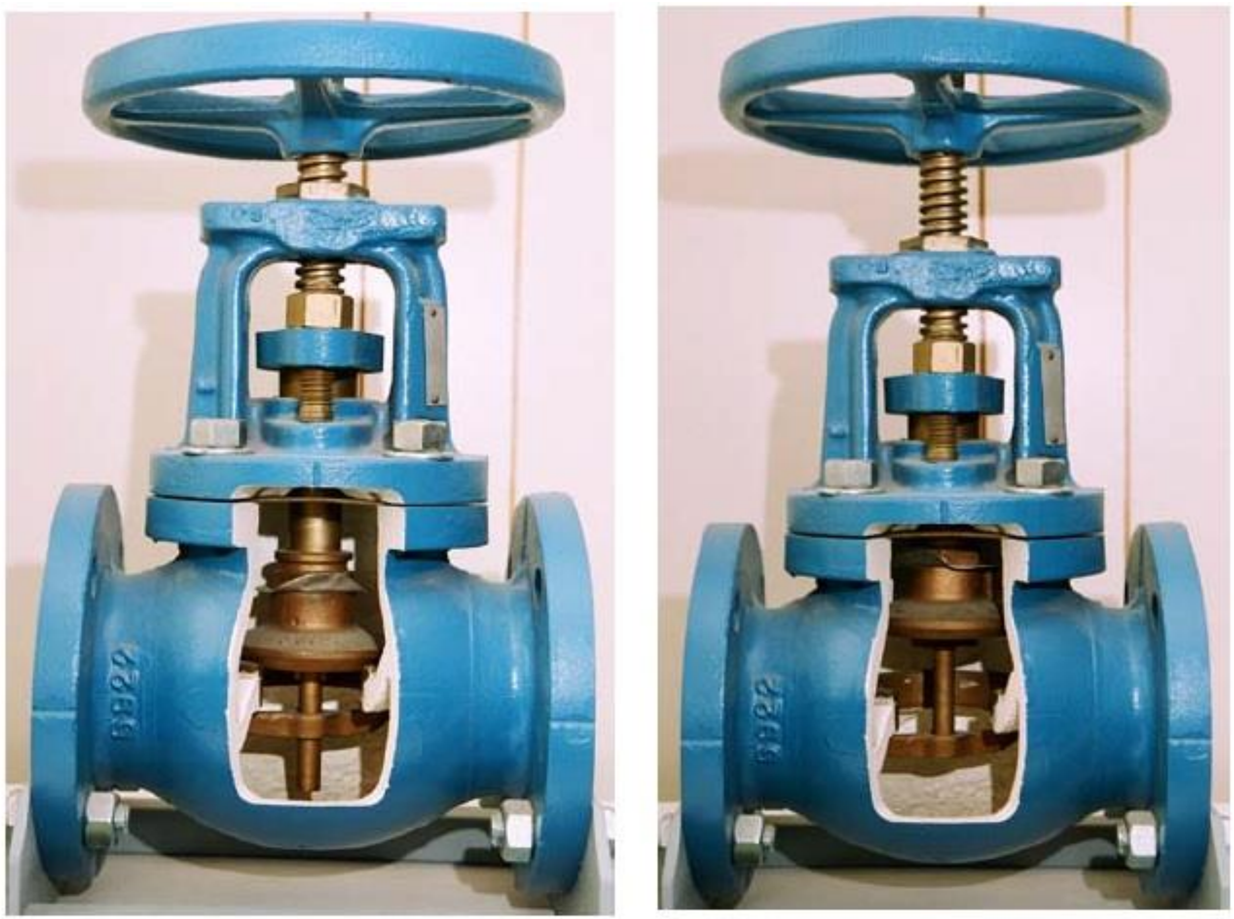
- **Globe Valves**

Globe valves are linear-motion valves and can look very similar to gate valves from the outside. Globe valves have rising stems but, unlike gate valves, the actuator is fixed to the stem and rises with it.



Classification of valves

- **Globe Valves**

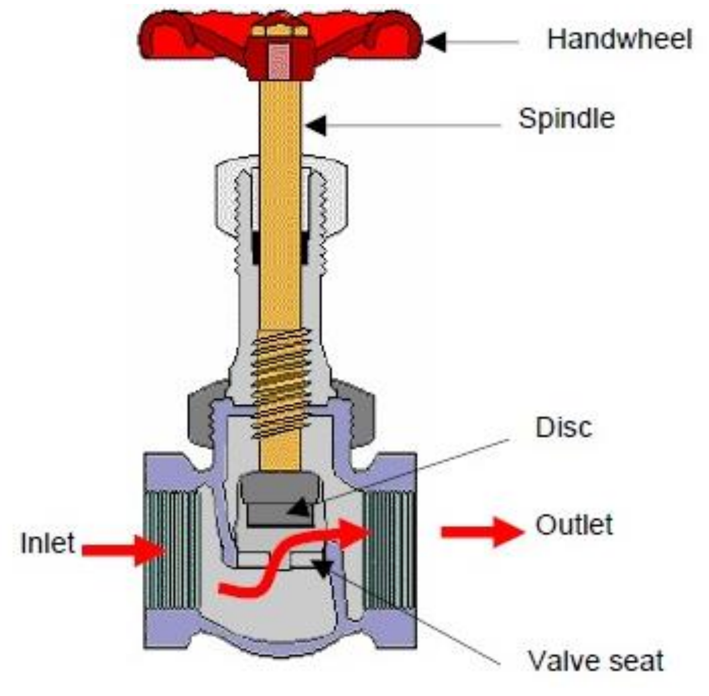


(a) Valve Closed | Globe Valve | (b) Valve Open

Classification of valves

- **Globe Valves**

Globe valve design makes them good for flow regulation as well as starting and stopping flow. In most designs, the flow direction is as shown in Figure. Here, the fluid pressure helps to push the valve open. The packing is not under pressure when the valve is closed and this helps it to last longer



Flow through Z-type Globe Valve

Classification of valves

Globe Valves

The flow direction is often marked on the valve body.
Make sure that you fit the valve the correct way around.

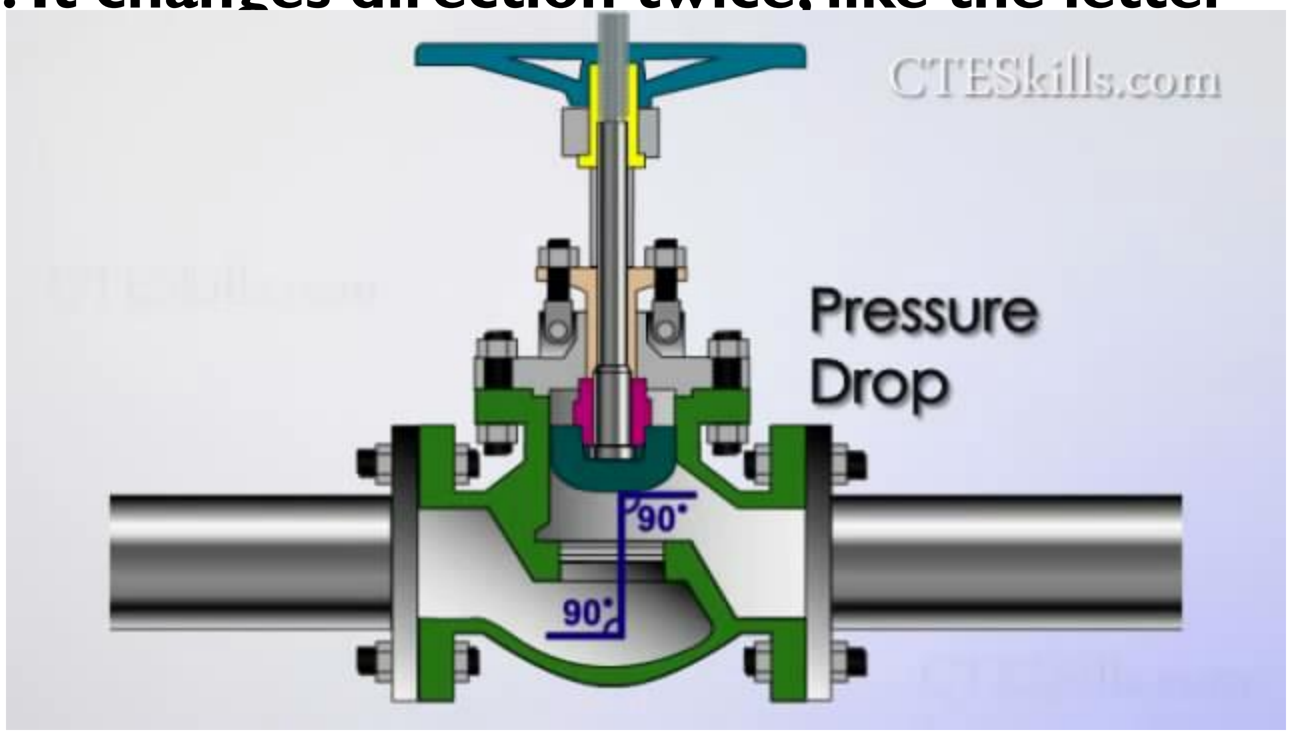
Globe valves can have three main types of body.

- **Z-type**
- **angle**
- **Y-type**

Classification of valves

- **Globe Valves**

The valves shown in Figures above have Z-type bodies. The name is given because of the path the fluid has to take as it passes through the valve. It changes direction twice, like the letter Z.



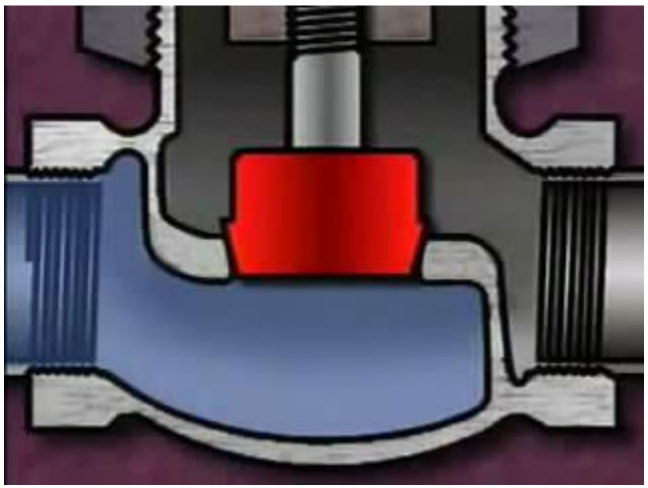
Classification of valves

- **Globe Valves**

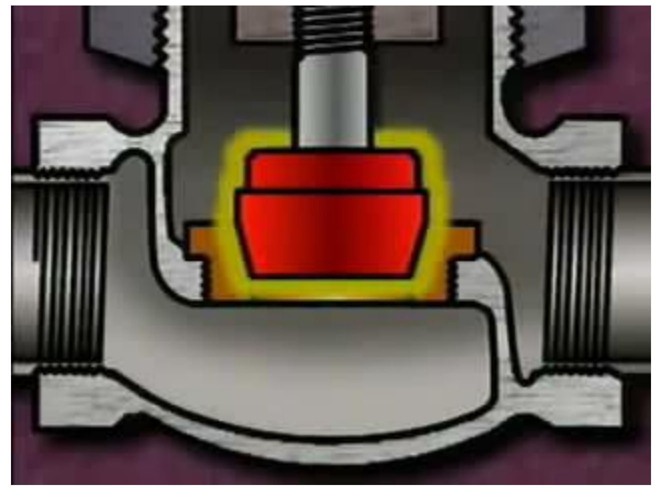
Z-type globe valves are used mainly for small-size, low-pressure applications. In large, high-pressure lines, the changes of flow direction cause a large pressure drop and turbulence that can damage the trim.

Classification of valves

- **Globe Valves**



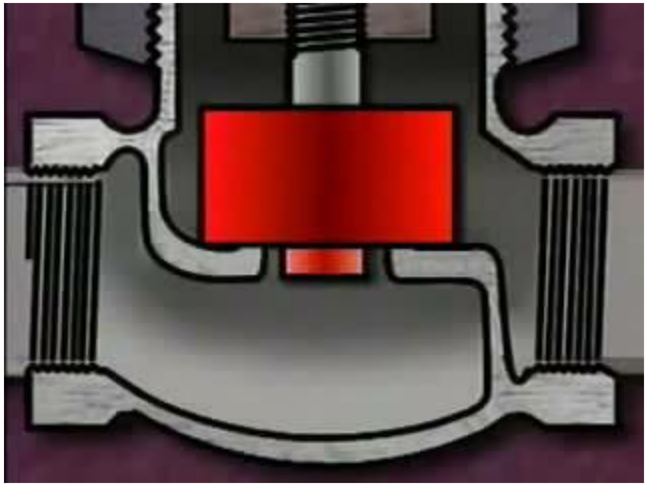
Used for stop and start flow

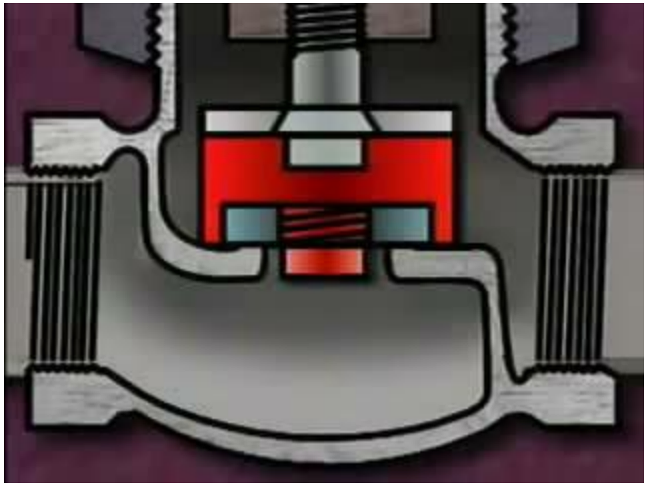


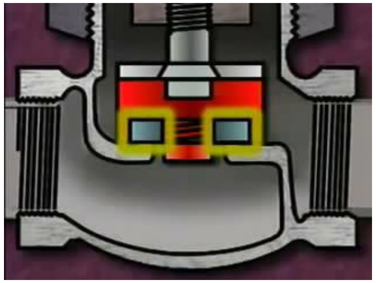
Used for regulate flow

Classification of valves

Globe Valves





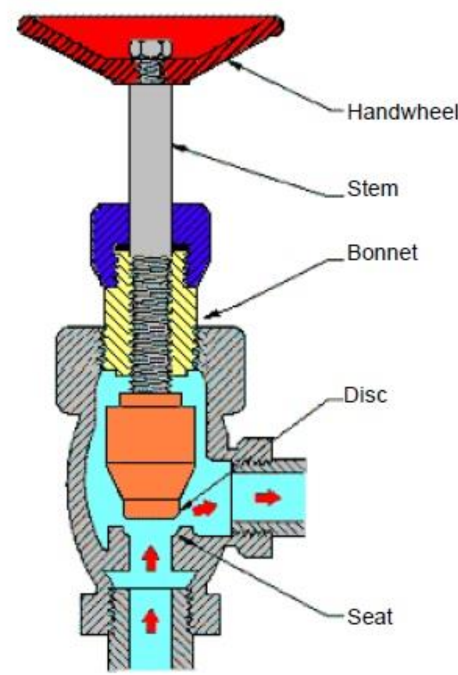


Rapper or o-ring disk

Classification of valves

- **Globe Valves**

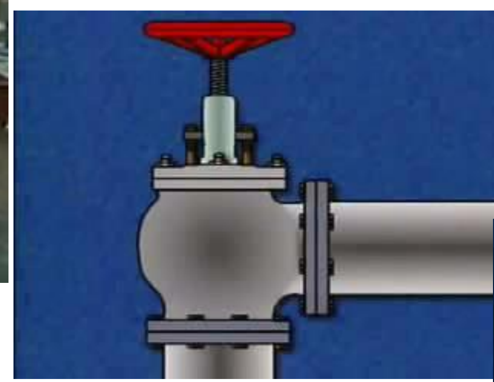
Figure below shows an angle-type globe valve. The flow changes direction only once and the pressure drop is less than for the Z-type. It can be used for medium and high pressure applications.

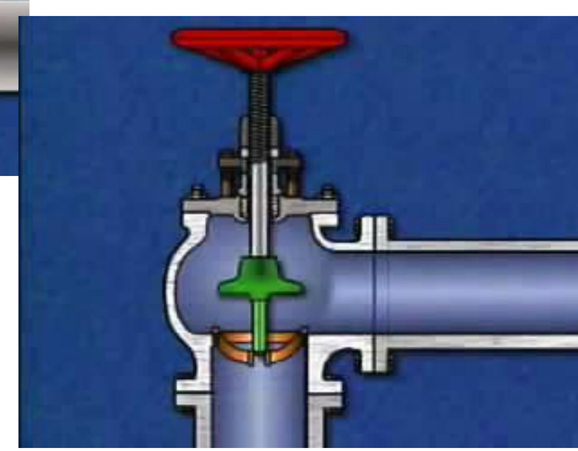


Classification of valves

- **Globe Valves**

An angle-type globe valve

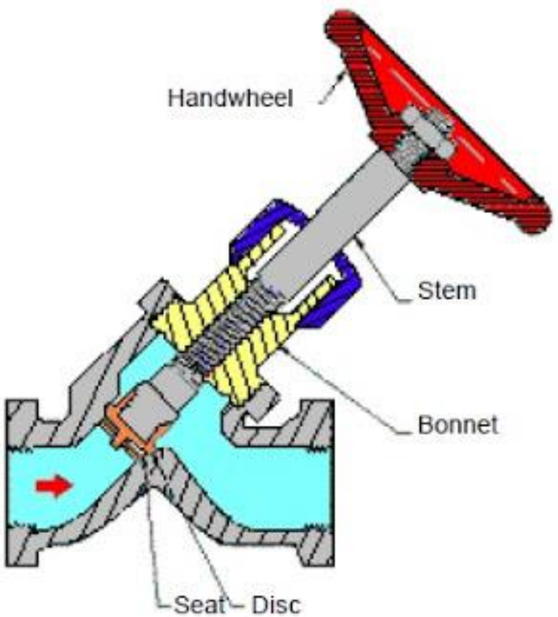




Classification of valves

- **Globe Valves**

Figure below shows a Y-type globe valve. Having the seat at about 45o to the flow direction straightens the flow path and reduces the pressure drop. This type of valve can be used for high-pressure applications.



Classification of valves

- **Globe Valves**

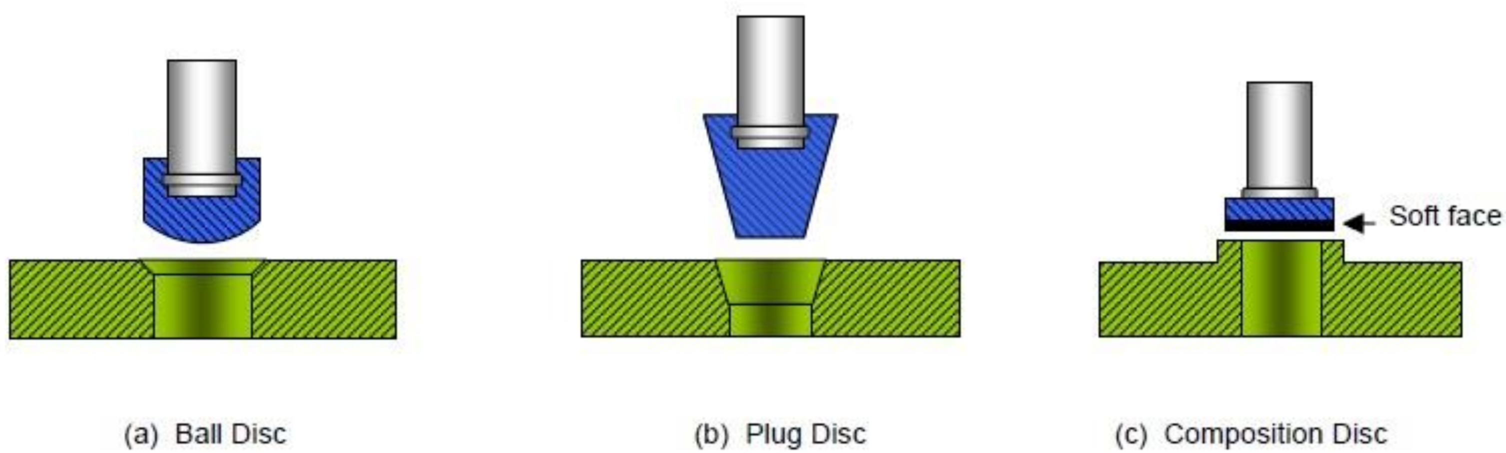
Most globe valves use one of three types of disc:

- **Ball**
- **Plug**
- **Composition**

Classification of valves

- ## Globe Valves

Ball discs have a curved lower surface. They seal on a tapered seat that has a flat surface, as shown in Figure below. They are used mainly for low-pressure and low temperature applications.



Globe Valve Discs

Classification of valves

- **Globe Valves**

Plug discs come in different shapes but are all tapered. The seat has a matching taper as shown in Figure (b).

Composition discs have a hard backing piece with a soft face as shown in Figure(c). Hard particles trapped between the disc and the seat push into the soft face, maintaining a good seal. Composition discs are replaceable.

