PROFLUID

VALVE TRAINING

Valve Overview

What is a Valve?

- A valve is a mechanical device that regulates, directs, and controls the flow of fluids by opening, closing, or partially obstructing pathways.

- Functions:
- Starts and stops fluid flow.
- Regulates flow and pressure.
- Controls flow direction.
- Maintains pressure within piping systems.
- Relieves excess pressure or vacuum.

Different Industry Needs

Mining:

Corrosion resistance, abrasion resistance, strength, and durability, various types of pressure

Oil and gas:

Corrosion resistance, strength, durability, and temperature resistance

Defence:

Corrosion resistance, strength, durability, and weight

Manual VS Actuated

Manual valve		Actuated valve	
Pros	Cons	Pros	Cons
- No power source required - Cheaper - Easy use - Durable and robust	- Human required - Require more maintenance - Less precise - Limited flexibility	- Remote control - High precision - Low maintenance - Versatile - Real-time data	- Need constant power - Expensive - Difficult initial installation - More complex design - Frequent calibration required

Materials

CARBON STEEL

Very good mechanical properties, good resistance to stress corrosion and sulfides. CS has high and low temperature strength, is very tough and has excellent fatigue strength.

- Cast Iron (ASTM A48, ASTM A47, A74,A746)
- Cast Steel (ASTM A216 Gr WCB, A352 Gr LCB/C)

LESS COMMONLY USED

- Titanium
- Hastelloy
- Bronze
- Plastic
- Nickel
- Aluminium

STAINLESS STEEL

Better corrosion resistance

- 304
- 316
- Duplex
- Super Duplex

Classification

Function

- On/Off
- Control
- …

End Connection

- Flanged
- Welded (Socket, Butt)
- Threaded

How it operates?

- Handwheel
- Lever
- Actuator
- …

Valve Opening Motions

- Linear
- Rotary
- Quarter Turn

Based on Functions

Isolation

- Gate Valve
- Ball Valve
- Plug Valve
- Piston Valve
- Diaphragm Valve
- Butterfly Valve
- Pinch Valve

Regulation

- Globe Valve
- Needle Valve
- Butterfly Valve
- Diaphragm Valve
- Ball Valve
- Plug Valve
- Pinch Valve

Relief Valve

- Pressure Relief Valve
- Vacuum Relief Valve

Based on Functions

Non Return

- Swing Check Valve
- Lift Check Valve

Swing Check Valve

Special Purpose

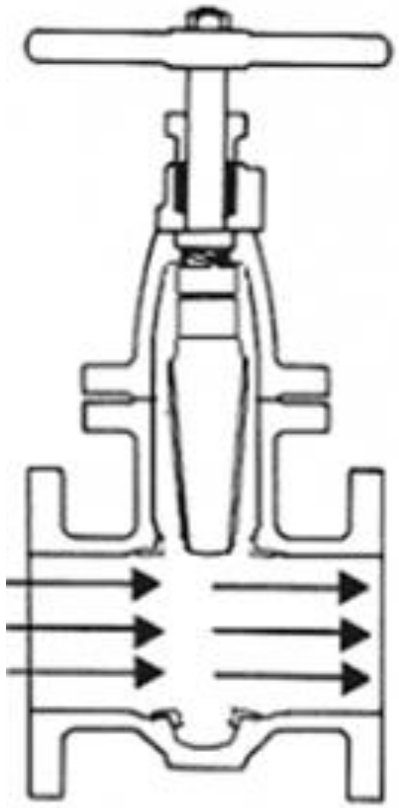
- Multi Port Valve
- Float Valve
- Foot Valve
- Knife Gate Valve
- Line Blind Valve

Knife GateValve

Valve Opening Motions

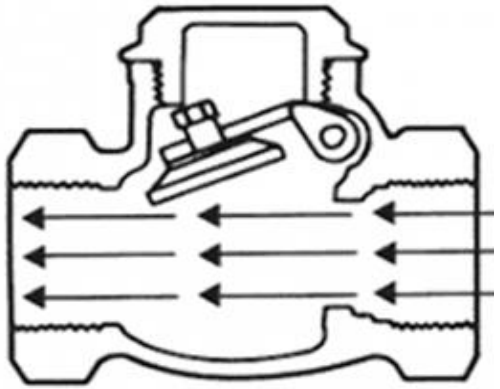
Linear Motion

- Gate
- Globe
- Lift Check
- In-Line Check
- Stop Check
- Pinch
- Diaphragm
- Safety



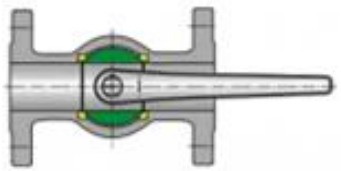
Rotary Motion

- Swing Check
- Tilting Check
- Folding-Disc Check
- Stop Check
- Butterfly
- Plug