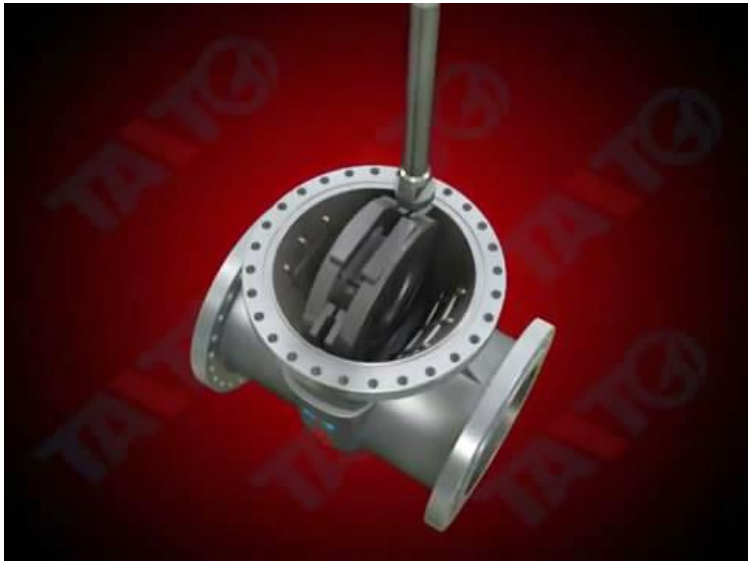
Classification of valves

- ## Globe Valves

Globe Valve Disk and Stem Connections

Globe valves employ two methods for connecting disk and stem:

•T-slot construction and disk nut construction. In the T-slot design, the disk slips over the stem.



Classification of valves

- **Globe Valves**

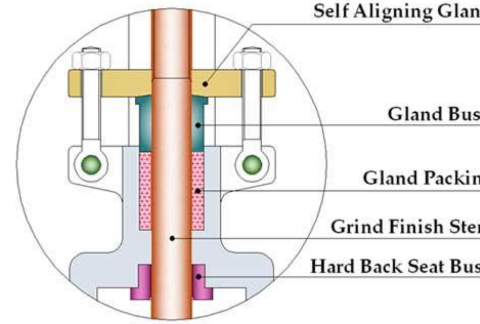
<u>Globe Valve Disk and Stem Connections</u>

Globe valves employ two methods for connecting disk and stem:

•In the disk nut design, the disk is screwed into the stem.

Classification of valves

- **Globe Valves**



Bonnet Assembly

<u>Globe Valve Seats</u>

Globe valve seats are either integral with or screwed into the valve body.

Many globe valves have backseats. A backseat is a seating arrangement that provides a seal between the stem and bonnet.

When the valve is fully open, the disk seats against the backseat.

The backseat design prevents system pressure from building against the valve packing.

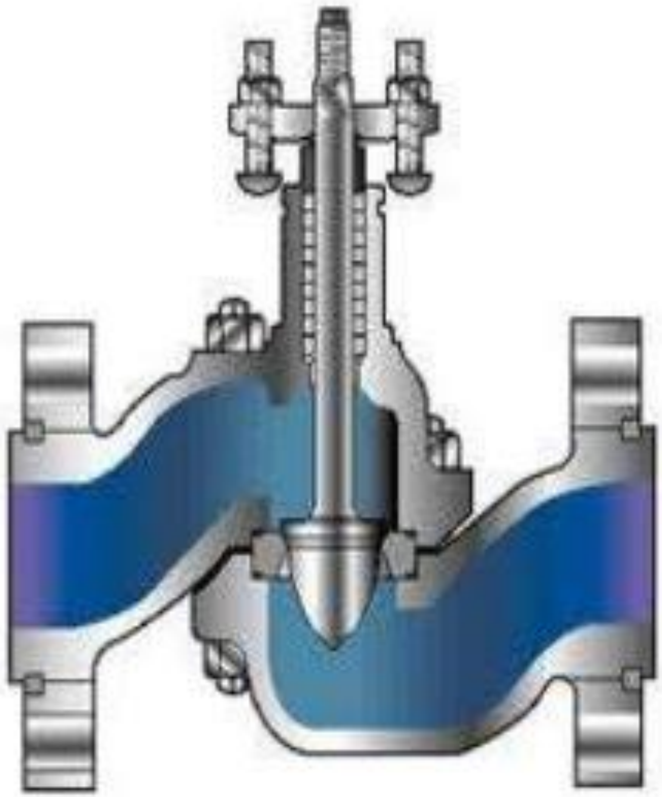
Classification of valves

- **Globe Valves**

Globe Valve Direction of Flow

For low temperature applications, globe and angle valves are ordinarily installed so that pressure is under the disk. This promotes easy operation, helps protect the packing, and eliminates a certain amount of erosive action to the seat and disk faces. For high temperature steam service, globe valves are installed so that pressure is above the disk. Otherwise, the stem will contract upon cooling and tend to lift the disk off the seat

Globe Valves



Advantages

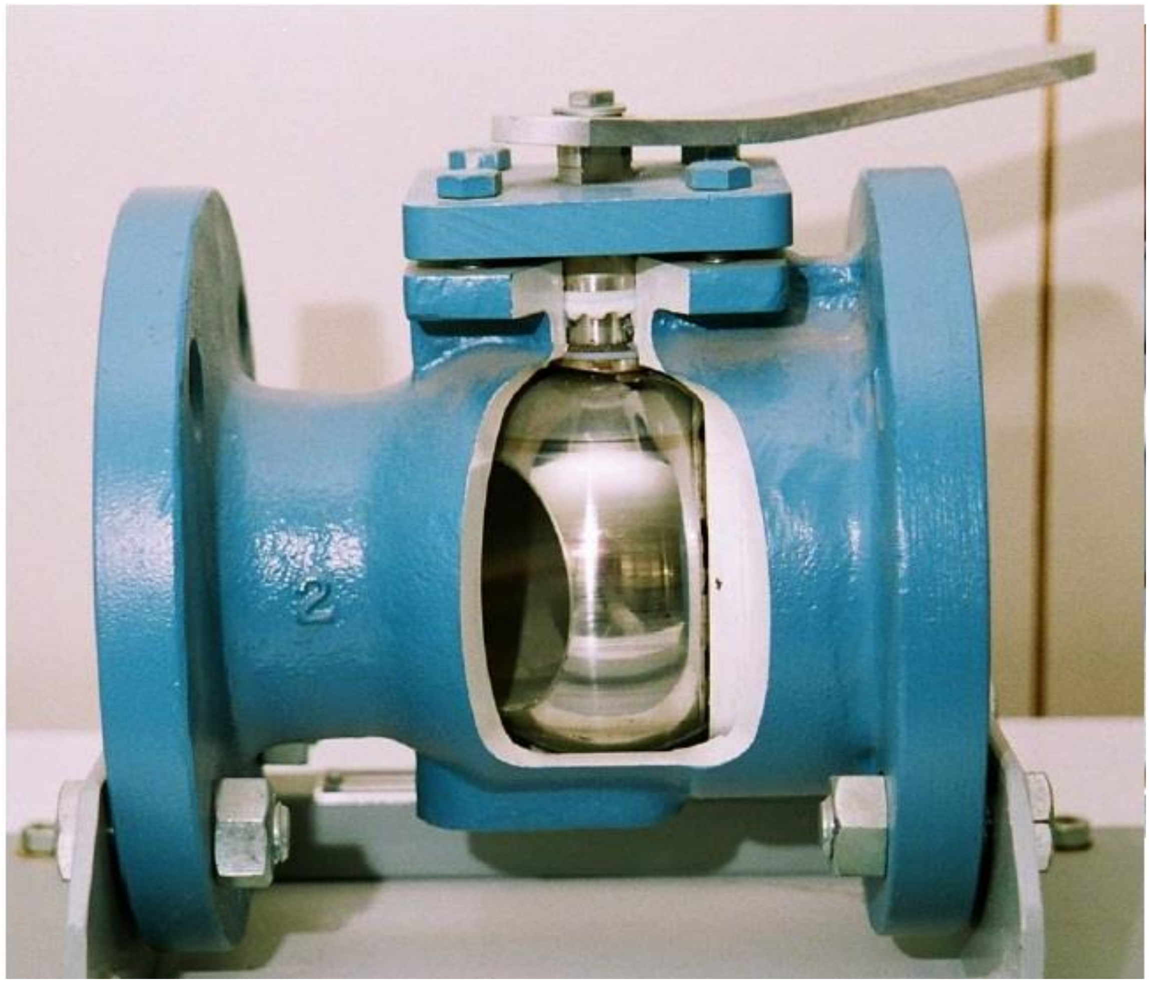
- Recommended for throttling applications.
- Good for frequent operation.
- Easy to repair.

Disadvantages

- Flow path causes a significant pressure drop.
- Globe valves are more costly than alternative valves.

Classification of valves

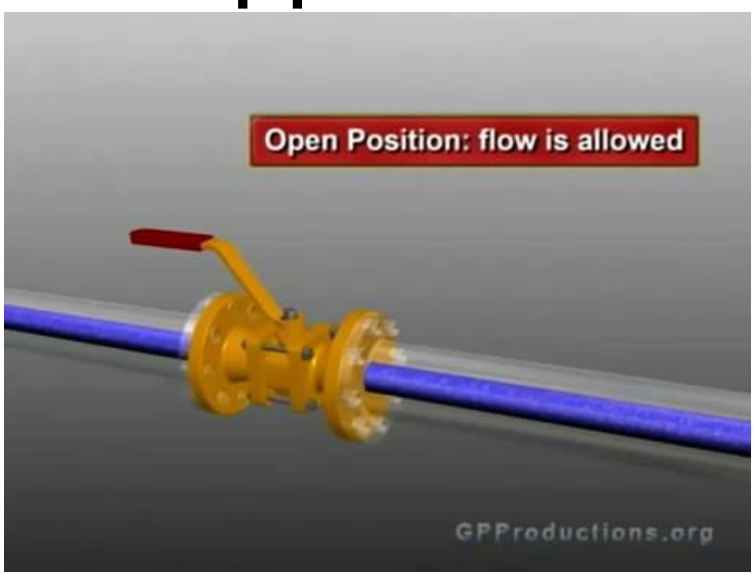
- **Ball Valves**

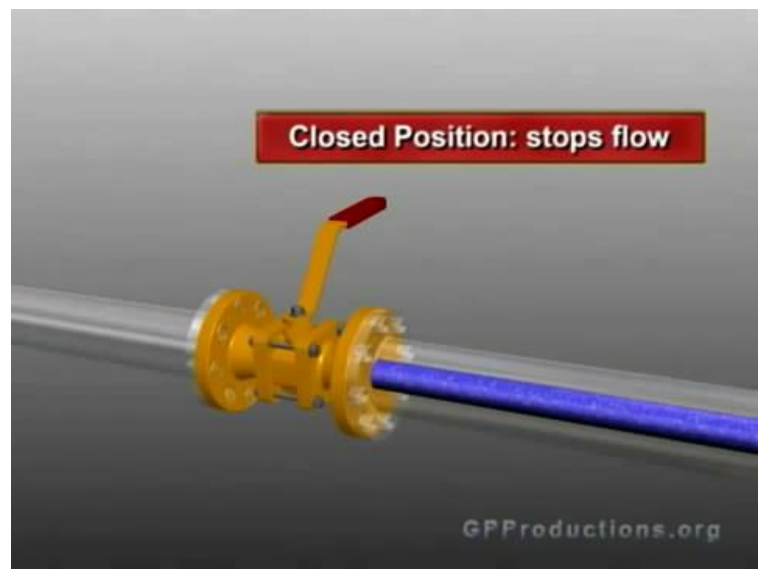


Classification of valves

- **Ball Valves**

Ball valves start and stop flow by rotating a ball-shaped closing element.
They are classed as rotational-motion valves.
The ball has a hole through it of the same diameter as the pipeline.





Classification of valves

- **Ball Valves**

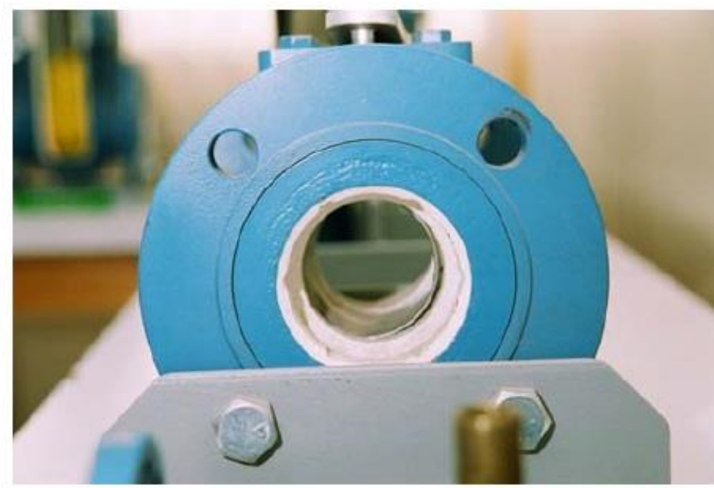
The valve is open when the hole lines up with the inlet and outlet of the valve body. ABOVE FIGURE **shows a ball valve with part of the body cut away to show the closing element.**

Classification of valves

- **Ball Valves**

Most ball valve actuators are of the quick-acting type, which require a 90°turn of the valve handle to operate the valve. Other ball valve actuators are planetary gear-operated.
This type of gearing allows the use of a relatively small hand-wheel and operating force to operate a fairly large valve.

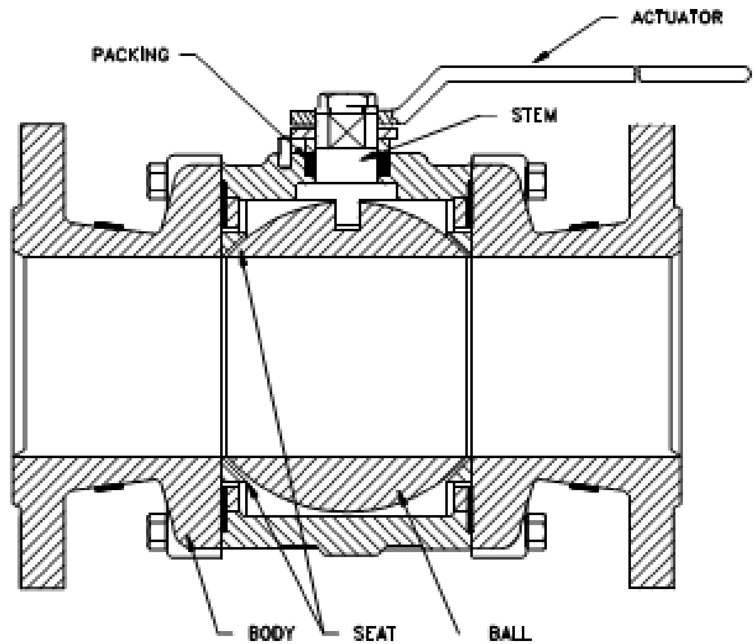
(a) Valve Closed

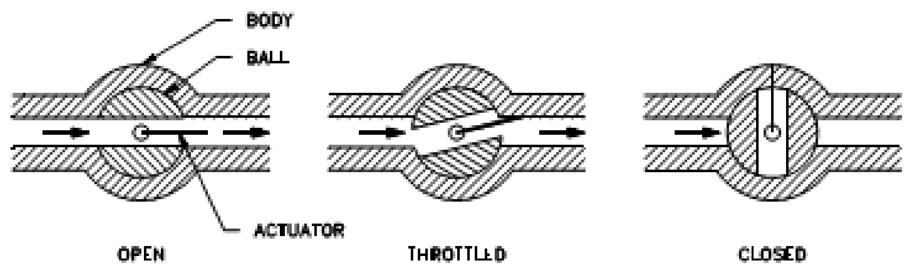


(b) Valve Open

Classification of valves

- **Ball Valves**





Classification of valves

- **Ball Valves**

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.

Classification of valves

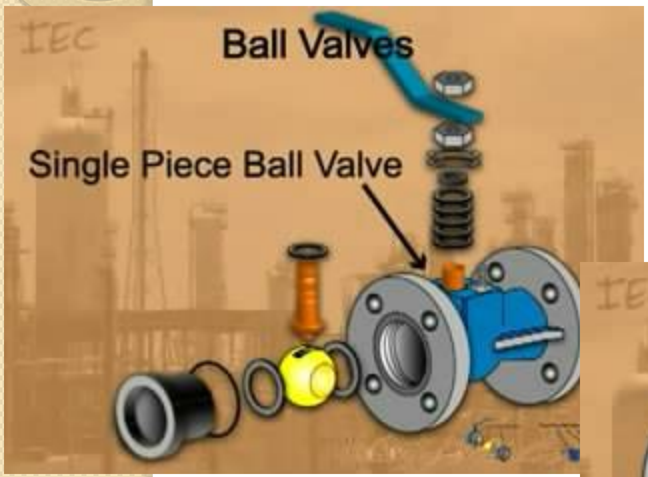
- **Ball Valves**

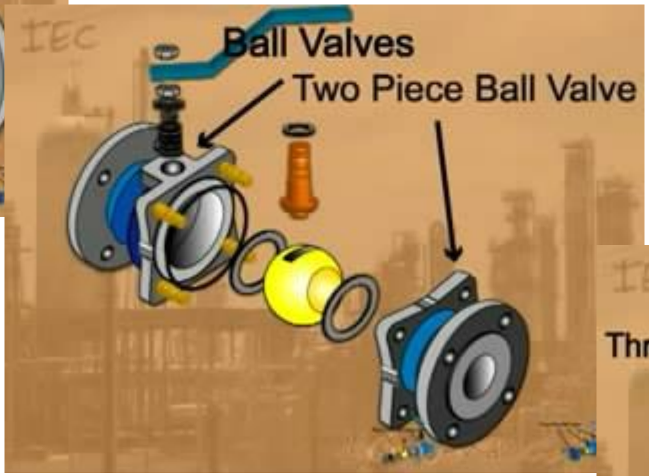
Disadvantages

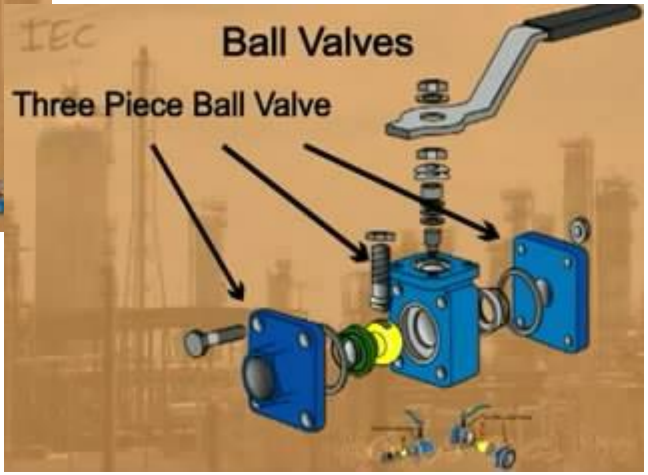
Conventional ball valves have relatively poor throttling characteristics. In a throttling position, the partially exposed seat rapidly erodes because of the impingement of high velocity flow.

Classification of valves

- **Ball Valves body styles.**

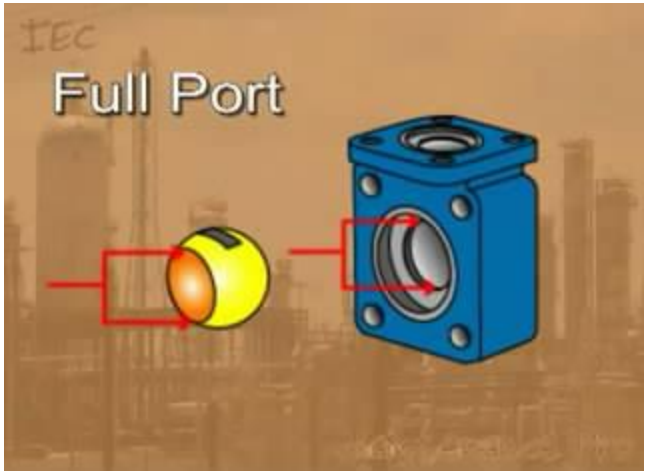


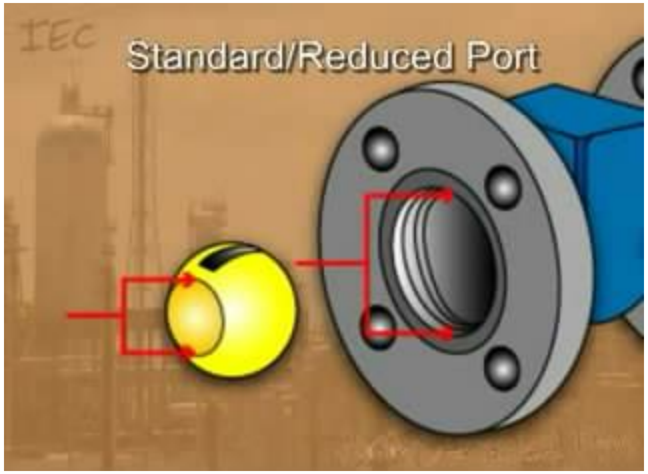




Classification of valves

- **Ball Valves body styles.**



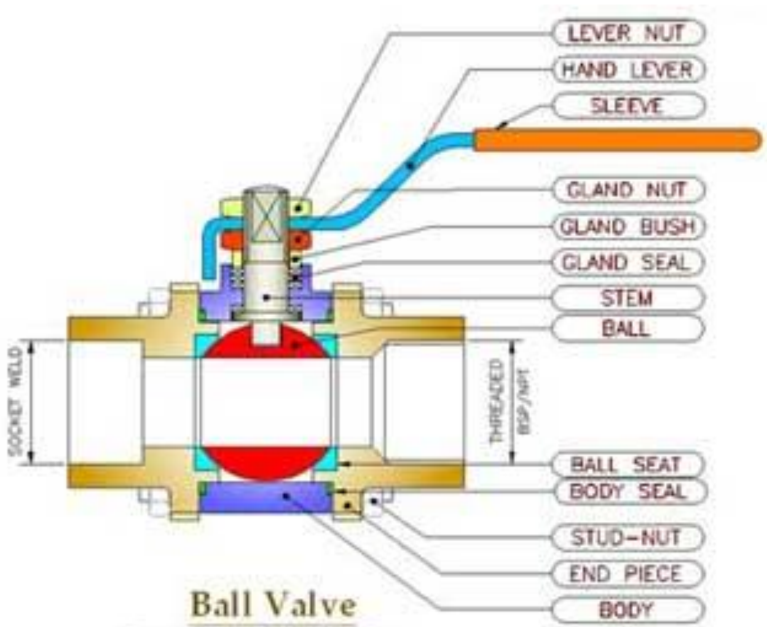


Classification of valves

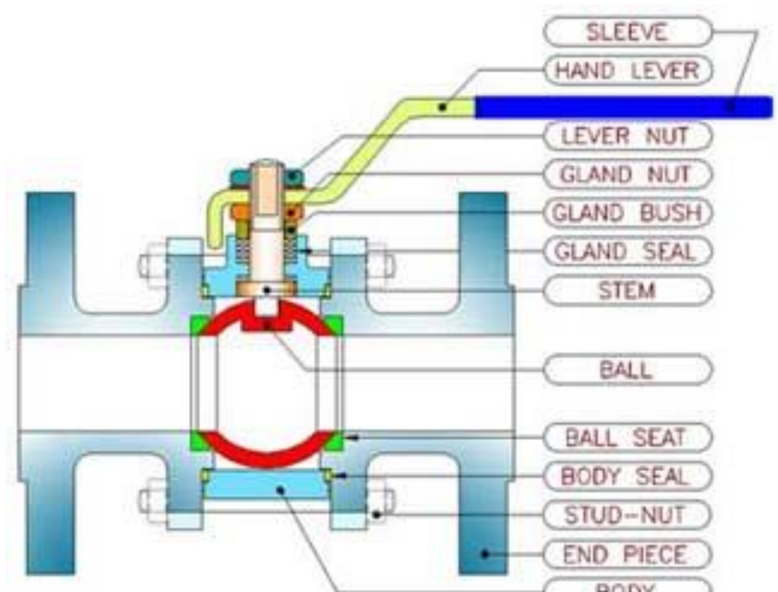
- **Ball Valves**

Ball Valve Stem Design

The stem in a ball valve is not fastened to the ball. It normally has a rectangular portion at the ball end which fits into a slot cut into the ball. The enlargement permits rotation of the ball as the stem is turned.



Ball Valve
Three Piece Design, Full Port
Screwed/Socket Weld End



Full Port, Floating Ball
Ball Valve

Classification of valves

- **Ball Valves**

Ball Valve Bonnet Design

A bonnet cap fastens to the body, which holds the stem assembly and ball in place.
Adjustment of the bonnet cap permits compression of the packing, which supplies the stem seal. Packing for ball valve stems is usually in the configuration of die-formed packing rings normally of TFE, TFE-filled, or TFE-impregnated material. Some ball valve stems are sealed by means of O-rings rather than packing.

Classification of valves

- **Ball Valves**

Ball Valve Position

Some ball valves are equipped with stops that permit only 90°rotation. Others do not have stops and may be rotated 360°. With or without stops, a 90°rotation is all that is required for closing or opening a ball valve.

The handle indicates valve ball position. When the handle lies along the axis of the valve, the valve is open.

When the handle lies 90°across the axis of the valve, the valve is closed. Some

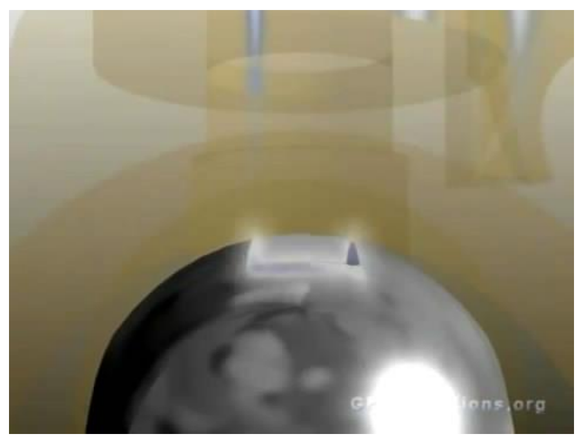
ball valve stems have a groove cut in the top face of the stem that shows the flowpath through the ball. Observation of the groove position indicates the position of the port through the ball. This feature is particularly advantageous on multiport ball valves

Classification of valves

- **Ball Valves**

<u>Ball Valve Position</u>

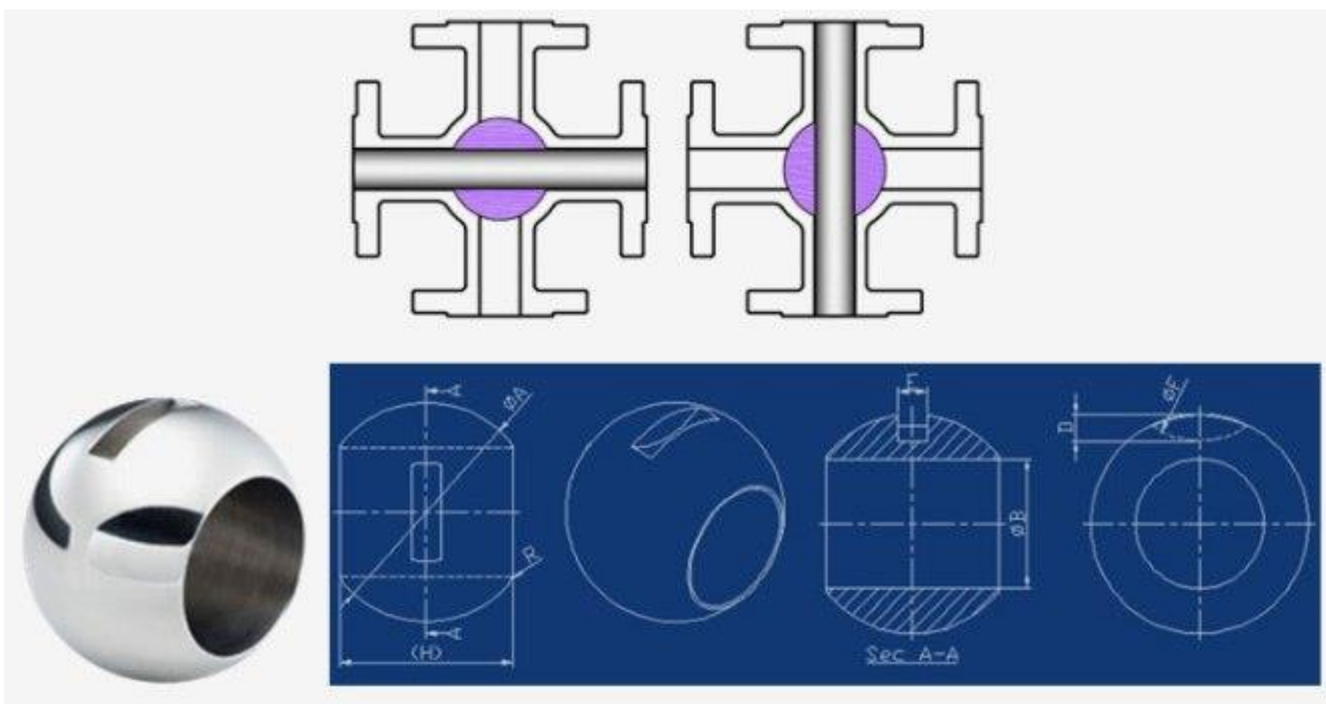
ball valve stems have a groove cut in the top face of the stem that shows the flowpath through the ball. Observation of the groove position indicates the position of the port through the ball. This feature is particularly advantageous on multiport ball valves



Classification of valves

- **Ball Valves**

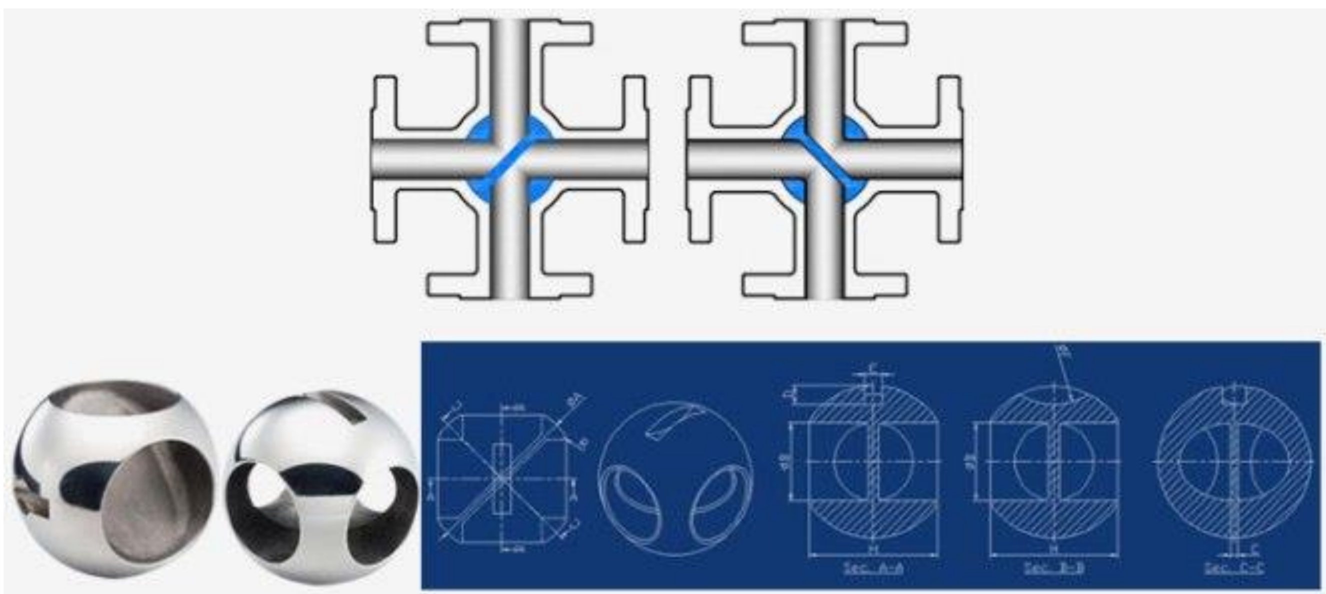
Straight port-4way



Classification of valves

- **Ball Valves**

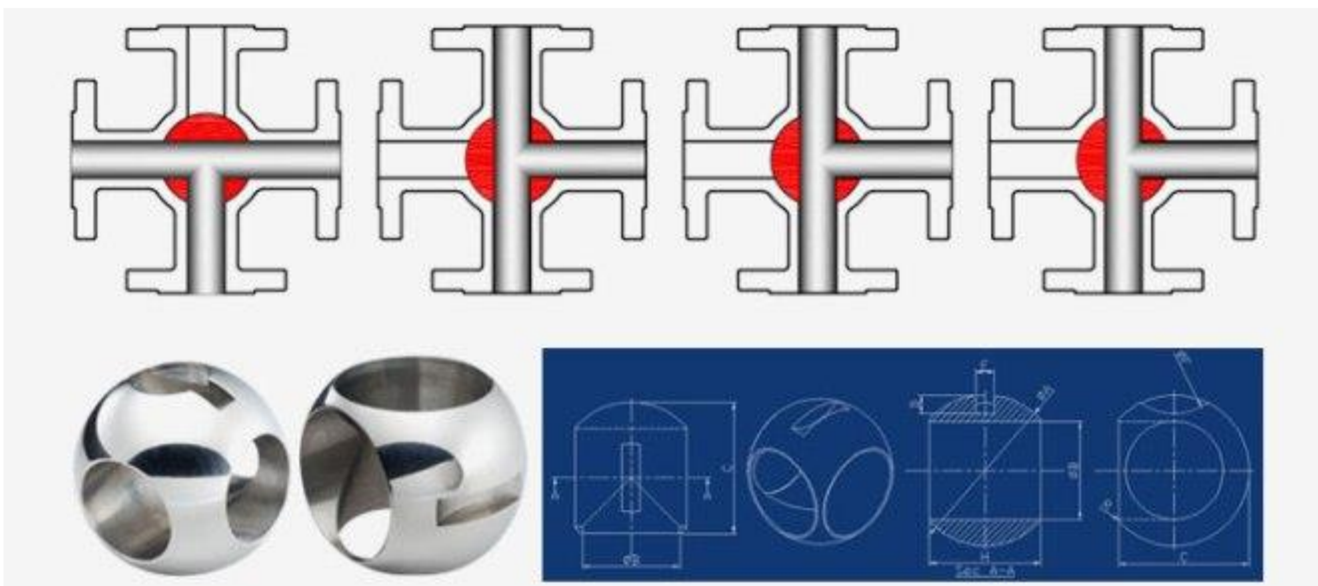
X port-4way



Classification of valves

- **Ball Valves**

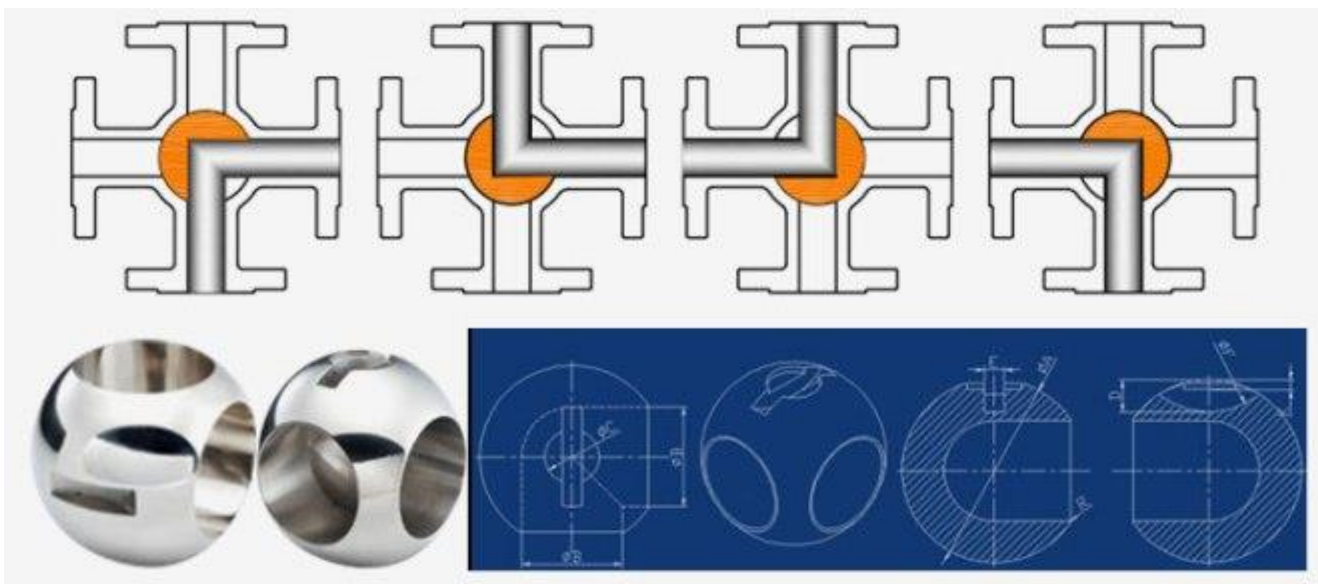
T port-4way



Classification of valves

- **Ball Valves**

L port-4way



Classification of valves

- **Ball Valves**

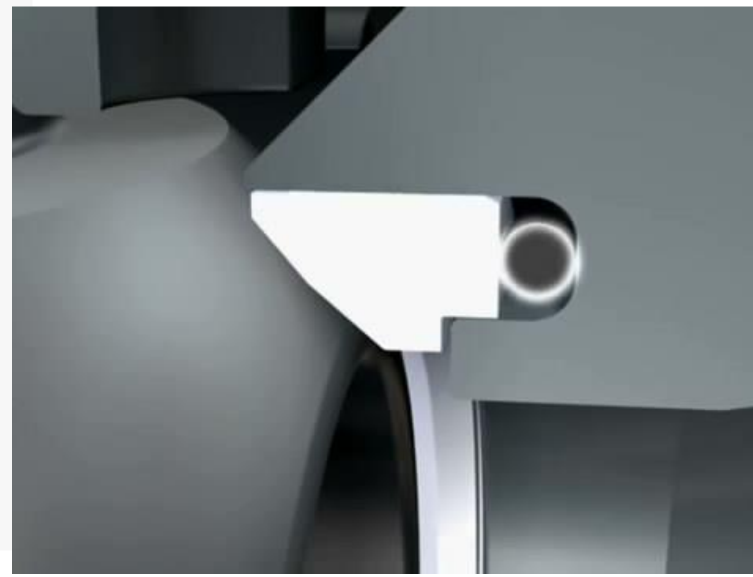
mixed

First diverted

Scand diverted

Classification of valves

- **Ball Valves**



Valve seat

Classification of valves

- **Ball Valves materials**

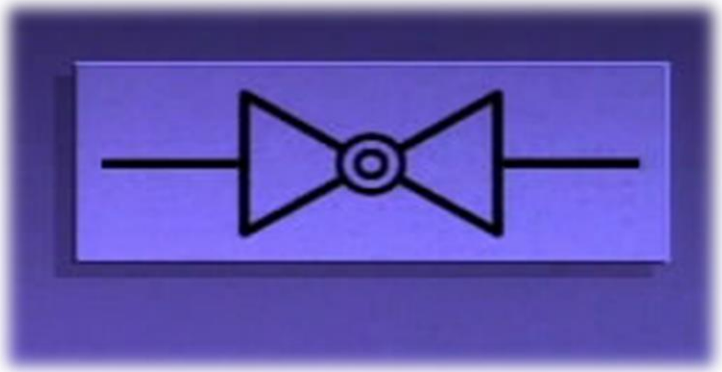
PVC for water application

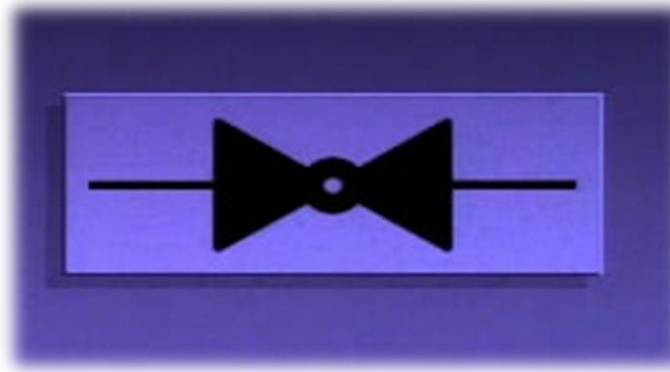
APS for cooling application

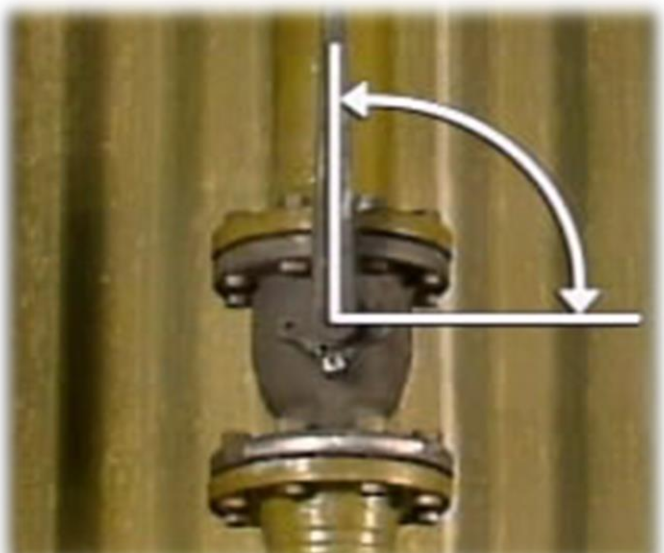
Classification of valves

- **Ball Valves materials**

PP and PVDS for aggressive media





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Ball Valves

Advantages

- Maintains and regulates high volume, high pressure, and high temp flow
- Low purchase and maintenance costs.
- No lubrication requirements.
- Give tight sealing with low torque.
- Time of valve operation is minimized.
- Can be used for throttling service.
- Can handle fluids with suspended solids.