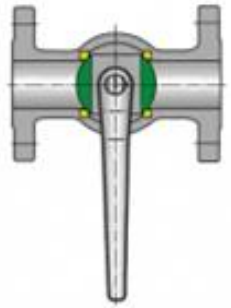


Quarter Turn

- Ball
- Butterfly
- Plug



ON POSITION



OFF POSITION

Type of Actuators

Manual

- Hand Wheel
- Hand Lever
- Gear Wheel
- Chain

Power

- Electric/Motor
- Air/Pneumatic
- Hydraulic
- Solenoid

Pneumatic Actuator

Automatic

PROFLUID

Actuators

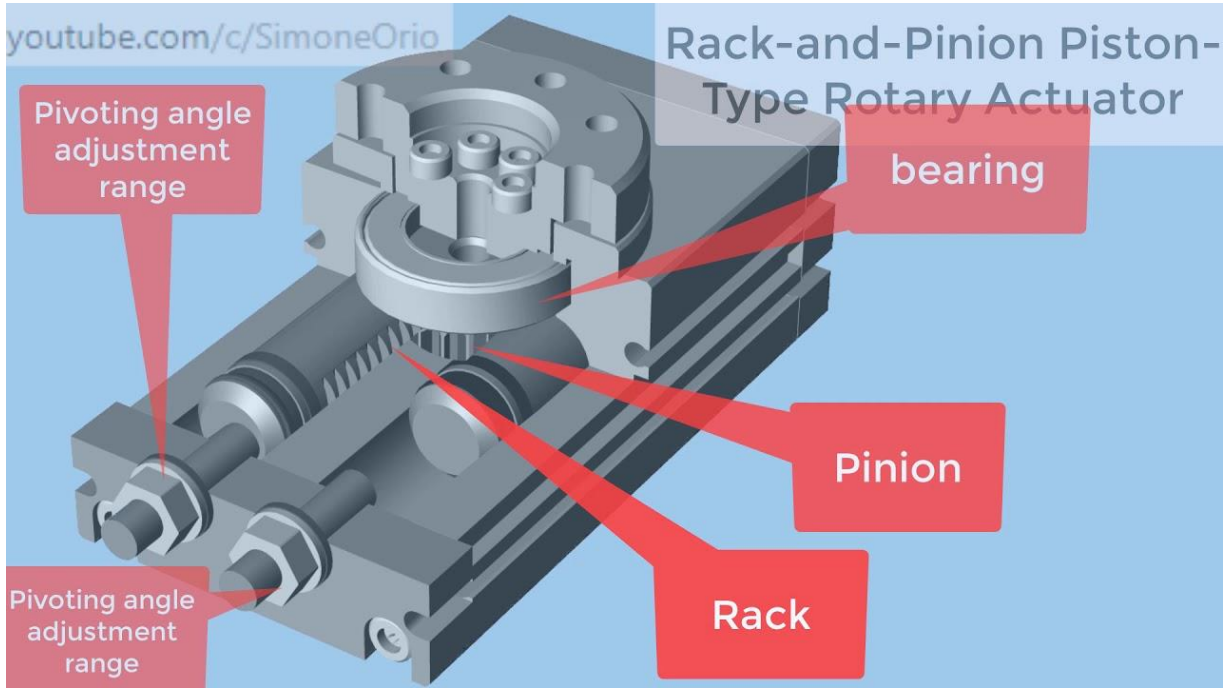
Automatic actuator	Electric actuator
- Can be powered by various energy source - Operate based on signals from automated control systems - Broad applicability - Capable of operating in a variety of environments	- Powered by electricity - Controlled by electrical signals - Precise control - Energy-efficient - Can be affected by electrical failures - Can be more expensive in initial setup - Slower but more precise movement

Actuator Accessories

- Limit switch: Electromechanical device used to detect the presence or absence of an object, or to determine whether the movement limits of that object have been exceeded.
- Positioners: Ensure that a valve or actuator precisely reaches and maintains a desired position.
- Gearbox: Mechanical device used to change the speed and torque in a motor.
- Air filter regulator: Ensure that the actuator receives clean, dry, and properly pressurized air.
- Solenoid: Electromechanical component that converts electrical energy into mechanical motion.

Inside an Actuator

- Pivoting angle adjustment range: Safety, and efficiency of systems by providing precise control, flexibility, and adaptability to changing conditions.
- Bearing: Smooth motion, reducing energy consumption, minimizing wear, and enhancing the overall performance and reliability of machinery.
- Pinion: Converting motion, transmitting torque, and achieving precise control.
- Rack: Achieving precise and controlled linear motion. It enables efficient force transmission, accurate positioning, and adaptability in various mechanical and automation applications.