Disadvantages

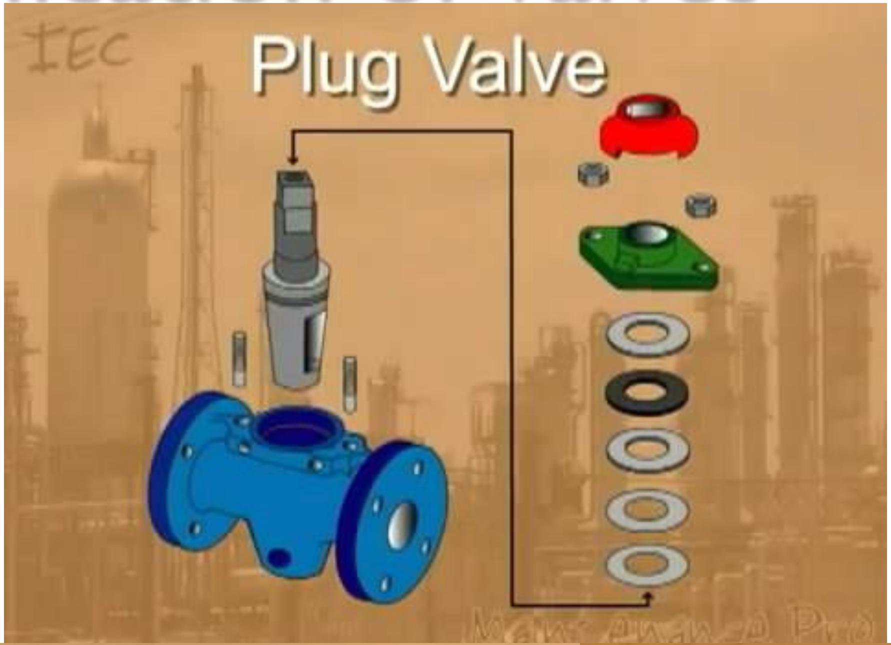
- Have relatively poor throttling characteristics.
- Difficult to clean, leads to contamination

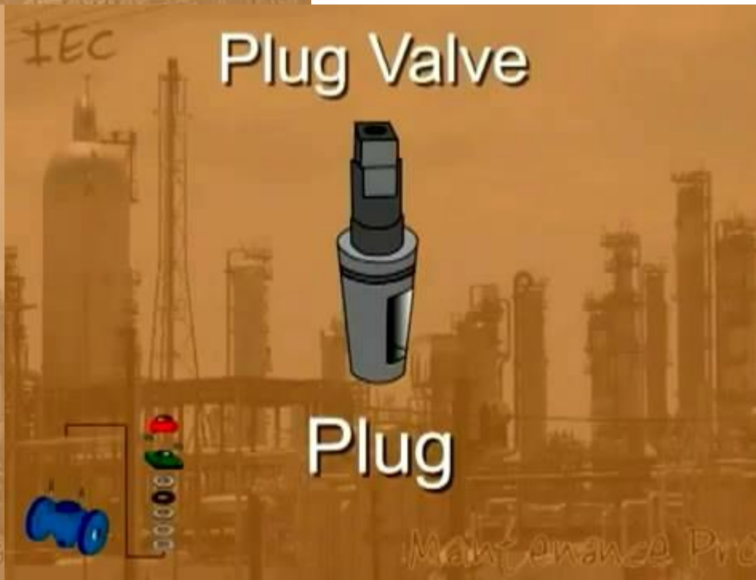
Classification of valves

- **Plug Valves**

Single-port Plug Valve

Classification of valves



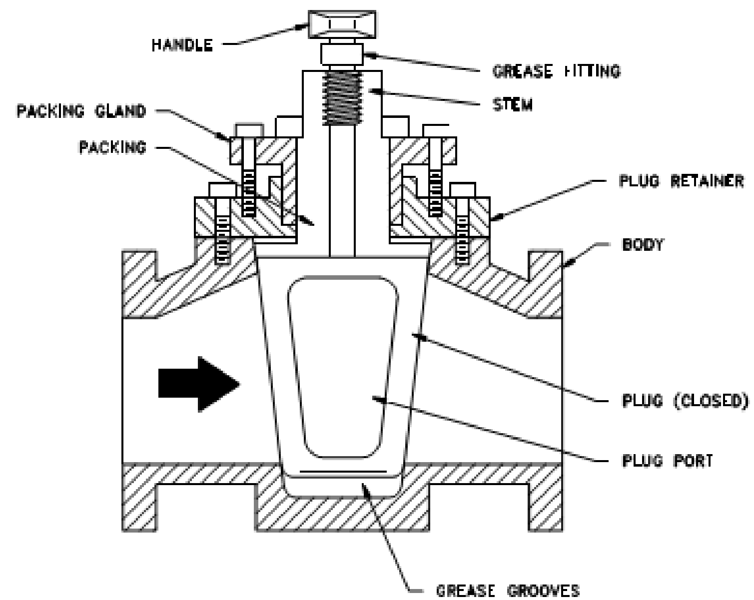


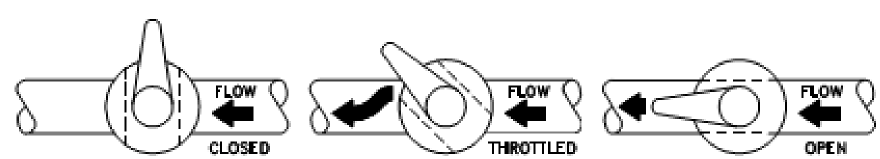
Classification of valves

- **Plug Valves**

Operation of a plug valve is similar to the ball valve; they are also rotational-motion valves. The main difference is the shape of the closing element, which is a tapered plug of circular section.

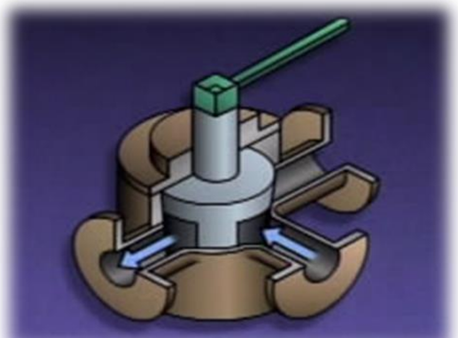
The plug has a hole called a port. Figure above shows a plug valve that is lined with PTFE to protect it from corrosion and allow lubricant-free operation.

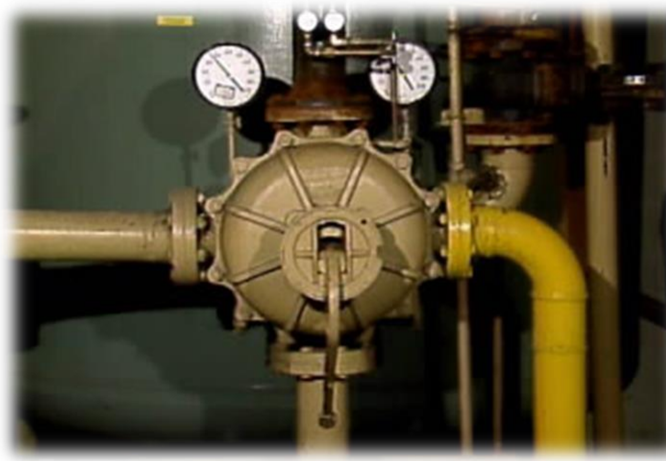




Single-port plug valves are used to start and stop flow.

Multi-port plug valves redirect flow from one pipeline to another.





Classification of valves

▲ Full Bore Pattern Plug

- **Plug Valves**

Plug Valve Disks

Plugs are either round or cylindrical with a taper.

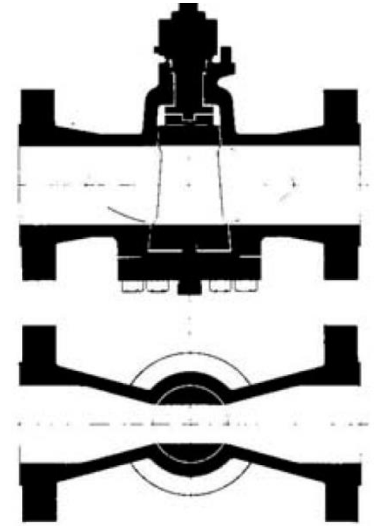
They may have various types of port openings, each with a varying degree of area relative to the corresponding inside diameter of the Pipe.

a)Rectangular Port Plug

The most common port shape is the rectangular port. The rectangular port represents at least 70% of the corresponding pipe's cross-sectional area.

Classification of valves

- **Plug Valves**



Plug Valve Disks

b)Round Port Plug

Round port plug is a term that describes a valve that has a round opening through the plug. If the port is the same size or larger than the pipe's inside diameter, it is referred to as a full port. If the opening is smaller than the pipe's inside diameter, the port is referred to as a standard round port. Valves having standard round ports are used only where restriction of flow is unimportant.

c)Diamond Port Plug

A diamond port plug has a diamond-shaped port through the plug. This design is for throttling service. All diamond port valves are venturi restricted flow type.

Classification of valves

- ## Plug Valves

Lubricated Plug Valve Design

The most common fluids controlled by plug valves are gases and liquid hydrocarbons.

Some water lines have these valves, provided that lubricant contamination is not a serious danger. Lubricated plug valves may be as large as 24 inches and have pressure capabilities up to 6000 psig. Steel or iron bodies are available.

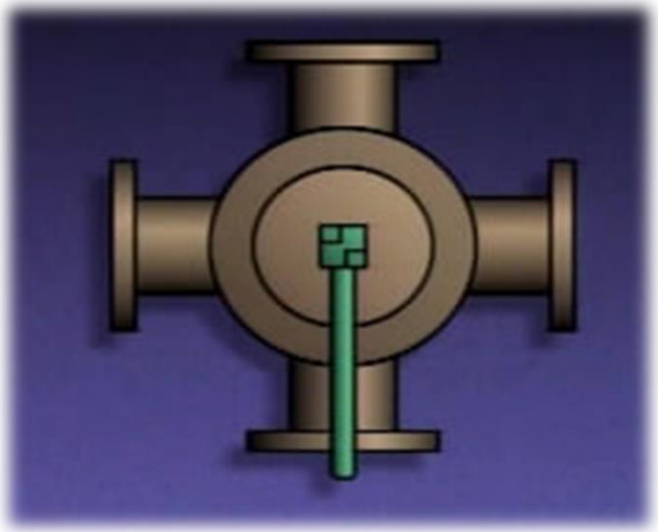
The plug can be cylindrical or tapered

Classification of valves

- **Plug Valves**

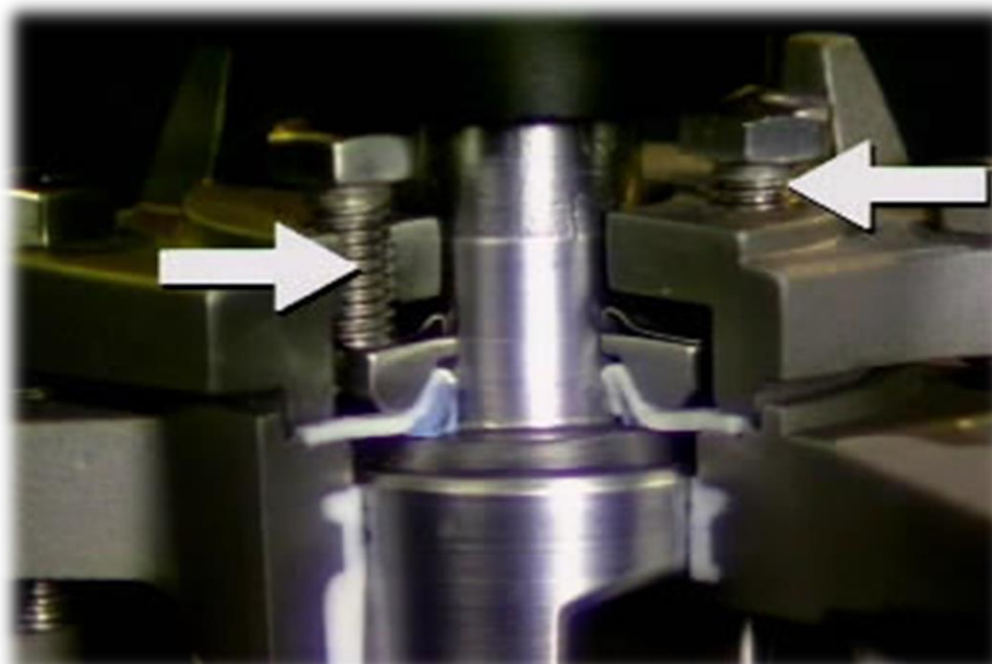
Manually Operated Plug Valve Installation

When installing plug valves, care should be taken to allow room for the operation of the handle, lever, or wrench. The manual operator is usually longer than the valve, and it rotates to a position parallel to the pipe from a position 90°to the pipe.



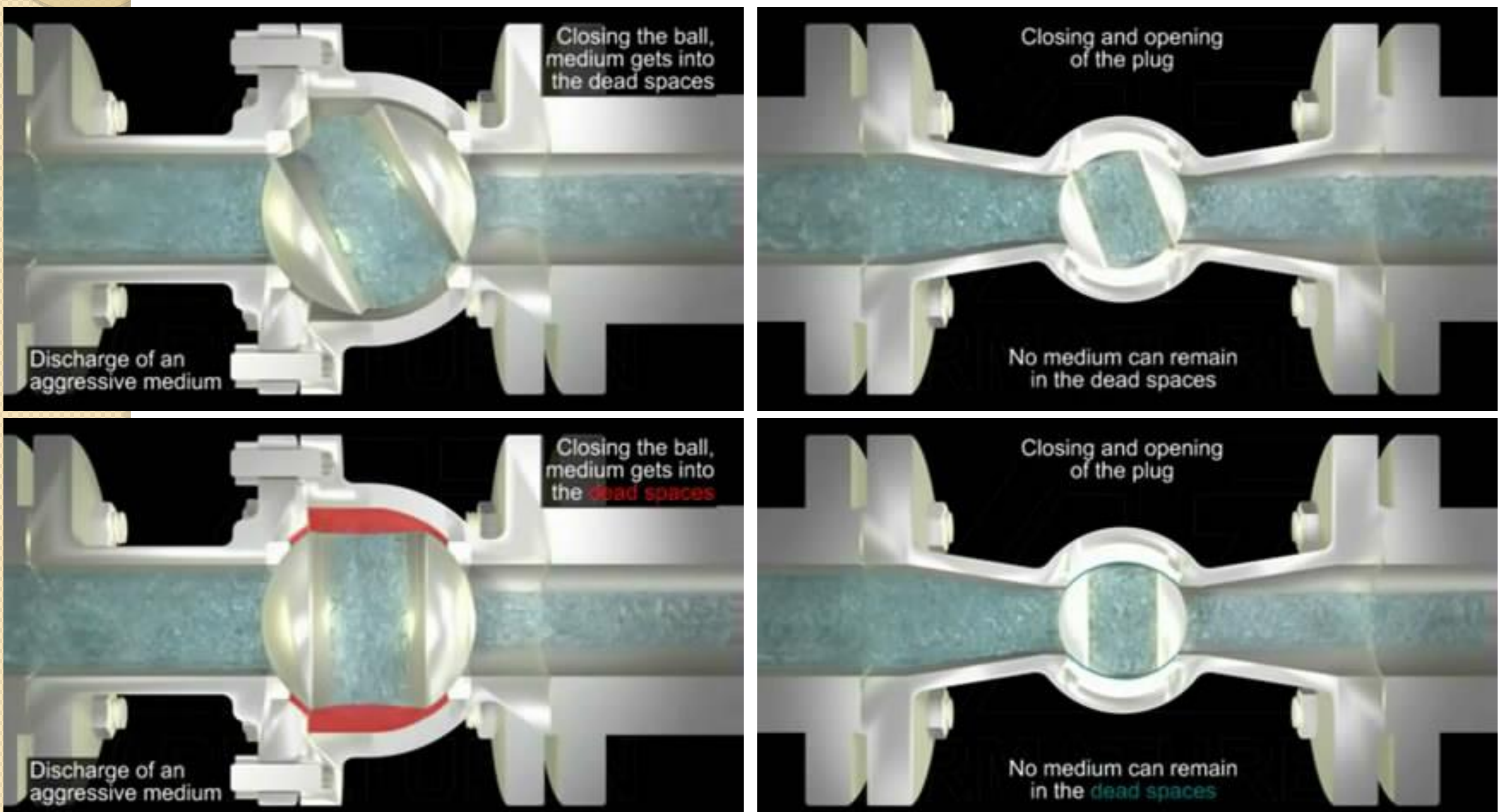
Plug Valve Glands

The gland of the plug valve is equivalent to the bonnet of a gate or globe valve. The gland secures the stem assembly to the valve body. There are three general types of glands: single gland, screwed gland, and bolted gland.



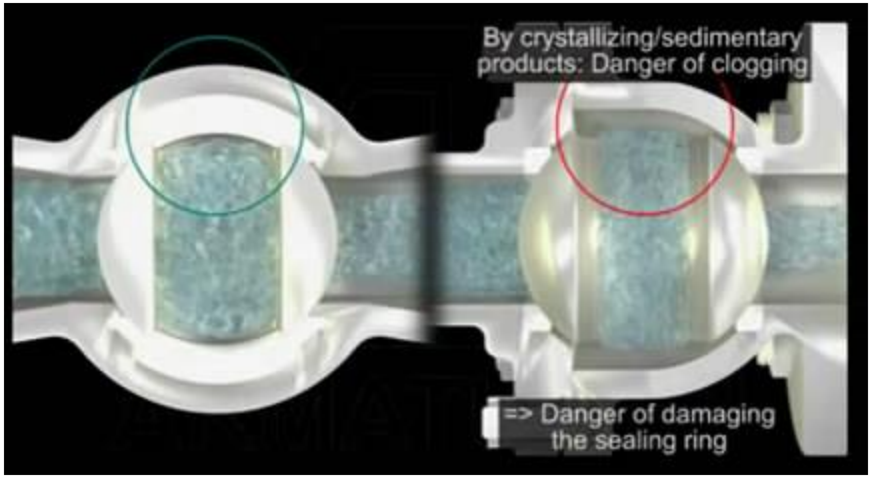
Classification of valves

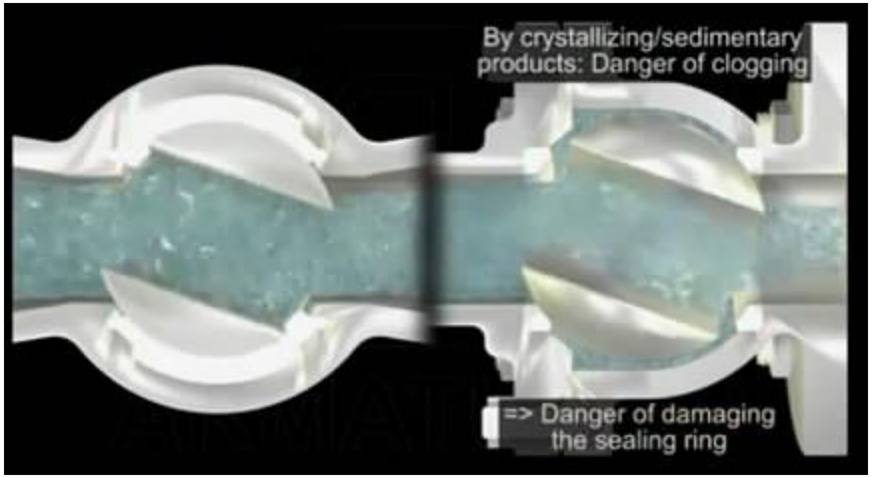
- **Compare Ball Valve and plug valve.**



Classification of valves

- **Compare Ball Valve and plug valve.**



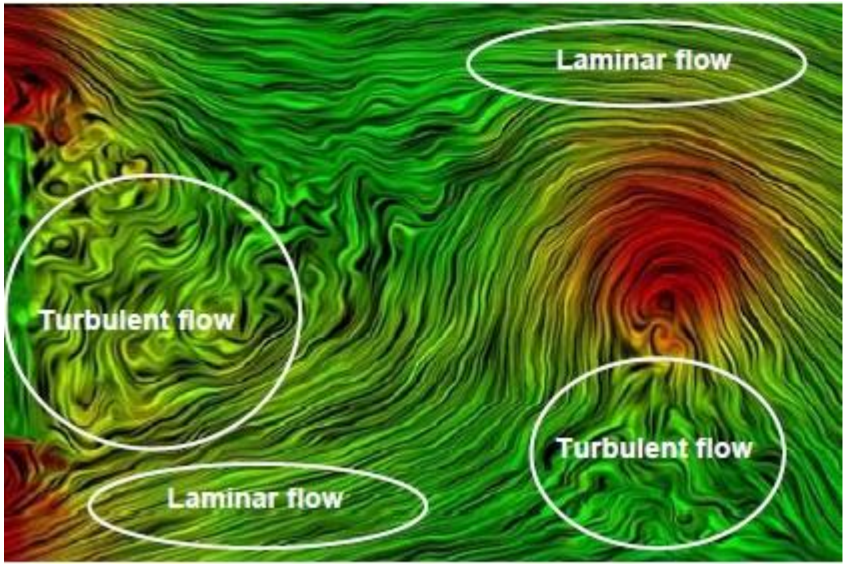


Classification of valves

Flow Control (Throttle) Valves:

The control of flow rate by reducing the area of the flow path through a valve is called throttling. Throttling a fluid also reduces its pressure.

Block valves should not be used to throttle flow. The pressure drop across them is too great and the flow becomes turbulent. Fluid flow can be either smooth (laminar), or not smooth (turbulent) as shown in Figure



Classification of valves

Flow Control (Throttle) Valves:

Turbulent flow can cause many problems in pipelines and equipment. In a valve, it can erode the closing element and valve seat. Erosion was described in the earlier module in this course: Bearings. It is the slow wearing away of a solid material by a fluid passing over it. Turbulent flow increases the rate of wear. Figure shows smooth and turbulent flow in rivers.

(a) Turbulent

(b) Laminar

Classification of valves

Flow Control (Throttle) Valves:

Throttle valves are designed to operate partially opened with little pressure loss and turbulence.

Throttle valves are also called regulating valves.

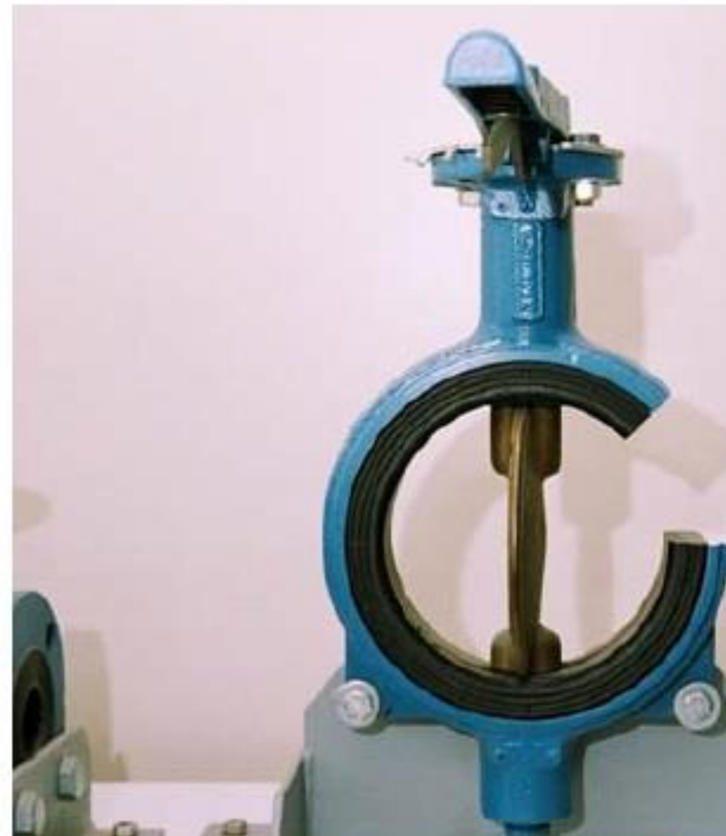
There are four main types:

- Globe valves
- Diaphragm valves
- Needle valves
- Butterfly Valves

Classification of valves

- **Butterfly Valves**

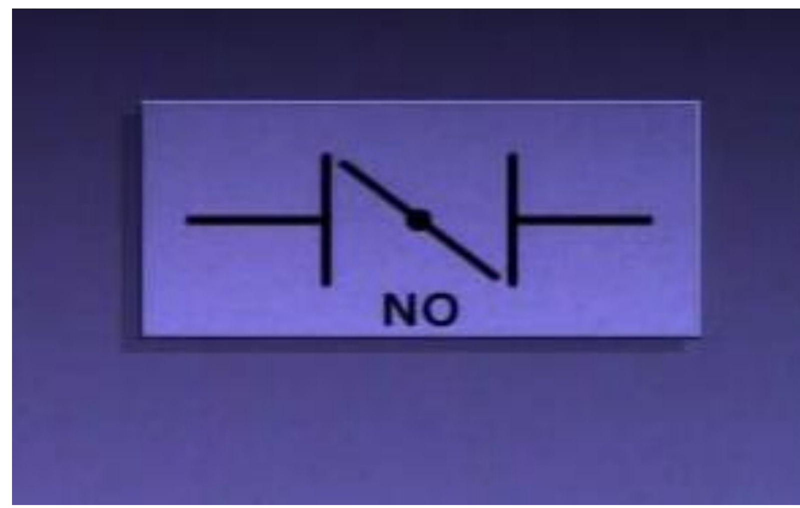
(a) Valve Closed



(b) Valve Open

Butterfly Valves

Butterfly valves are rotational-motion valves. Like ball and plug valves, they need only a quarter turn (90o) to fully open or close them.



Classification of valves

- **Butterfly Valves**

They can start, stop and regulate flow, although they **are not very good** at completely stopping flow. Figure below shows a typical butterfly valve. The lever is in line with the pipeline when the valve is open.

Classification of valves

- **Butterfly Valves**

Classification of valves

- **Butterfly Valves**

The closing element is a circular disc of a similar diameter to the ID of the pipe. The disc turns to open and close the valve. The disc or seat may be made of a polymer (plastic) to give a better seal.

Operating a butterfly valve can take a lot of force as you have to push it against the fluid pressure. Larger valves usually have geared actuators to make operation easier, as shown in Figure below.

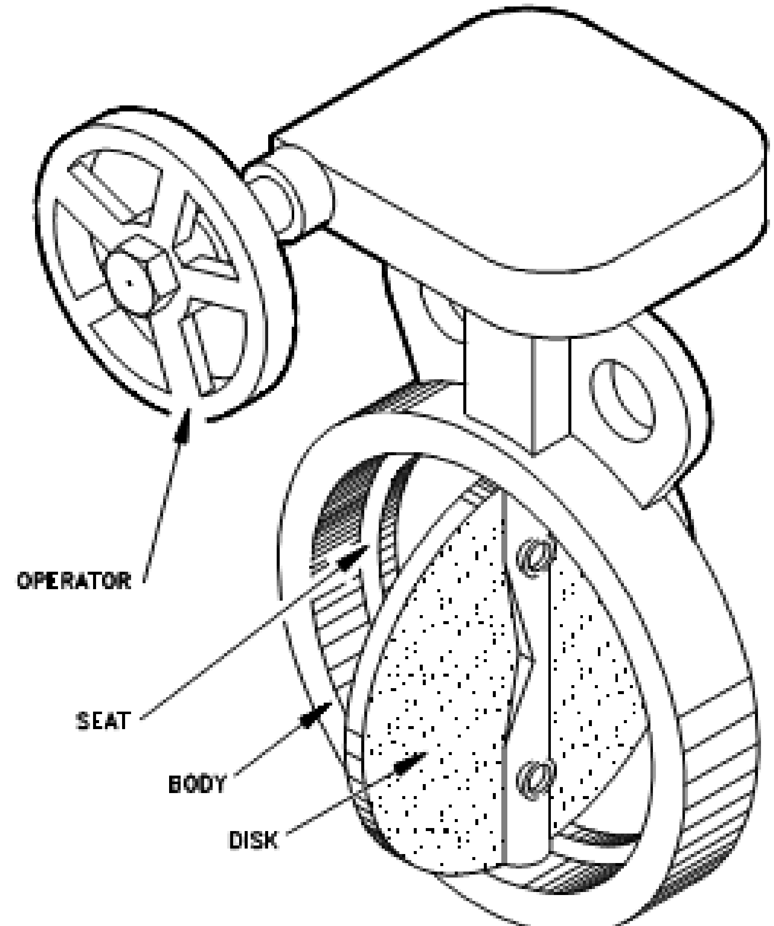
Classification of valves

- **Butterfly Valves**

Butterfly valves are simple and take up little space. This makes them especially good for use in large pipelines or where there is not much space.

Classification of valves

- **Butterfly Valves**



Classification of valves

- **Butterfly Valves**

Butterfly Valve Seat Construction

Stoppage of flow is accomplished by the valve disk sealing against a seat that is on the inside diameter periphery of the valve body.

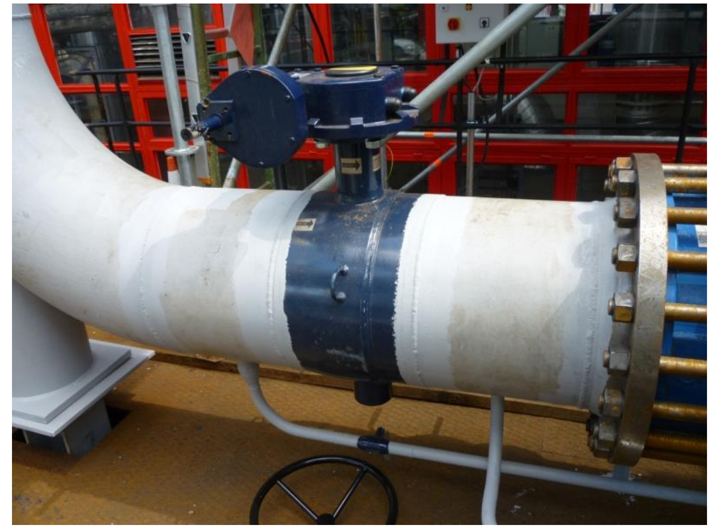
Butterfly Valve Body Construction

The most economical is the **wafer type** that fits between two pipeline flanges.

Another type, the **lug wafer design**, is held in place between two pipe flanges by bolts that join the two flanges and pass through holes in the valve's outer casing.

Classification of valves

- **Butterfly Valves**



Classification of valves

- **Butterfly Valves**

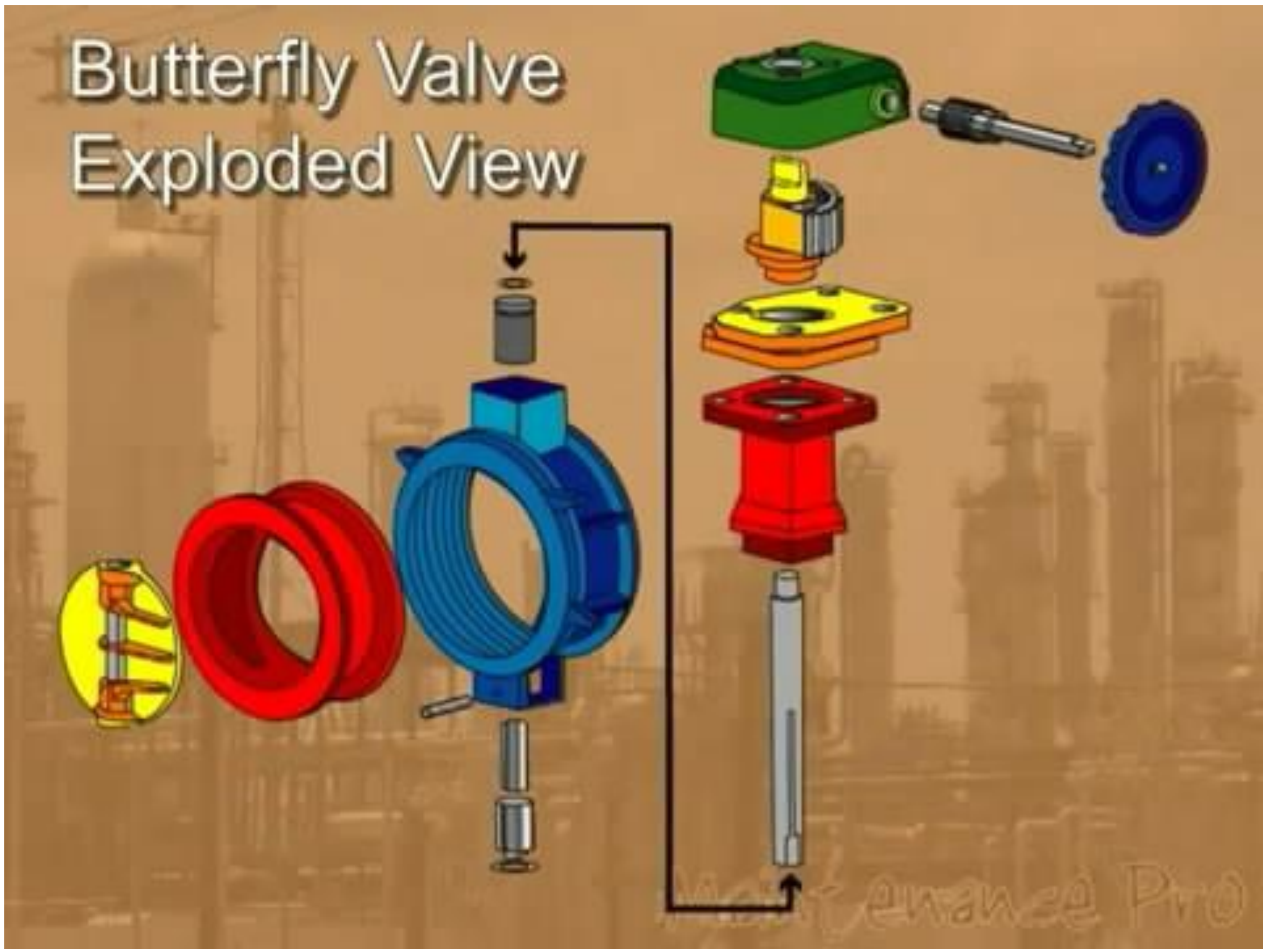
Butterfly Valve Disk and Stem Assemblies

The stem and disk for a butterfly valve are separate pieces. The disk is bored to receive the stem.

Two methods are used to secure the disk to the stem so that the disk rotates as the stem is turned. In the first method, the disk is bored through and secured to the stem with bolts or pins. The alternate method involves boring the disk as before, then shaping the upper stem bore to fit a squared or hex-shaped stem. This method allows the disk to "float" and seek its center in the seat. Uniform sealing is accomplished and external stem fasteners are eliminated.

Classification of valves

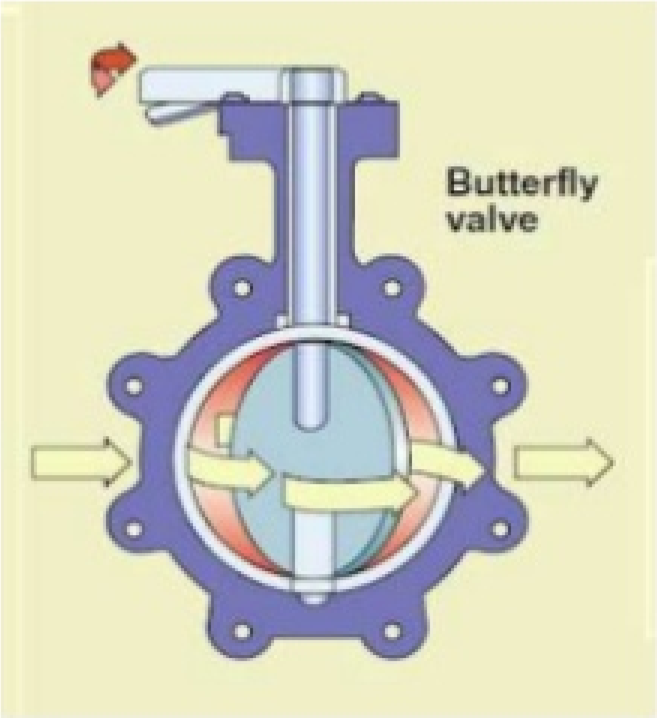
- **Butterfly Valves**



Butterfly Valves

Advantages

- They are suitable for large valve applications.
- Compact, lightweight design.
- The maintenance costs are usually low.
- Pressure drop across a butterfly valve is small.
- Used with chemical or corrosive media.



Disadvantages

- Difficult to clean
- Throttling limited to low differential pressure
- Potential for cavitations and choke
- Unguided disc movement is affected by flow turbulence

Classification of valves

- **Diaphragm Valves**

A diaphragm valve is a linear motion valve that is used to start, regulate, and stop fluid flow.

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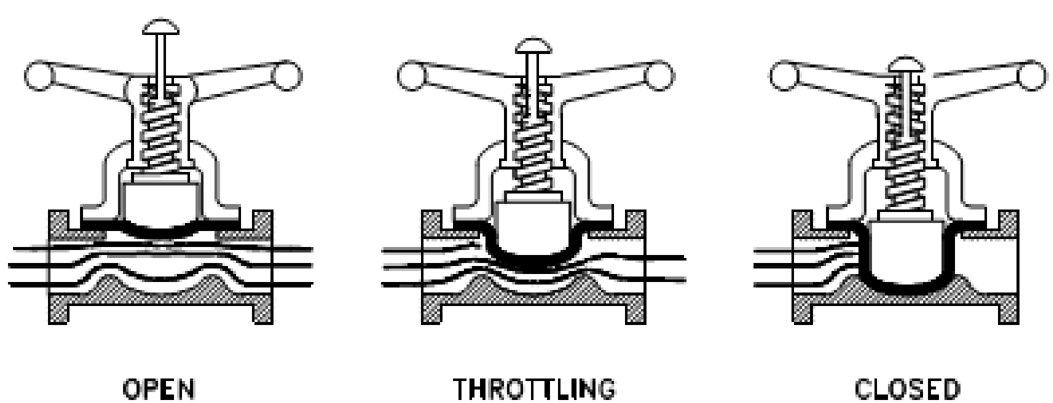


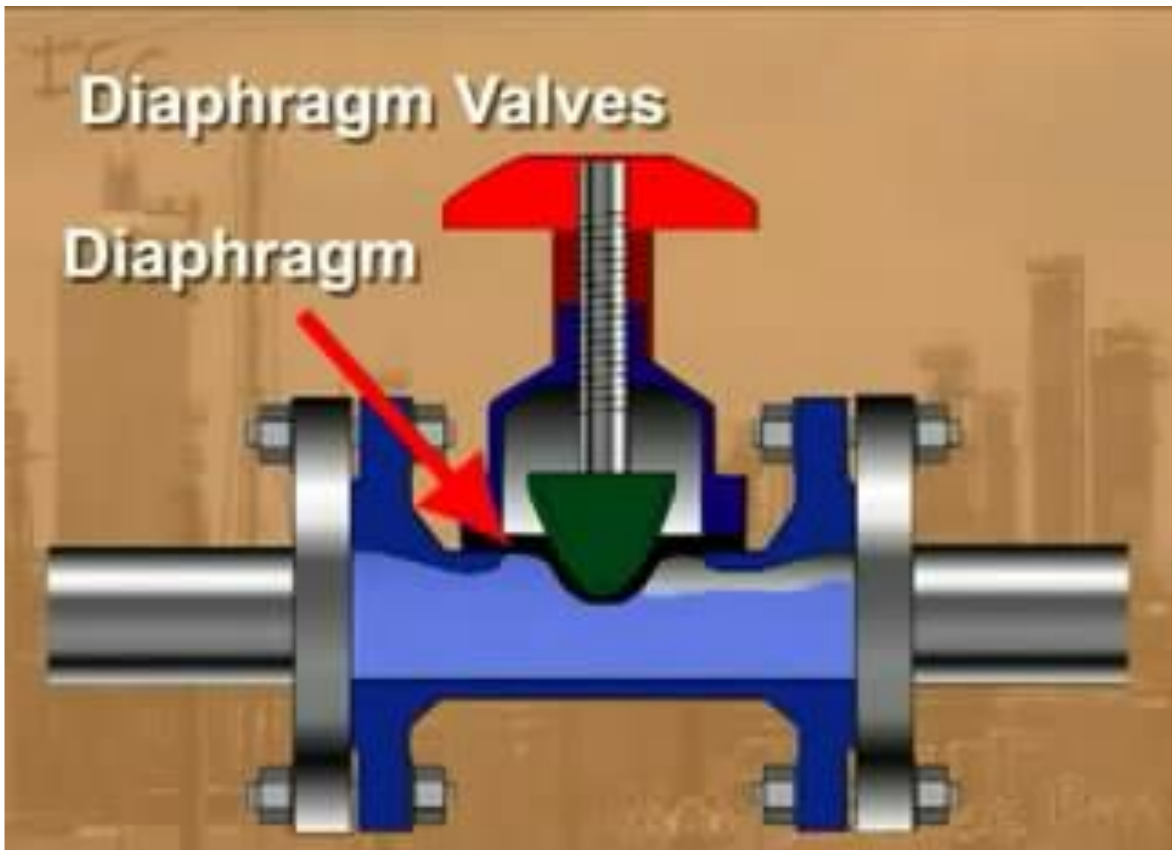
Classification of valves

- **Diaphragm Valves**

Classification of valves

- **Diaphragm Valves**

The name is derived from its flexible disk, which mates with a seat located in the open area at the top of the valve body to form a seal