Pressure Range

- The Class refers to a pressure rating of X pounds per square inch (psi) at a reference temperature
- The PN (Pressure Nominal) indicates a pressure rating of X bar at a reference temperature
- Example:
  - When you see Class 150 (PN) it means the valve or flange meets the pressure-temperature rating requirement of ISO and ANSI standards

ANSI Class

- 125
- 150
- 250
- 300
- 400
- 600
- 900
- 1500
- 2500

Nominal Pressure (PN)

- PN 8
- PN 10
- …

Components of the Valve

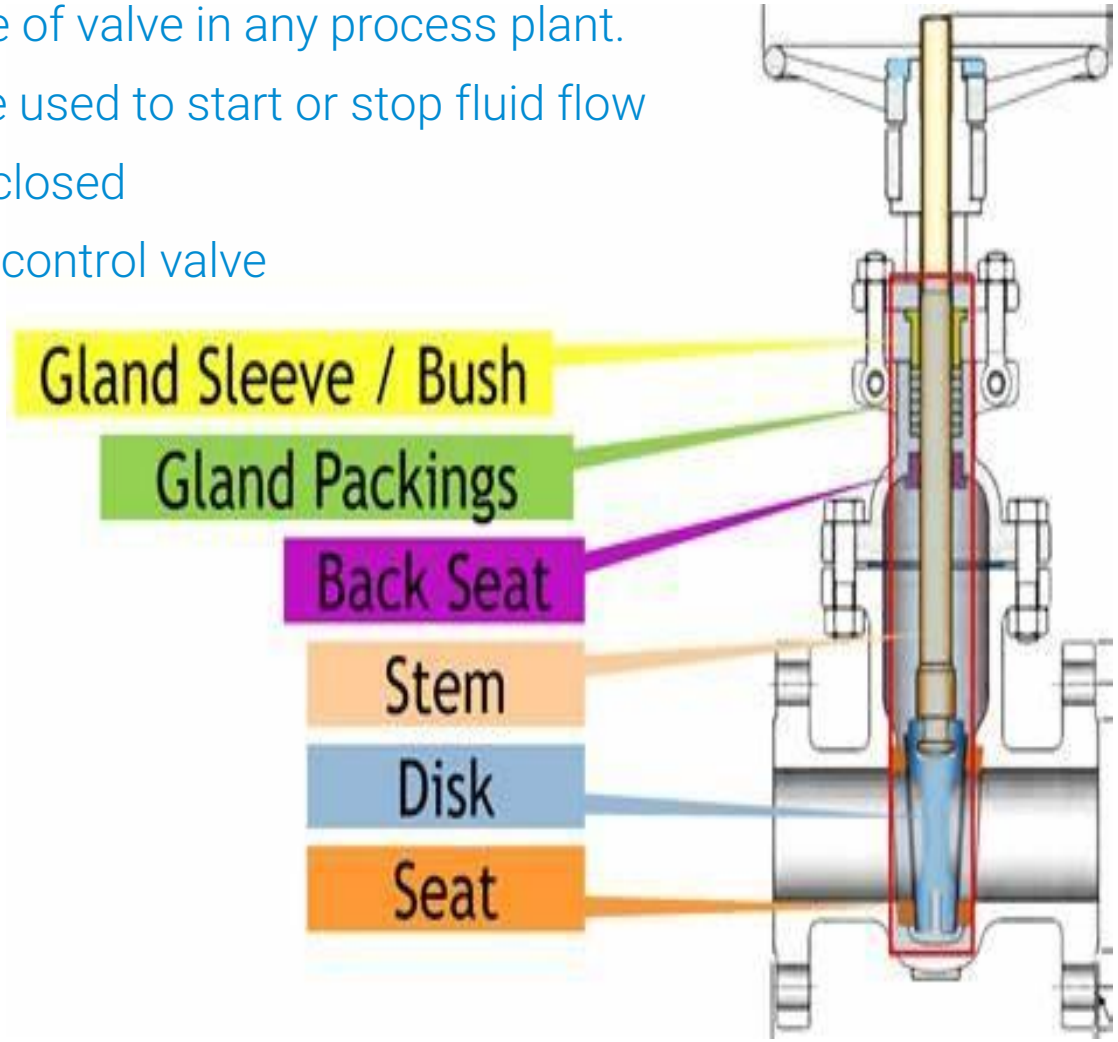
Valve Trim

Trim is the internal and replaceable parts of the Valves

- Includes:
  - Disk
  - Seat
  - Stem
  - Back seat
  - Glands
  - Spacers
  - Guides
  - Bushings
  - Retaining pins
  - Internal Springs

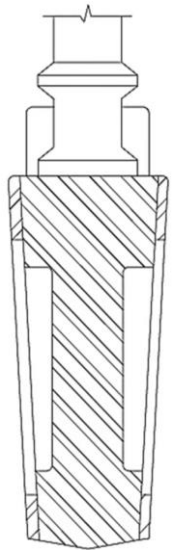
Gate Valve

- Most common type of valve in any process plant.
- Linear motion valve used to start or stop fluid flow
- Fully open or Fully closed
- Cannot be used as control valve

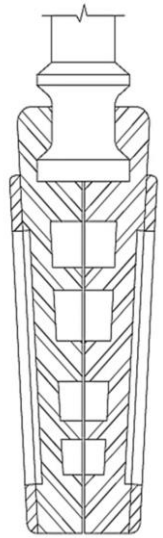


Gate Valve

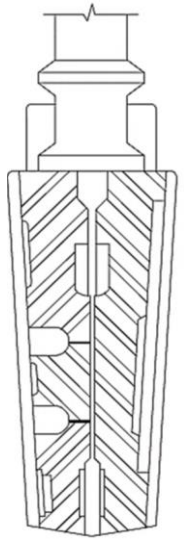
- Construction of the valve:
  - Body
  - Bonnet
  - Stem
  - Seats (Seat Ring)
  - Disk/Wedge
    - Solid wedge
    - Flexible wedge
    - Split wedge or parallel disk