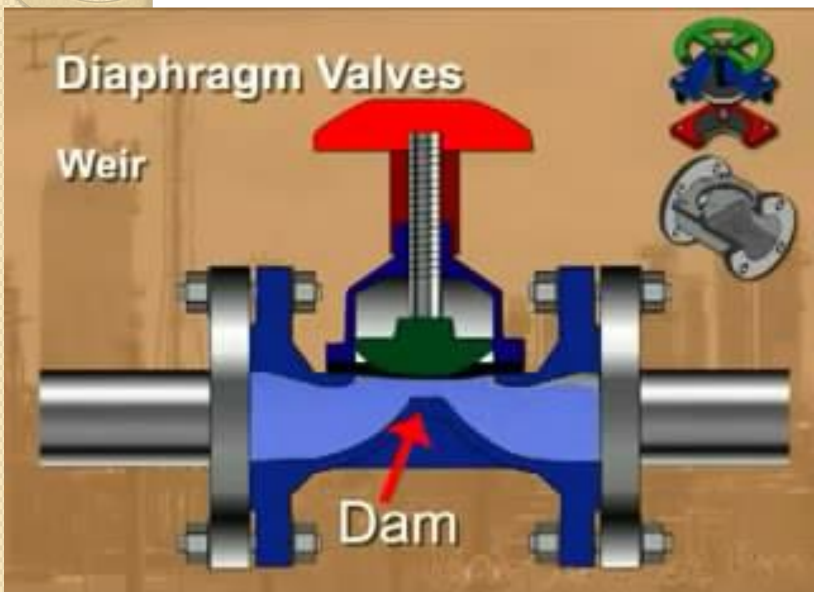


Classification of valves

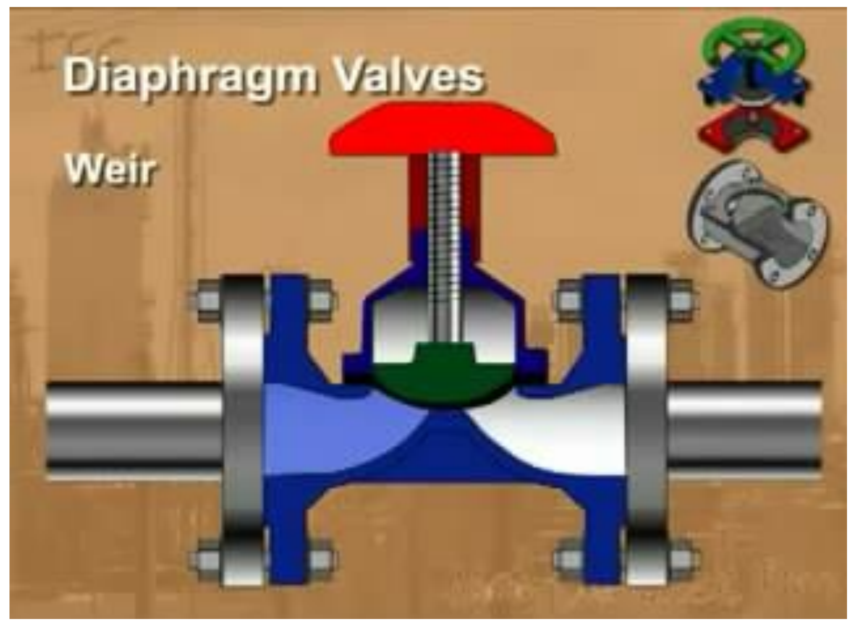
- **Diaphragm Valves 2 types**

Classification of valves

- **Diaphragm Valves**

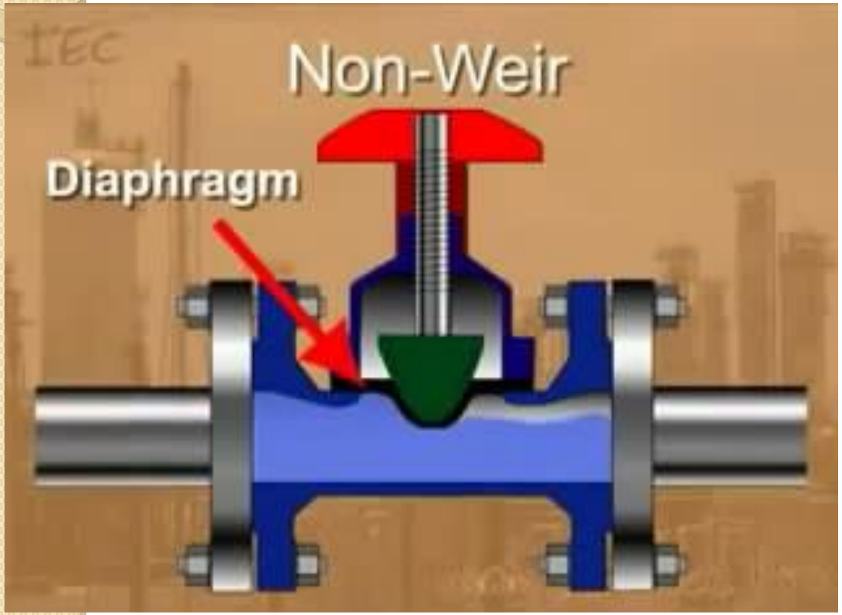


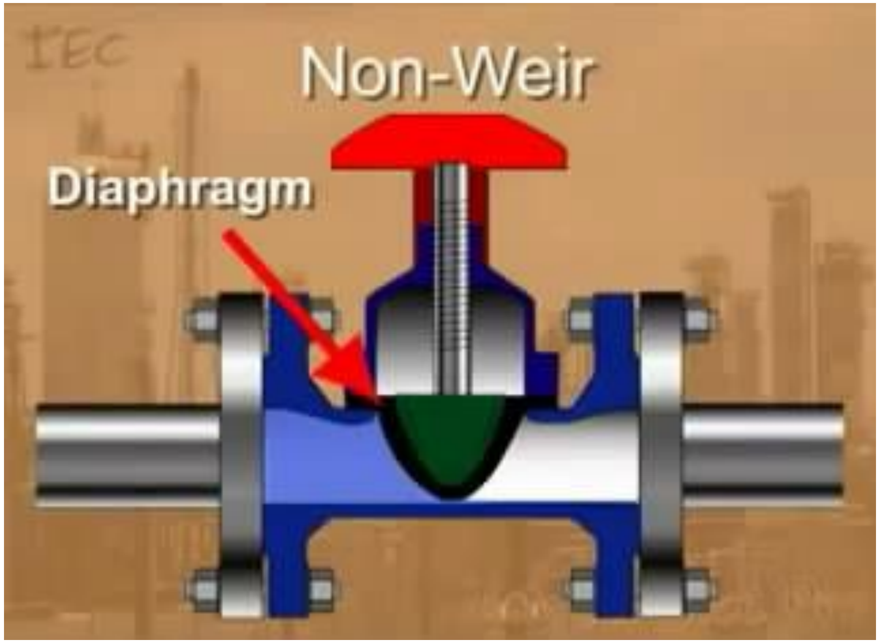
Pressure drop occur



Classification of valves

- **Diaphragm Valves**



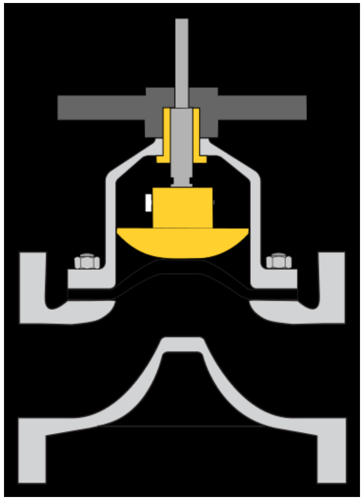


Pressure drop depends on valve position

Classification of valves

- **Diaphragm Valves**

Diaphragm valves are particularly suited for the handling of corrosive fluids, fibrous slurries, radioactive fluids, or other fluids that must remain free from contamination.



Classification of valves

- **Diaphragm Valves**

Diaphragm Construction

The operating mechanism of a diaphragm valve is not exposed to the media within the pipeline.

Sticky or viscous fluids cannot get into the bonnet to interfere with the operating mechanism.

Many fluids that would clog, corrode, or gum up the working parts of most other types of valves will pass through a diaphragm valve without causing problems. Conversely, lubricants used for the operating mechanism cannot be allowed to contaminate the fluid being handled.

There are no packing glands to maintain and no possibility of stem leakage.

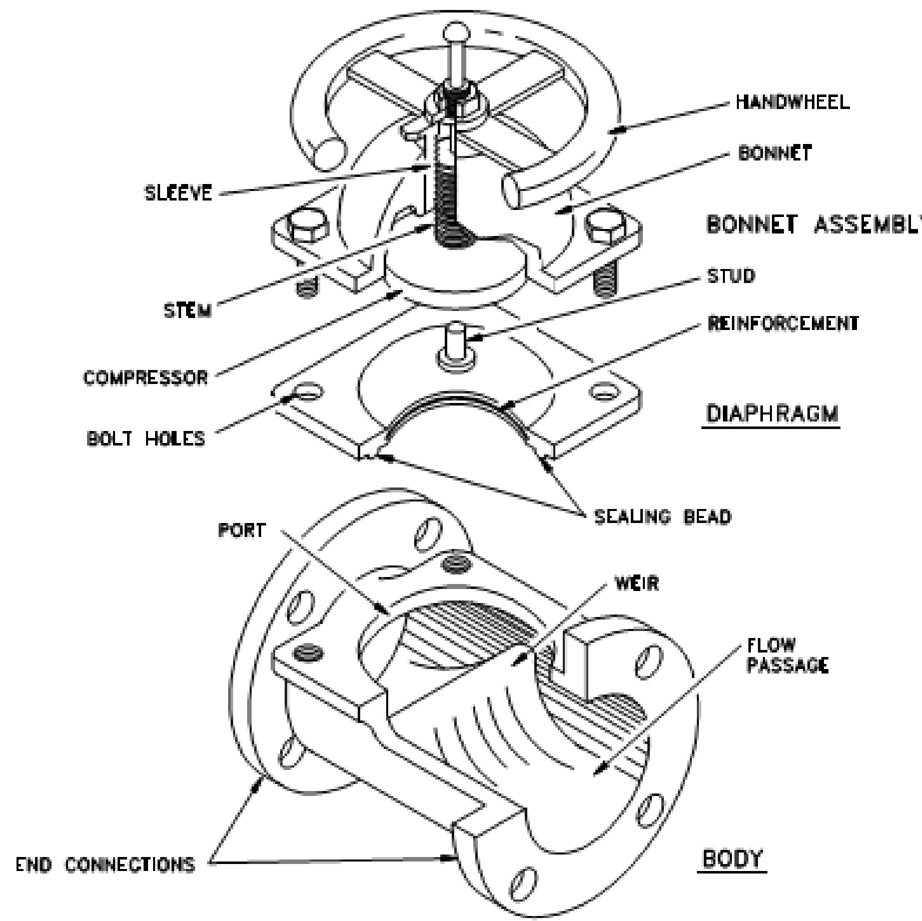
There is a wide choice of available diaphragm materials.

Diaphragm life depends upon the nature of the material handled, temperature, pressure, and frequency of operation.

Classification of valves

- **Diaphragm Valves**

Some elastomeric diaphragm materials may be unique in their excellent resistance to certain chemicals at high temperatures. However, the mechanical properties of any elastomeric material will be lowered at the higher temperature with possible destruction of the diaphragm at high pressure.
Consequently, the manufacturer should be consulted when they are used in elevated temperature applications



Classification of valves

- **Diaphragm Valves**

Classification of valves

- **Diaphragm Valves**

<u>Diaphragm Valve Stem Assemblies</u>

Diaphragm valves have stems that do not rotate.

The valves are available with indicating and Non-indicating stems.

Classification of valves

- **Diaphragm Valves**

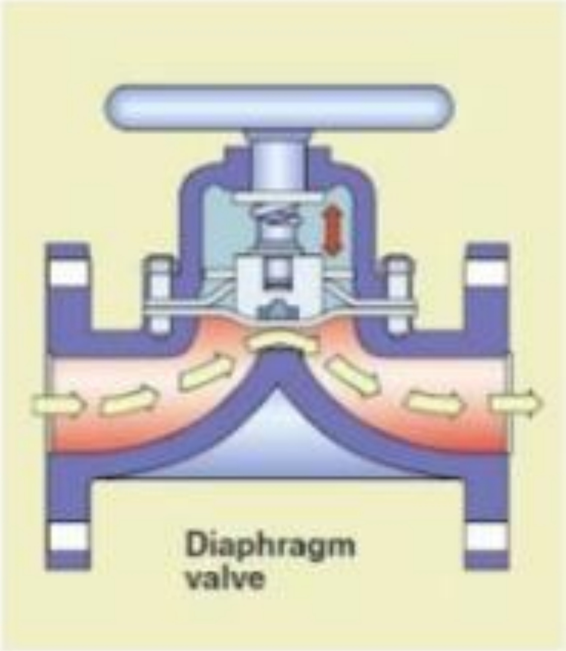
Diaphragm Valve Bonnet Assemblies

Some diaphragm valves use a quick-opening bonnet and lever operator. This bonnet is interchangeable with the standard bonnet on conventional weir-type bodies. A 90°turn of the lever moves the diaphragm from full open to full closed.

Diaphragm valves may also be equipped with chain wheel operators, extended stems, bevel gear operators, air operators, and hydraulic operators.

Many diaphragm valves are used in vacuum service.

Diaphragm Valves



Advantages

- valve components can be isolated from the process fluid.
- Valve construction prevents leakage of the fluid without the use of a gland seal (packing)

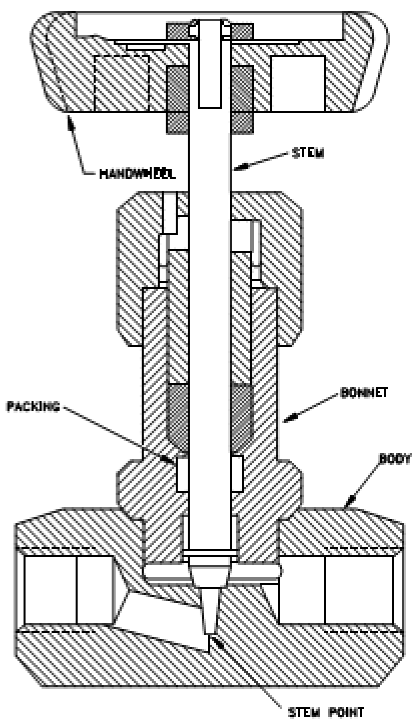
Disadvantages

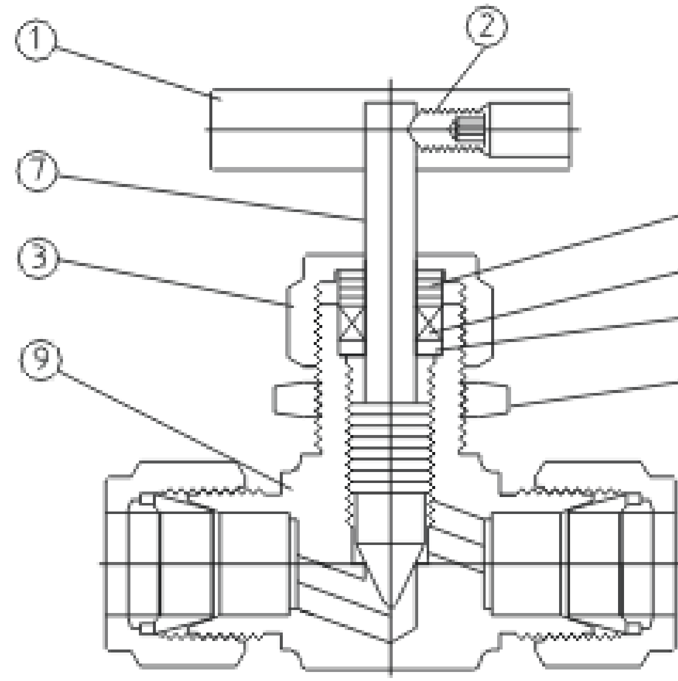
- The diaphragm becomes worn more easily and regular maintenance is necessary.
- These types of valves are generally not suited for very high temperature fluids and are mainly used on liquid systems.

Classification of valves

- **Needle Valves**

A needle valve is used to make relatively fine adjustments in the amount of fluid flow.





Classification of valves

- **Needle Valves**

<u>Needle Valve Applications</u>

Most constant pressure pump governors have needle valves to minimize the effects of fluctuations in pump discharge pressure.

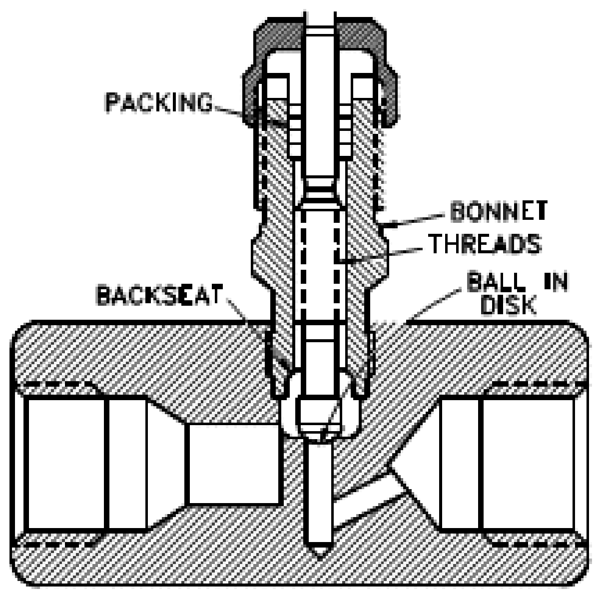
Needle valves are also used in some components of automatic combustion control systems where very precise flow regulation is necessary.

Classification of valves

- **Needle Valves**

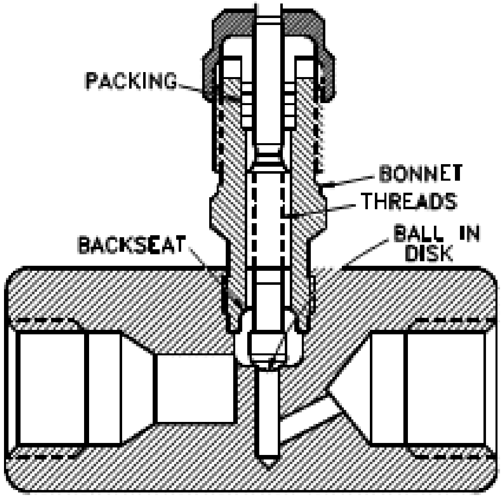
Needle Valve Body Designs

One type of body design for a needle valve is the bar stock body. Bar stock bodies are common, and, in globe types, a ball swiveling in the stem provides the necessary rotation for seating without damage.



Classification of valves

- **Needle Valves**



<u>Needle Valve Body Designs</u>

Needle valves are frequently used as metering valves.

Metering valves are used for extremely fine flow control.

The thin disk or orifice allows for linear flow characteristics. Therefore, the number of hand-wheel turns can be directly correlated to the amount of flow.

A typical metering valve has a stem with 40 threads per inch.

Needle valves generally use one of two styles of stem packing: an O-ring with TFE backing rings or a TFE packing cylinder.

Needle valves are often equipped with replaceable seats for ease of maintenance.

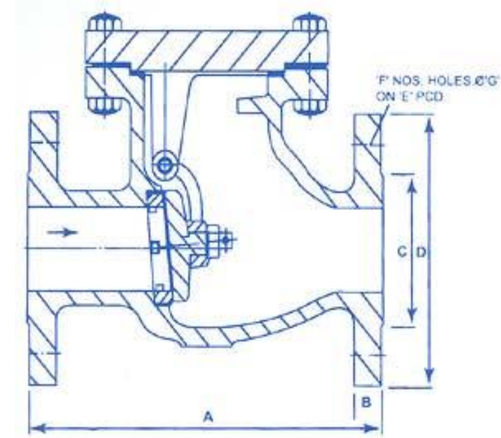
Classification of valves

- **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:

a) swing,
b) tilting-disk,
c) piston, butterfly,
d) and stop

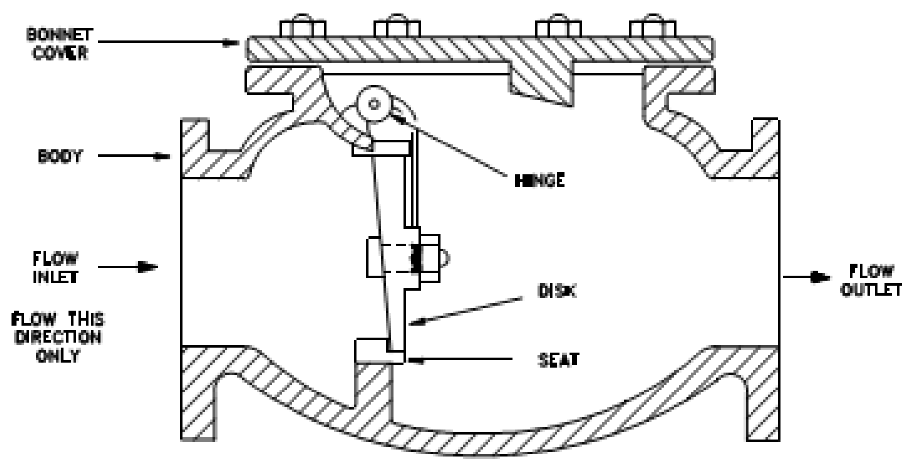
Classification of valves



- **Check Valves**

<u>Swing Check Valves</u>

The valve allows full, unobstructed flow and automatically closes as pressure decreases. These valves are fully closed when the flow reaches zero and prevent back flow. Turbulence and pressure drop within the valve are very low.



Classification of valves

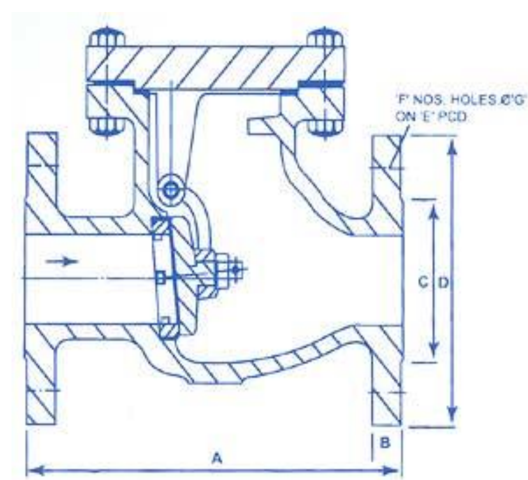
- **Check Valves**

<u>Swing Check Valves</u>

Swing check valves are usually installed in conjunction with gate valves because they provide relatively free flow.

They are recommended for lines having low velocity flow and should not be used on lines with pulsating flow when the continual flapping or pounding would be destructive to the seating elements.

This condition can be partially corrected by using an external lever and weight.

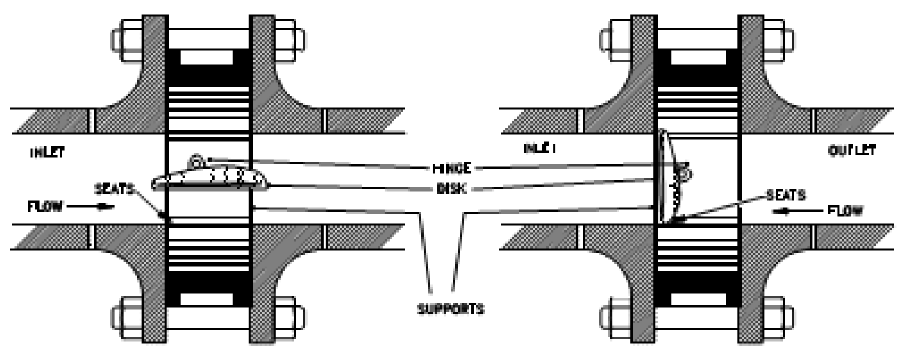


Classification of valves

- **Check Valves**

Tilting Disk Check Valves

The tilting disk check valve is similar to the swing check valve.
Like the swing check, the tilting disk type keeps fluid resistance and turbulence low because of its straight-through design.



Classification of valves

- **Check Valves**

<u>Tilting Disk Check Valves</u>

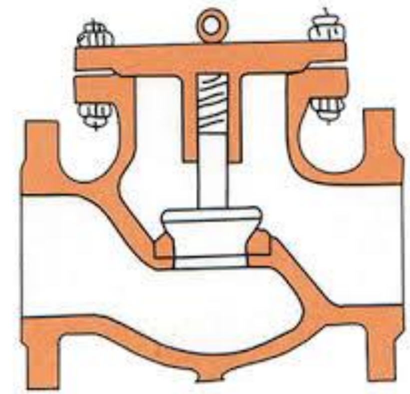
Tilting disk check valves can be installed in horizontal lines and vertical lines having upward flow.

Some designs simply fit between two flange faces and provide a compact, lightweight installation, particularly in larger diameter valves.

These valves are available with a soft seal ring, metal seat seal, or a metal-to-metal seal.

The latter is recommended for high temperature operation. The soft seal rings are replaceable, but the valve must be removed from the line to make the replacement.

Classification of valves



- **Check Valves**

Lift Check Valves

A lift check valve is commonly used in piping systems in which globe valves are being used as a flow control valve.