Solid wedge



Flexible wedge



Split wedge

Gate Valve

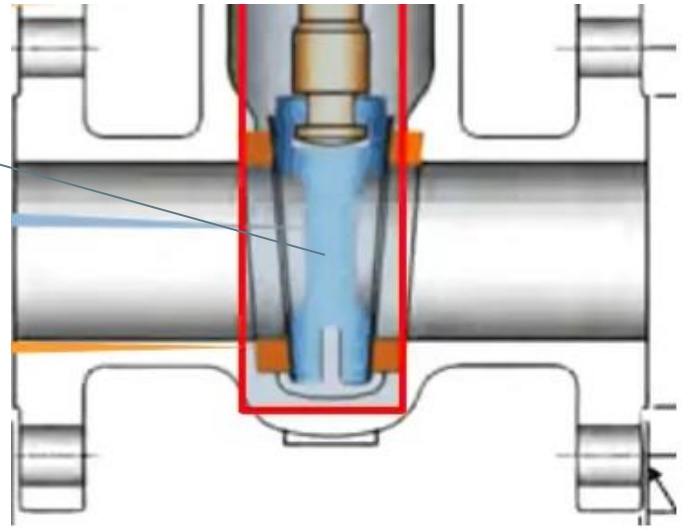
ADVANTAGES

- Good shutoff
- Very low pressure drop during operation.
- Most of the gate valve can be used as bidirectional valve
- Suitable for high pressure and temperature application
- Less maintenance

DISADVANTAGES

- Cannot be used to control the flow
- Slow operation (Advantage also)
- Subjected to vibration if used partially open
- Repairs, such as lapping and grinding, are generally more difficult.

Gate Valve - DISK



Fluid movement Control

- Start / Allow
- Reduce
- Stops flow

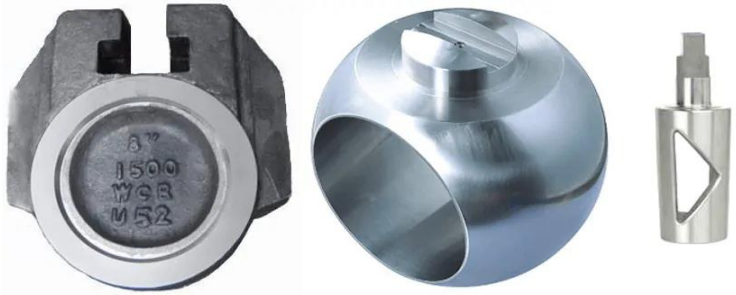
Types of disk define the name of the valve

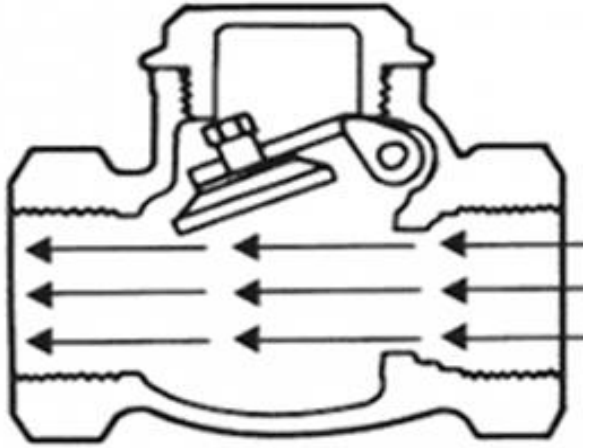
Made of:

- Cast
- Forged
- Fabricated
- Hard facing

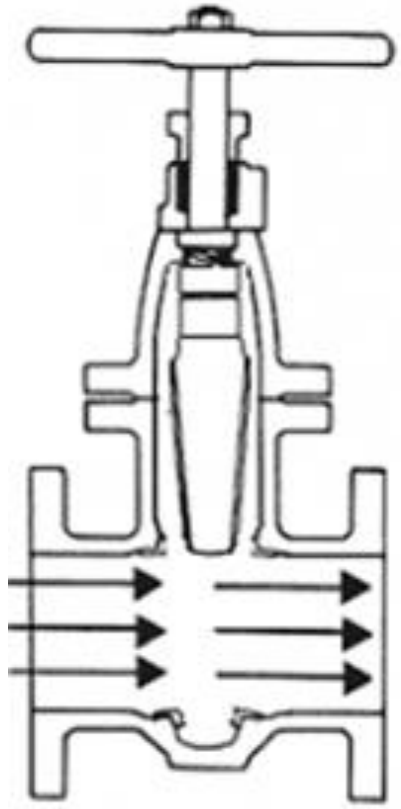
Fine surface finish

Pressure retaining part





Disk movement by flow



Disk movement by stem

Gate Valve - SEAT

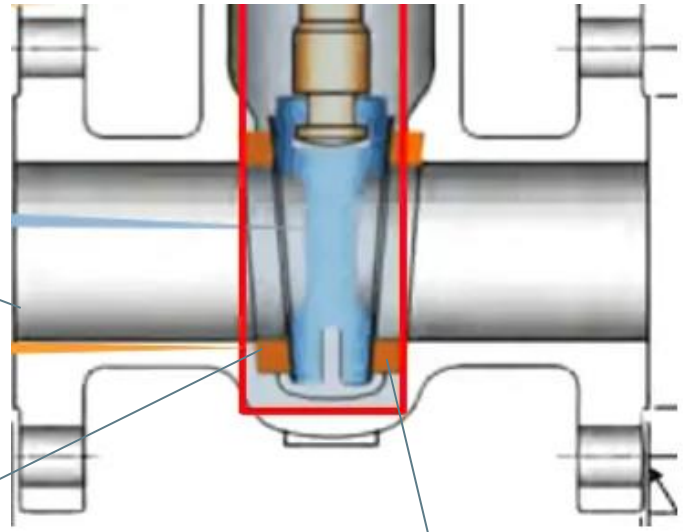
Seating surface for the disk

Integral to valve body

Forged metallic rings

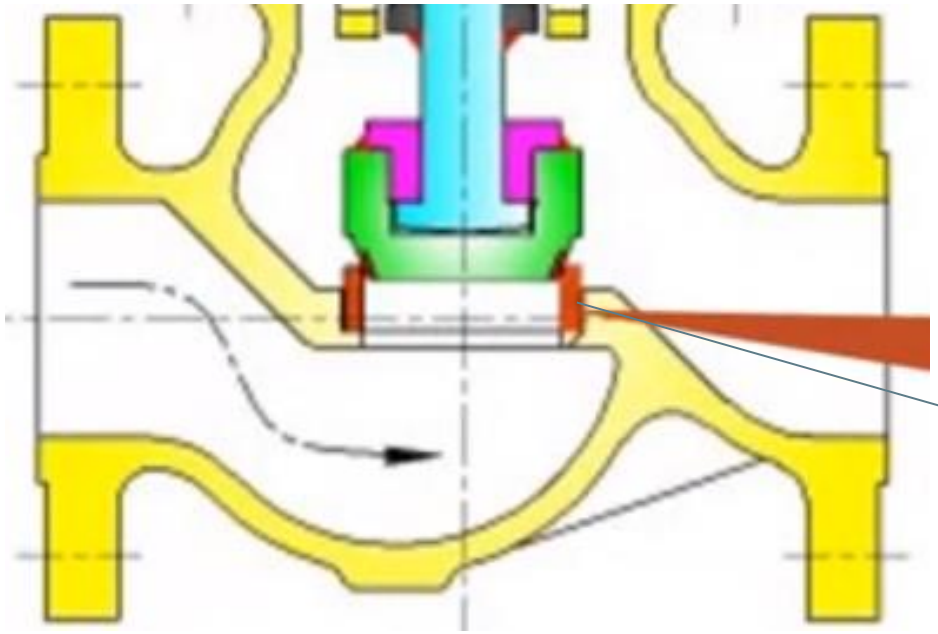