They have similar seating arrangements as globe valves.

Lift check valves are suitable for installation in horizontal or vertical lines with upward flow.

They are recommended for use with steam, air, gas, water, and on vapor lines with high flow velocities.

These valves are available in three body patterns:

a) horizontal,
b) angle,
c) and vertical.

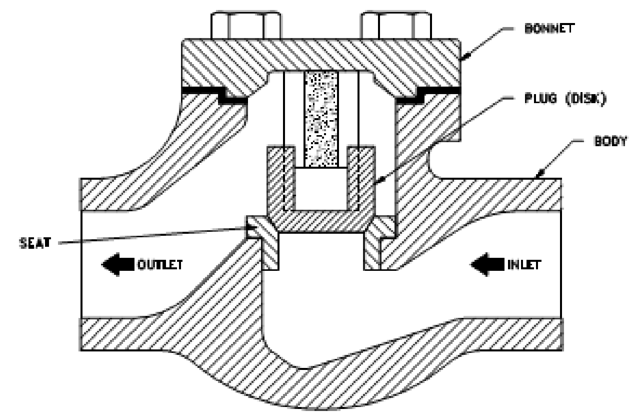
Classification of valves

- **Check Valves**

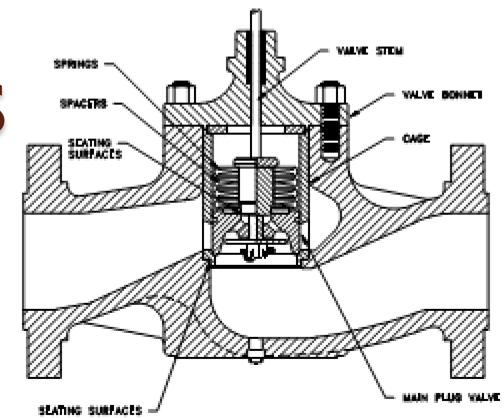
Lift Check Valves

Flow to lift check valves must always enter below the seat. As the flow enters, the disk or ball is raised within guides from the seat by the pressure of the upward flow.
When the flow stops or reverses, the disk or ball is forced onto the seat of the valve by both the backflow and gravity.

The seats of metallic body lift check valves are either integral with the body or contain renewable seat rings.
Disk construction is similar to the disk construction of globe valves with either metal or composition disks.



Classification of valves



- **Check Valves**

Piston Check Valves

A piston check valve is essentially a lift check valve.

It has a dashpot consisting of a piston and cylinder that provides a cushioning effect during operation. Because of the similarity in design to lift check valves, the flow characteristics through a piston check valve are essentially the same as through a lift check valve.

Installation is the same as for a lift check in that the flow must enter from under the seat.

Construction of the seat and disk of a piston check valve is the same as for lift check valves.

Valves of this type are used on water, steam, and air systems.

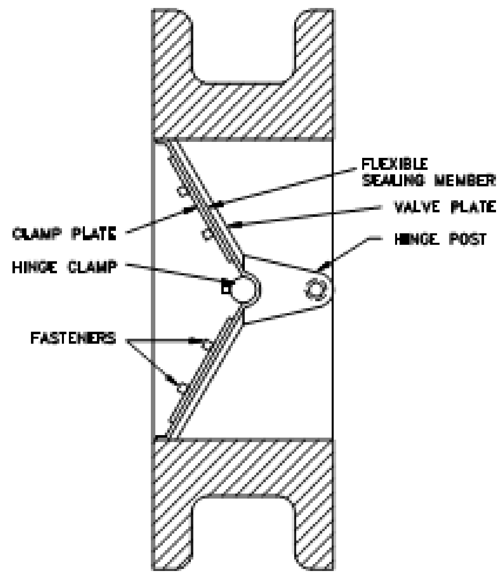
Classification of valves

- **Check Valves**

Butterfly Check Valves

Butterfly check valves have a seating arrangement similar to the seating arrangement of butterfly valves.

Flow characteristics through these check valves are similar to the flow characteristics through butterfly valves.

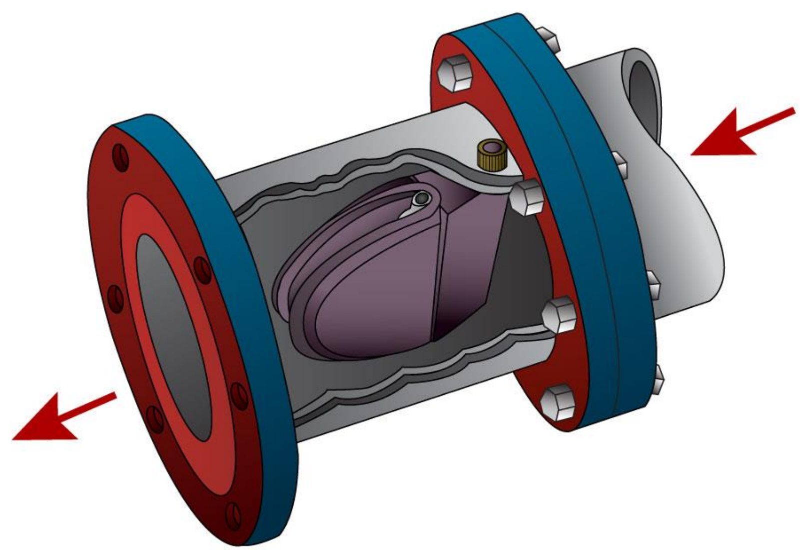


Classification of valves

- **Check Valves**

Butterfly Check Valves

Butterfly check valves may be installed horizontally or vertically with the vertical flow either upward or downward.
Care should be taken to ensure that the valve is installed so that the entering flow comes from the hinge post end of the valve; otherwise, all flow will be stopped



Classification of valves

- **Check Valves**

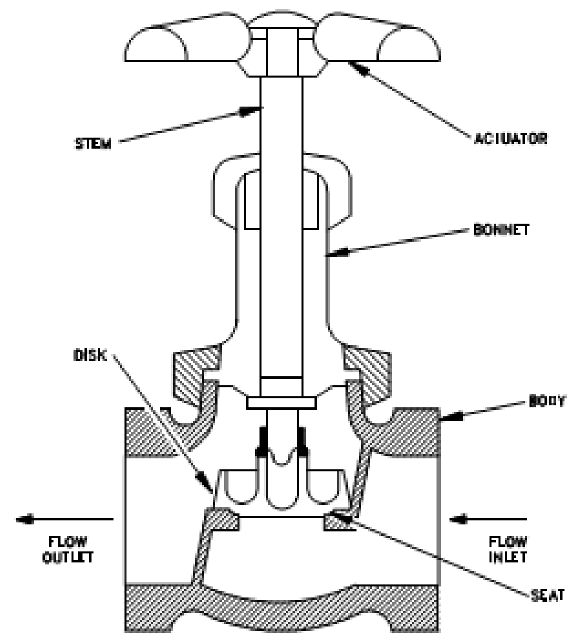
<u>Stop Check Valves</u>

A stop check valve is a combination of a lift check valve and a globe valve.

It has a stem which, when closed, prevents the disk from coming off the seat and provides a tight seal (similar to a globe valve).

When the stem is operated to the open position, the valve operates as a lift check.

The stem is not connected to the disk and functions to close the valve tightly or to limit the travel of the valve disk in the open direction



Classification of valves

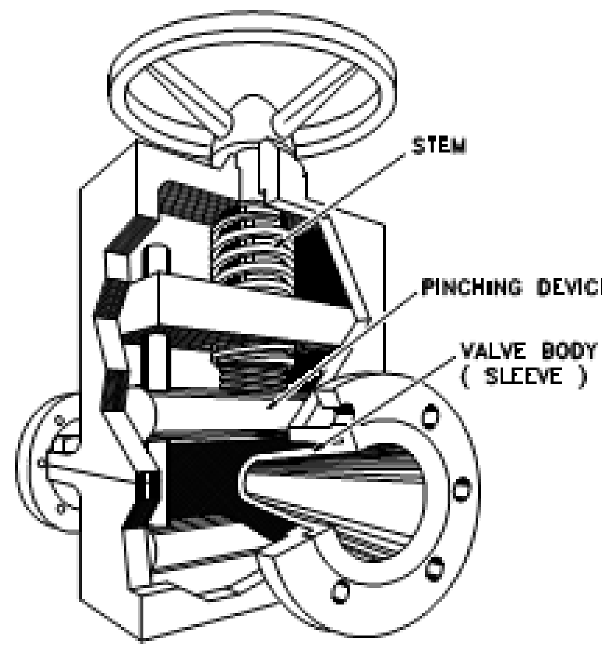
Pinch Valves

The relatively inexpensive pinch valve, Pinch Valves is the simplest in any valve design.

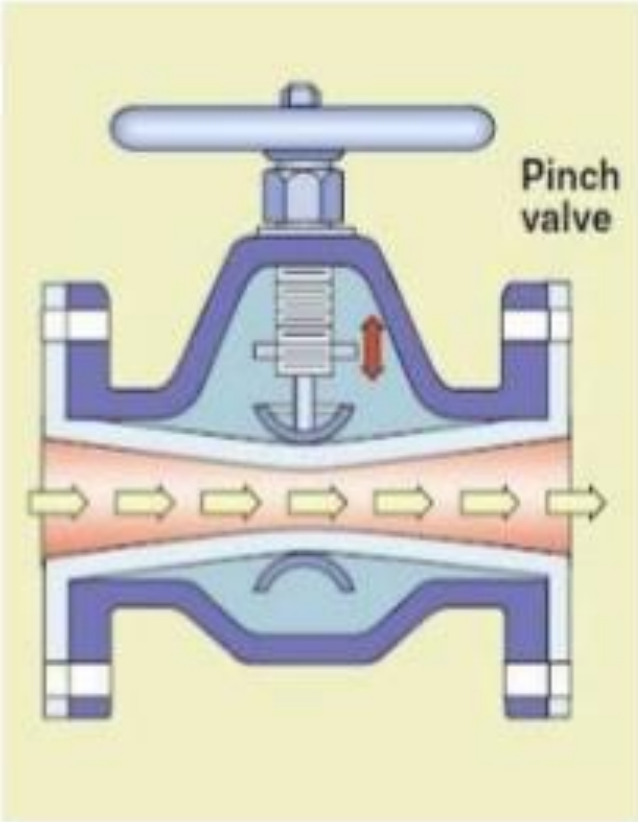
It is simply an industrial version of the pinch cock used in the laboratory to control the flow of fluids through rubber tubing.

Pinch valves are suitable for on-off and throttling services.

However, the effective throttling range is usually between 10% and 95% of the rated flow capacity.



Pinch Valve



Advantages

- They are ideally suited for the handling of slurries, liquids with large amounts of suspended solids, and systems that convey solids pneumatically.
- Can be used for application where corrosion or metal contamination of the fluid might be a problem.
- The flow passage is straight without any crevice.
- There are no internal moving parts in contact with the fluid.
- Low maintenance due to wear or pressure.
- Minimum items to change. Tube ONLY.

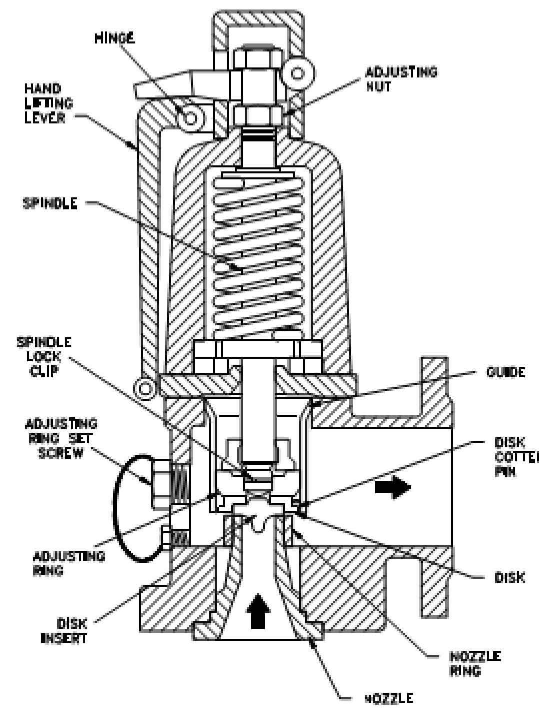
Disadvantages

- Cannot be used in high temperature/ pressure applications
- Cannot be used with gas media

Classification of valves

- **Relief and Safety Valves**

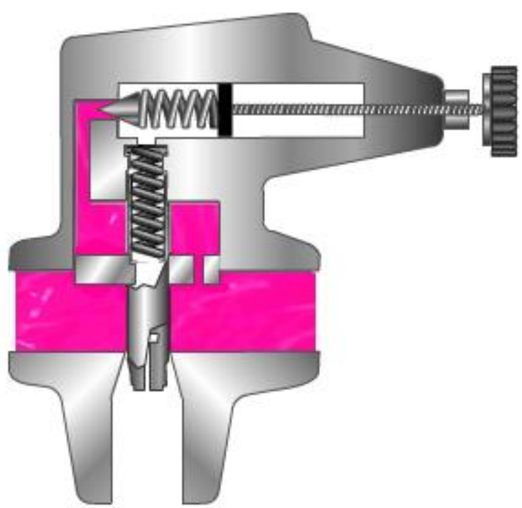
Relief and safety valves prevent equipment damage by relieving accidental over-pressurization of fluid systems.
The main difference between a relief valve and a safety valve is the extent of opening at the set-point pressure.

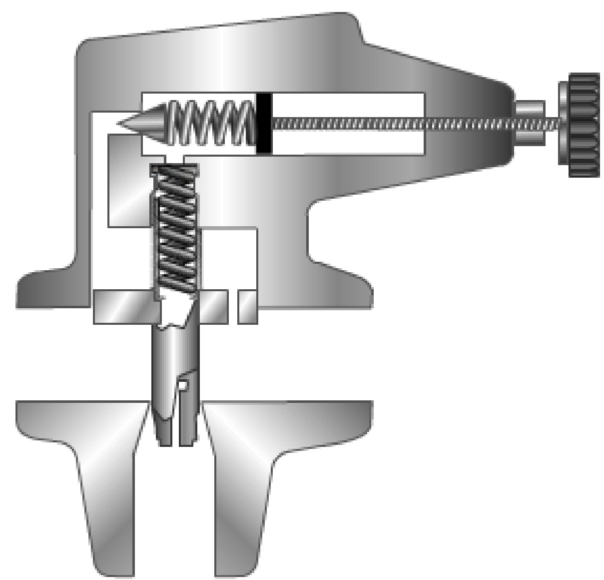


Classification of valves

- **Relief and Safety Valves**

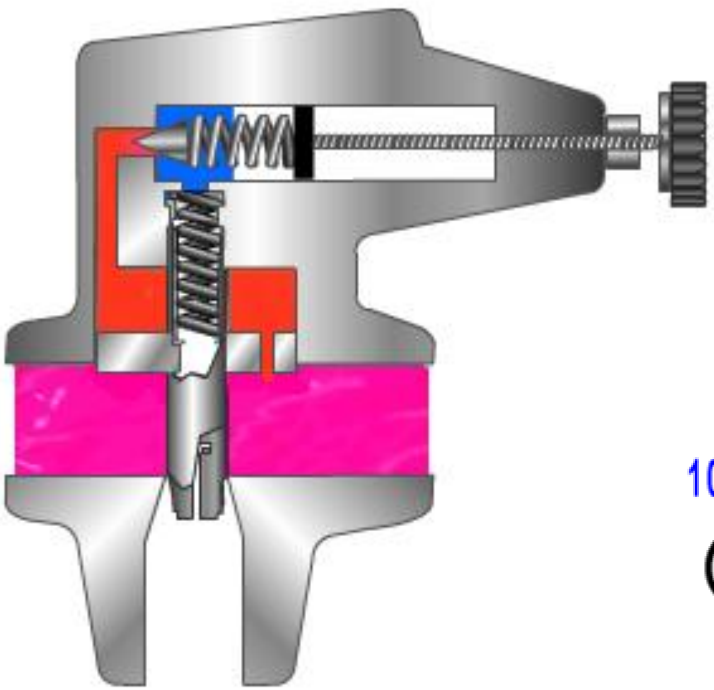
Pilot-operated relief valves are designed to maintain pressure through the use of a small passage to the top of a piston that is connected to the stem such that system pressure closes the main relief valve.

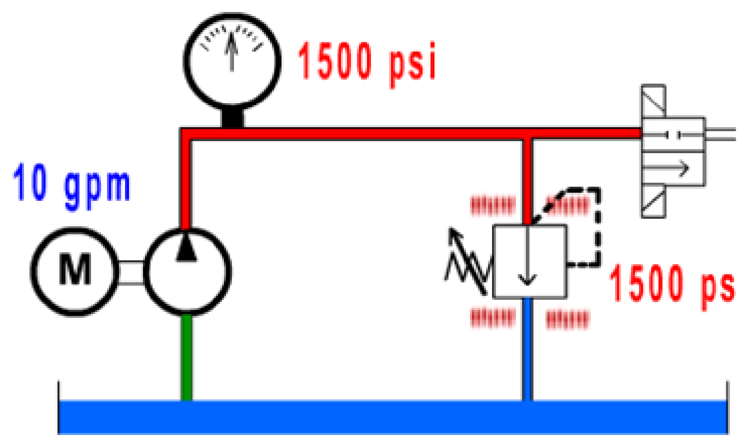




Classification of valves

- **Relief and Safety Valves**





VA LVE ACTUATORS

Some type of actuator is necessary to allow for the positioning of a valve.

The following types of valve actuators:

a. Manual

b. Electric motor

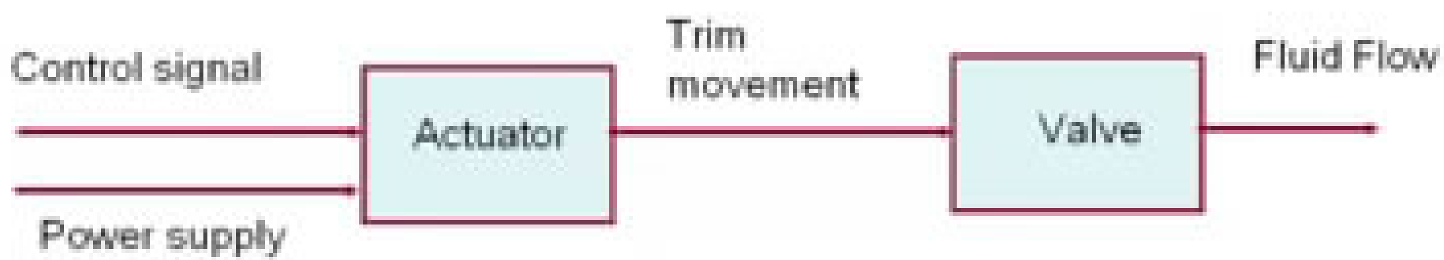
c. Pneumatic

d. Hydraulic

e. Solenoid

VA LVE ACTUATORS

Purposes of Actuators



VA LVE ACTUATORS

Valve actuators are selected based upon a number of factors including torque necessary to operate the valve and the need for automatic actuation.

VA LVE ACTUATORS

<u>Manual, Fixed, and Hammer Actuators</u>

Manual actuators are capable of Fixed Hand-wheel

placing the valve in any position but do not permit automatic operation.

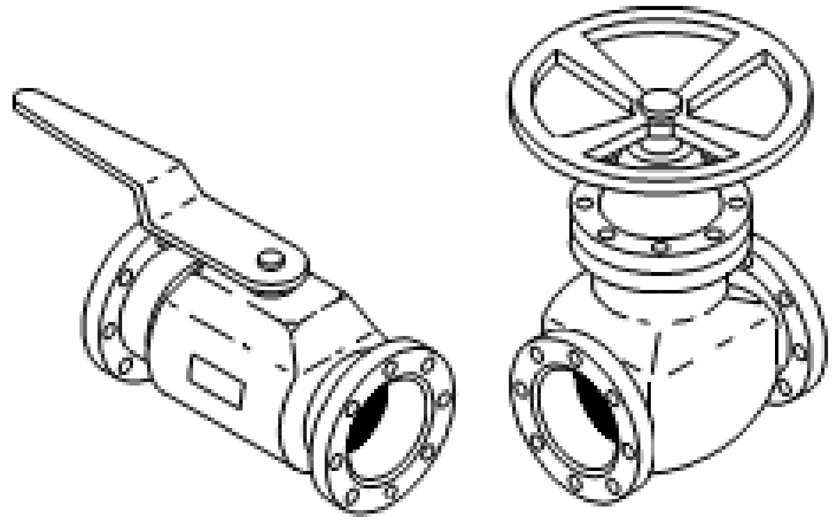
The most common type mechanical actuator is the hand-wheel. This type includes hand-wheels fixed to the stem, hammer hand-wheels, and

Hand-wheels connected to the stem

through gears.