Hard facing

Non-metallic rings

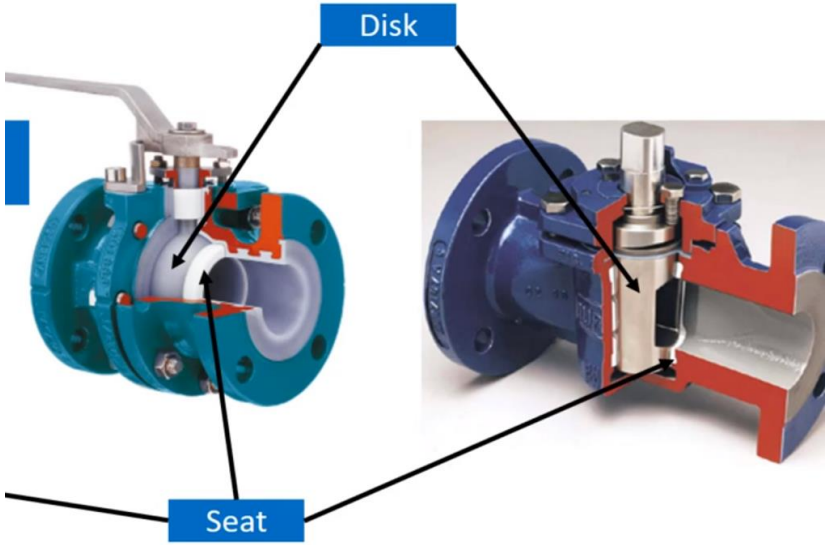


Up Stream Seat

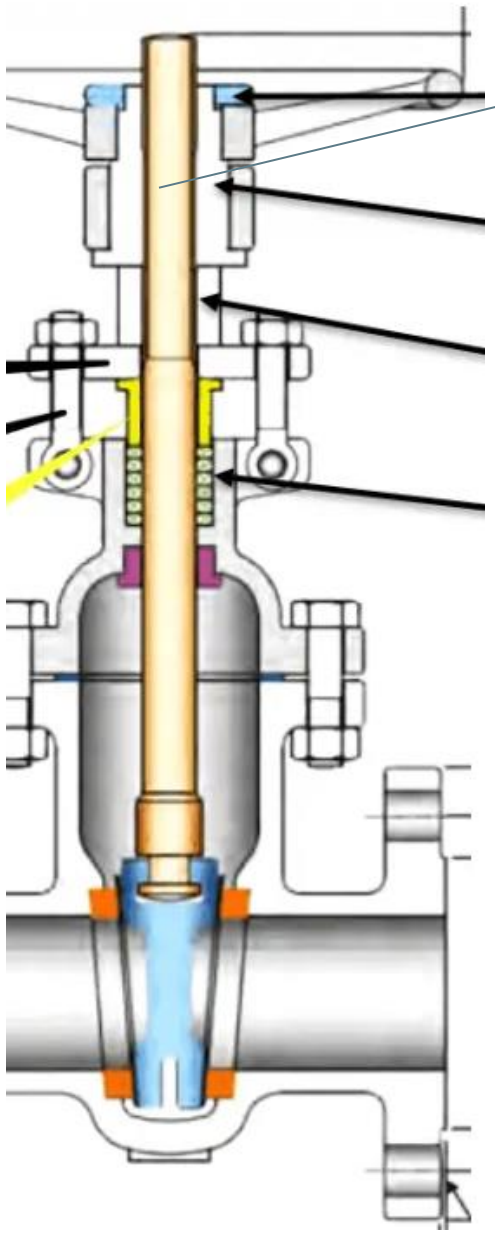
Down Stream Seat



Single Seat



Gate Valve - STEM

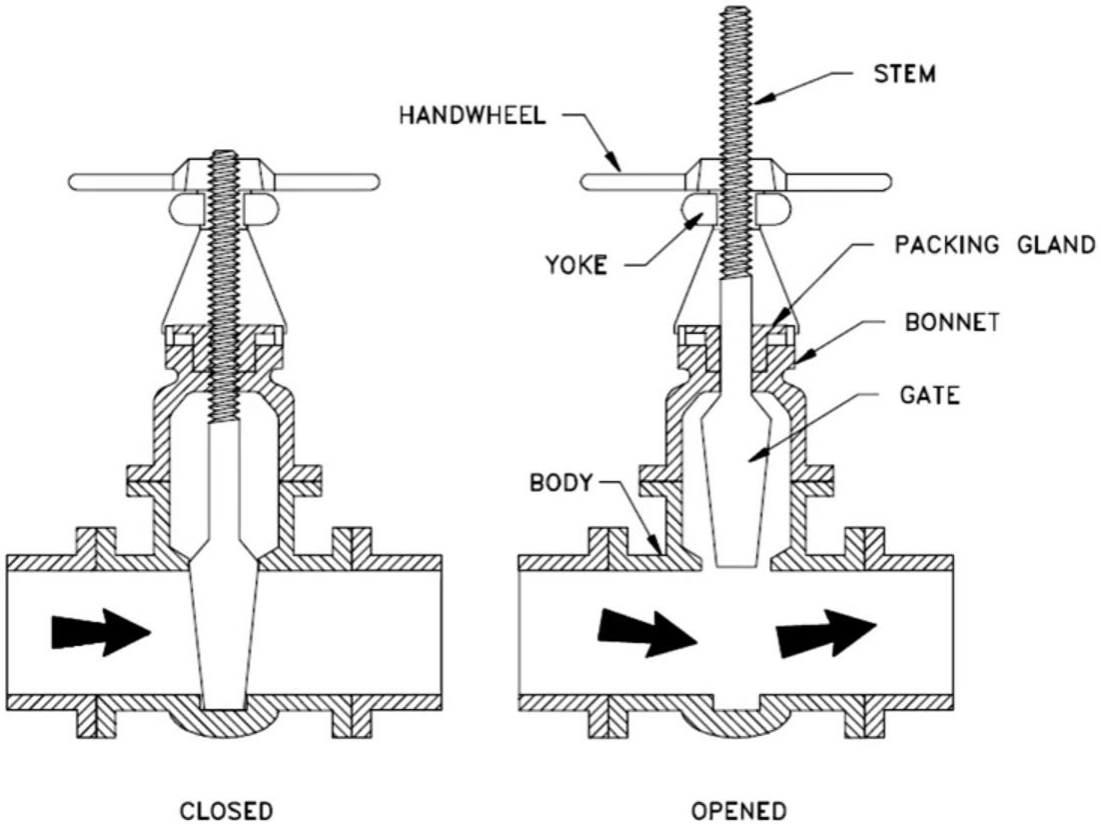


Connect the handwheel/ actuator and the disk.

Typically forged from stainless steel and connected to the disk by threaded or welded joints.