VA LVE ACTUATORS

<u>Manual, Fixed Actuators</u>

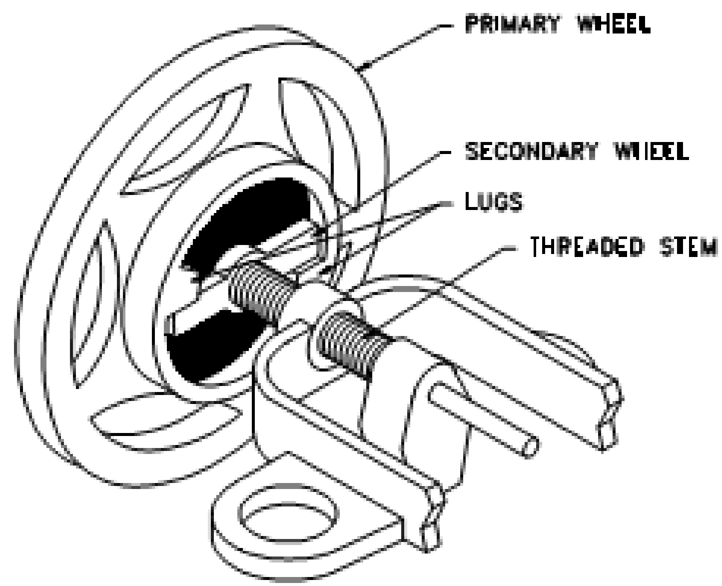


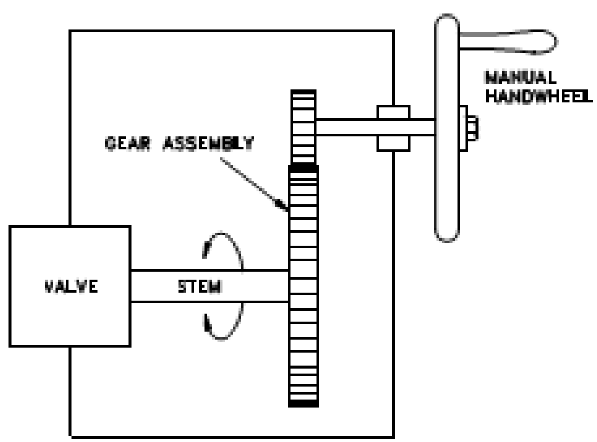
When these valves are exposed to high operating temperatures, valve binding makes operation difficult.

VA LVE ACTUATORS

Manual, Hammer Actuators

The hammer hand=wheel moves freely through a portion of its turn and then hits against a lug on a secondary wheel.
The secondary wheel is attached to the valve stem.
With this arrangement, the valve can be pounded shut for tight closure or pounded open if it is stuck shut.





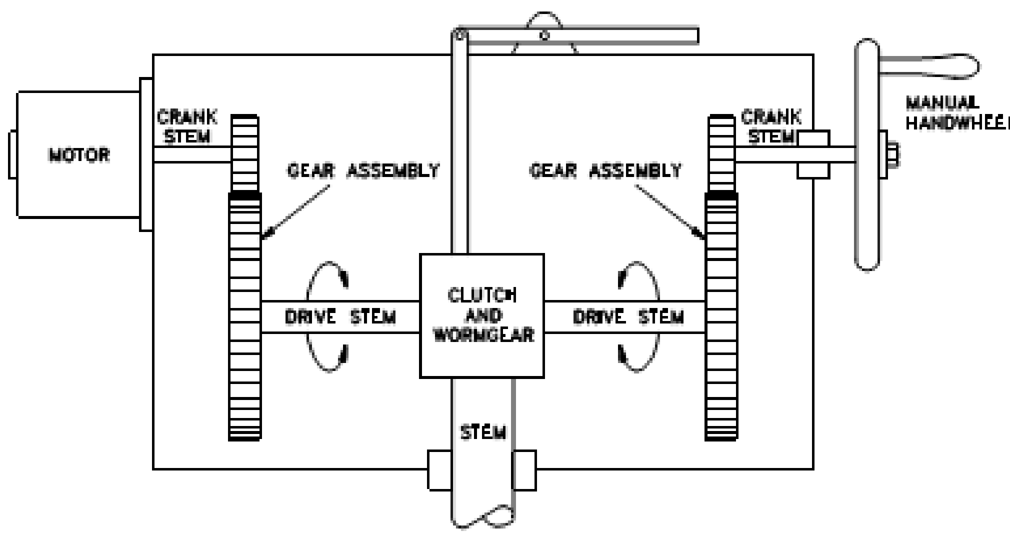
INCRAES OPINING TIME AND TOURQUE

VA LVE ACTUATORS

VA LVE ACTUATORS

Electric Motor Actuators

Electric motors permit manual, semi-automatic, and automatic operation of the valve.
Motors are used mostly for open-close functions, although they are adaptable to positioning the valve to any point opening .



VA LVE ACTUATORS

Electric Motor Actuators

The motor is usually a, reversible, high speed type connected through a gear train to reduce the motor speed and thereby increase the torque at the stem. Direction of motor rotation determines direction of disk motion. The electrical actuation can be semi-automatic, as when the motor is started by a control system.

A hand-wheel, which can be engaged to the gear train, provides for manual operating of the valve.

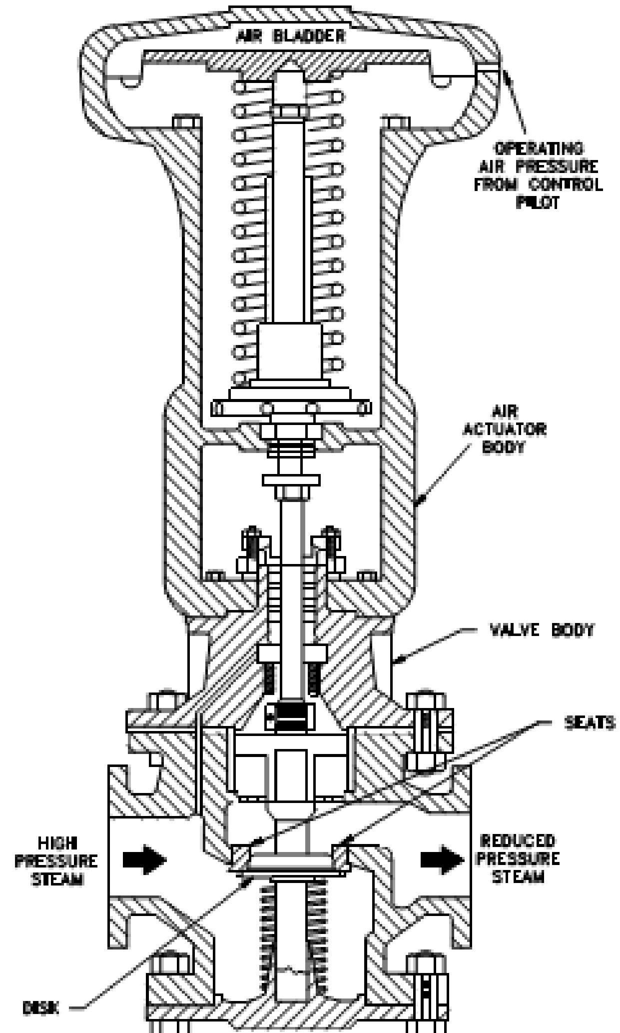
Limit switches are normally provided to stop the motor automatically at full open and full closed valve positions.

Limit switches are operated either physically by position of the valve or torsion ally by torque of the motor

VA LVE ACTUATORS

Pneumatic Actuators

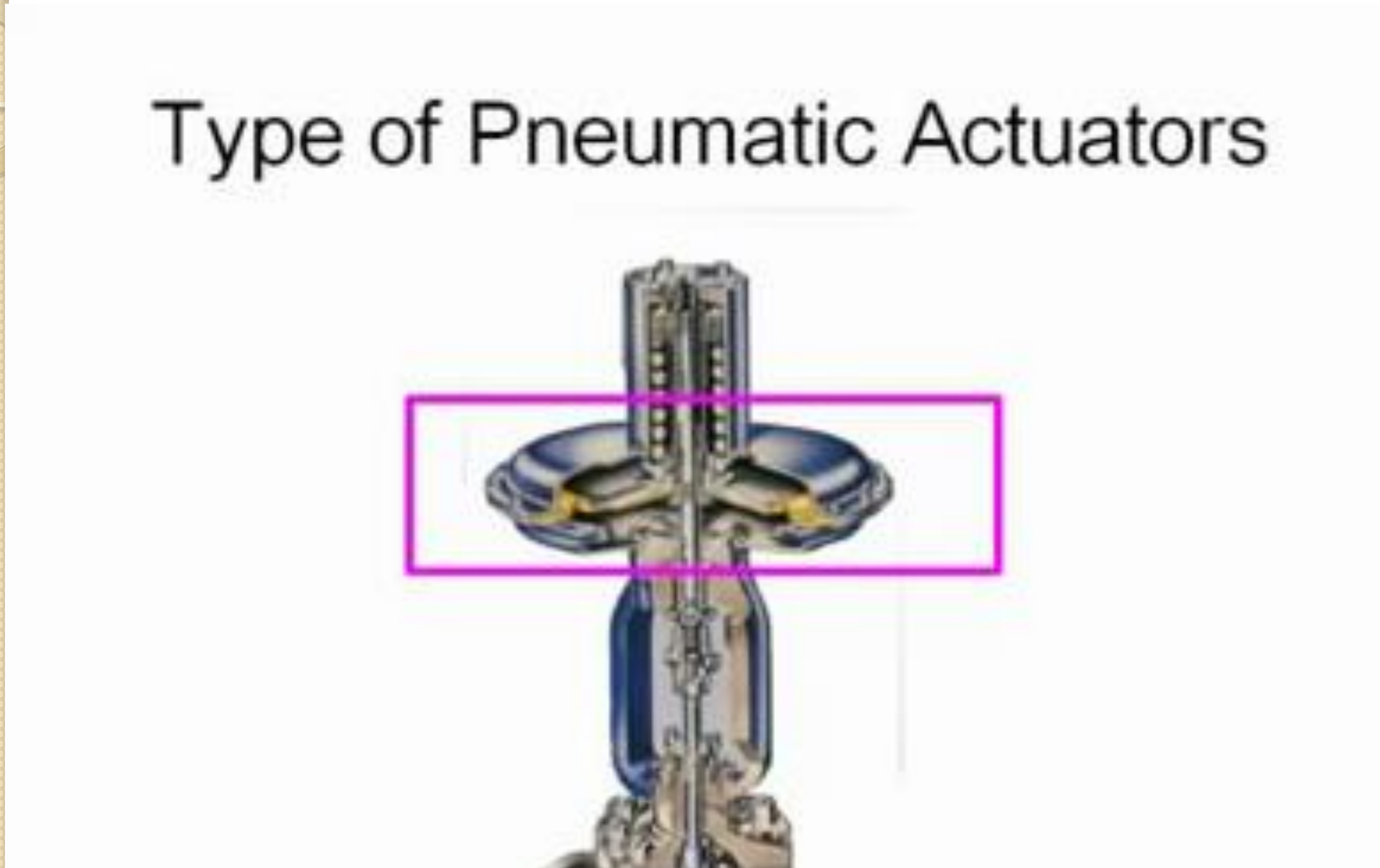
Pneumatic actuators use air pressure on either one or both sides of a diaphragm to provide the force to position the valve



VA LVE ACTUATORS

Pneumatic Actuators

VA LVE ACTUATORS



VA LVE ACTUATORS

VA LVE ACTUATORS

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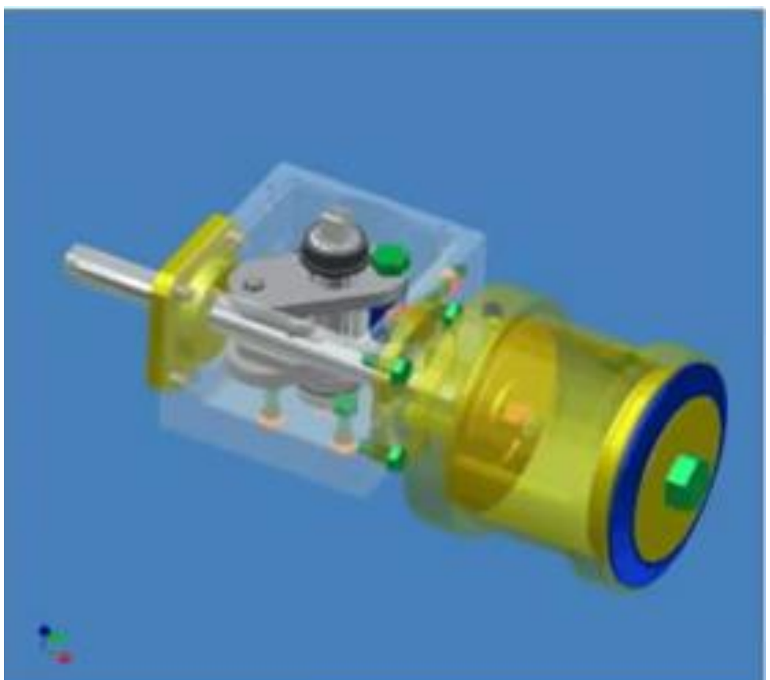


VA LVE ACTUATORS

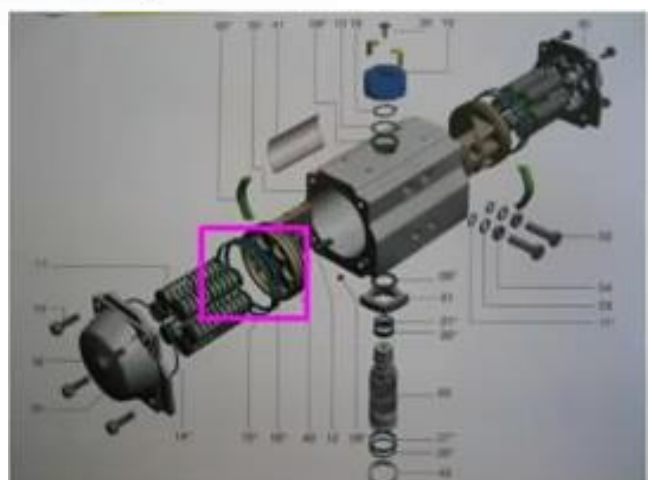
Pneumatic Actuators - Rotary

Rotary/Piston Actuators

Spring-Piston rotary actuator mounted on valve

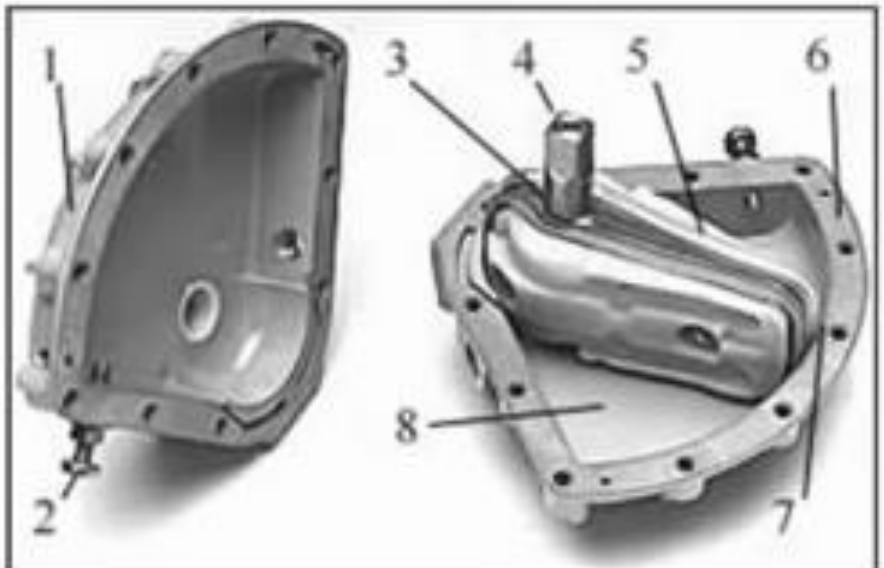
VA LVE ACTUATORS

Pneumatic Actuators – Rack & Pinion



VA LVE ACTUATORS

Rotary Vane Actuator



- Kinetrol Rotary Vane Actuator

VA LVE ACTUATORS

Hydraulic Actuators

Hydraulic actuators use a pressurized liquid on one or both sides of a piston to provide the force required to position the valve.

VA LVE ACTUATORS

VA LVE ACTUATORS

Solenoid Actuated Valves

Solenoid actuators have a magnetic slug attached to the valve stem. The force to position the valve comes from the magnetic attraction between the slug on the valve stem and the coil of the electromagnet in the valve actuator.

Valve End Connections

- Threaded ends
  - Used for small application up to 4 in. they are cheap but can be stripped and leak, for this reason they are used when leakage is not a problem. Threaded ends should not be used with corrosive processes, since the threads can either fail or become inseparable.

Threaded end

Valve End Connections

- Welded ends
  - When zero leakage is required for environmental, safety, or any efficiency reasons the piping can be welded to the valve, providing one piece construction. Many users insist that high-pressure application requires a permanent end especially if they involve high temperatures

Welded end

- Flanged ends
  - The most expensive but are the best from an installation and removal standpoint. The main advantage of flanges is that the valve can be removed easily from the line

Flanged end

Flange Types

A Flange is a method of connecting pipes, valves, pumps and other equipment to form a pipe work system.

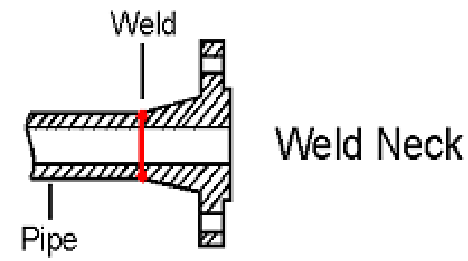
It also provides easy access for cleaning, inspection or modification.

Flanges are usually welded or screwed into such systems and then joined with bolts.

Flange Types

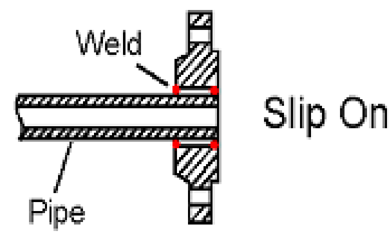
Weld Neck

This flange is circumferentially welded into the system at its neck which means that the integrity of the butt welded area can be easily examined by radiography. The bores of both pipe and flange match, which reduces turbulence and erosion inside the pipeline. The weld neck is therefore favoured in critical applications



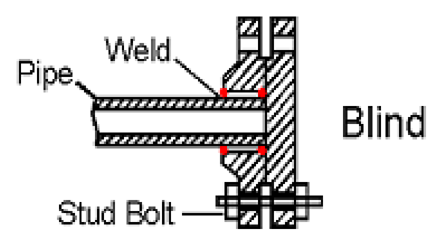
Slip-on

This flange is slipped over the pipe and then fillet welded. Slip-on flanges are easy to use in fabricated applications.



Blind

This flange is used to blank off pipelines, valves and pumps, it can also be used as an inspection cover. It is sometimes referred to as a blanking flange.



Flange Types

Socket Weld

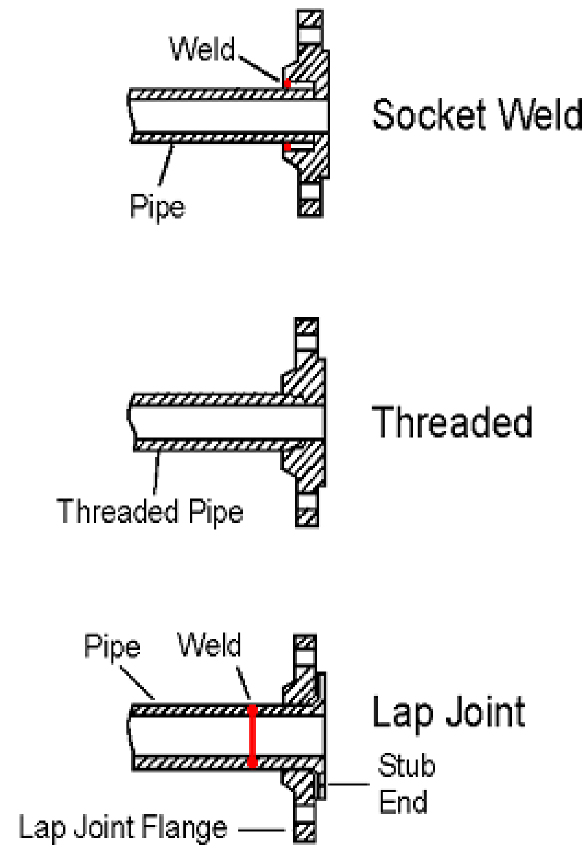
This flange is counter bored to accept the pipe before being fillet welded. The bore of the pipe and flange are both the same therefore giving good flow characteristics.

Threaded

This flange is referred to as either threaded or screwed. It is used to connect other threaded components in low pressure, non-critical applications. No welding is required.

Lap Joint

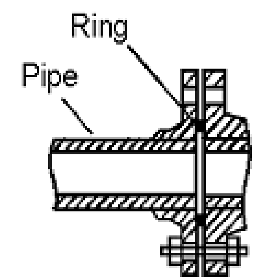
These flanges are always used with either a stub end or taft which is butt welded to the pipe with the flange loose behind it. This means the stub end or taft always makes the face. The lap joint is favoured in low pressure applications because it is easily assembled and aligned. To reduce cost these flanges can be supplied without a hub and/or in treated, coated carbon steel.



Flange Types

Ring Type Joint

This is a method of ensuring leak proof flange connection at high pressures. A metal ring is compressed into a hexagonal groove on the face of the flange to make the seal. This jointing method can be employed on Weld Neck, Slip-on and Blind Flanges.



Ring Type Joint

Valve troubleshooting guide

Do it first.

1. Make sure water is on and all valves(up stream, master valves).

2. Make sure the controller is plugged in to a live electric circuit and that it is programmed correctly.

Valve troubleshooting guide

Do it first.

1. Test the valve's manual bleed or activation handle, if any. If the valve operates correctly the problem may be with the controller or wiring.
2. Make sure the valve is installed in the proper direction, many have a flow arrow

Valve troubleshooting guide

Problem1.valve won't close

Water flows continuously it may flow freely or with reduced flow.

Case :

- Debris or worm seat or washer.
- Hydraulic.
- Solenoid assembly.
- Electrical.

Valve troubleshooting guide

Problem2.valve won't open

No water flows through the valve even when the controller signals it to turn on.

Case :

- Hydraulic.
- Electrical.

Valve troubleshooting guide

What if it still doesn’t work?

Electric globe valves usually have easily replaceable external and internal parts and diaphragm kits.

Valve replacement is often more cost effective than repair.