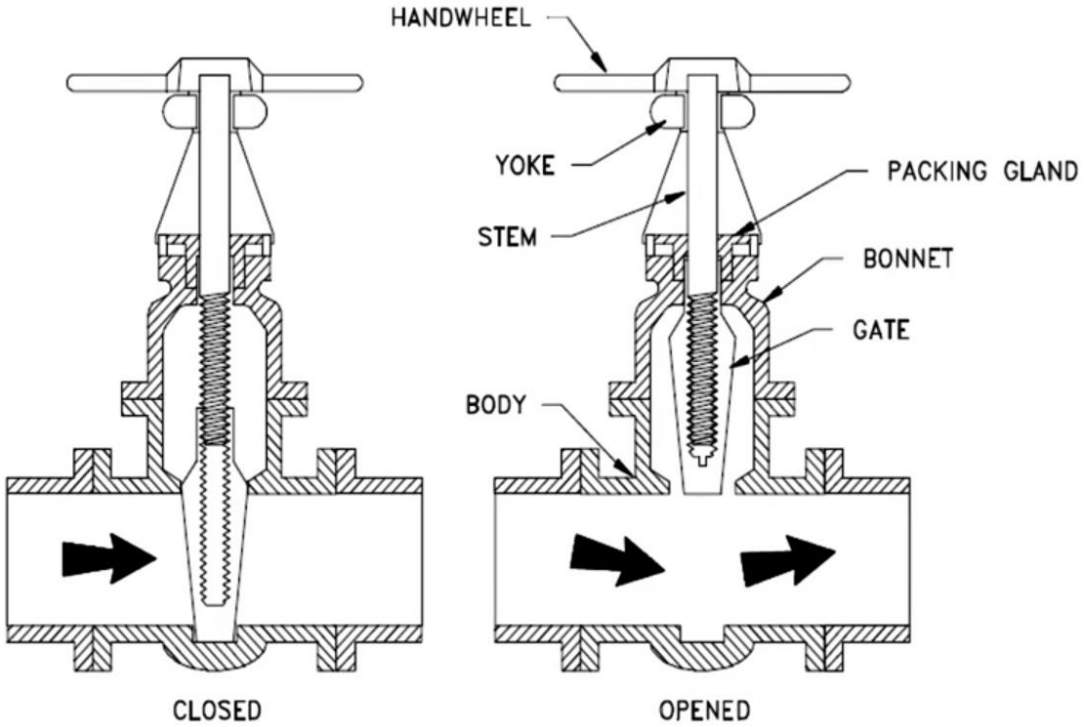
STEM TYPES

Rising: stem move up or down while opening and closing



STEM TYPES

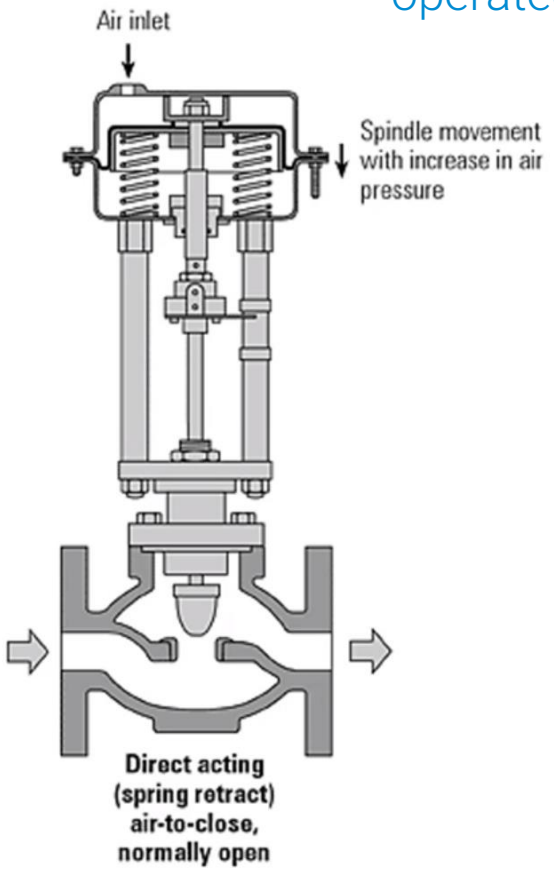
Non-Rising: There is no upward movement of the stem in a non-rising stem type.



STEM TYPES

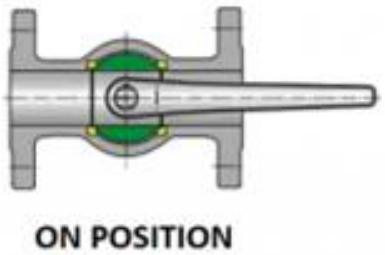
Sliding Stem: does not rotate or turn.

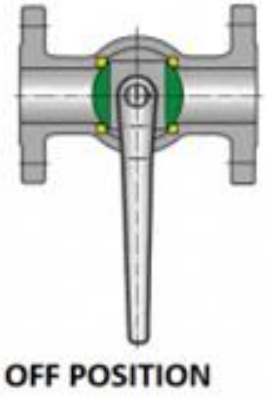
Slides in and out like lever (hand-operated lever, control valves)

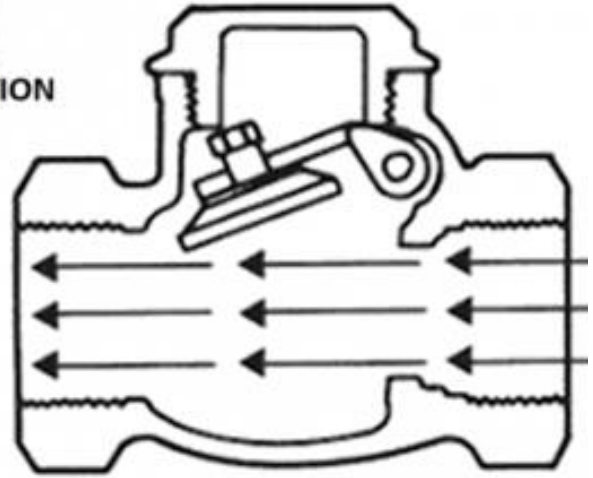


STEM TYPES

Rotary Stem: A 90-degrees quarter-turn movement of the stem open or close valve.



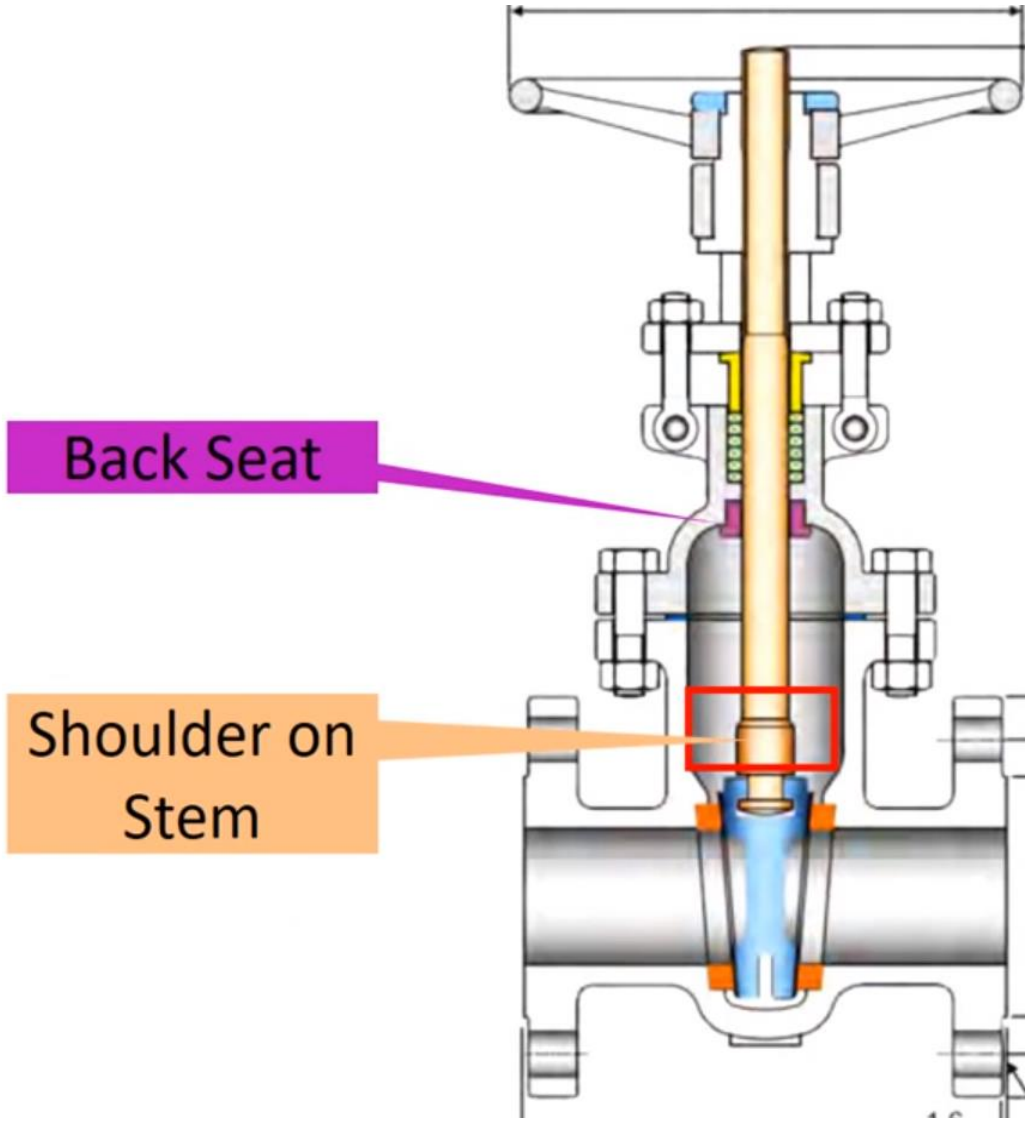




Gate Valve – BACK SEAT

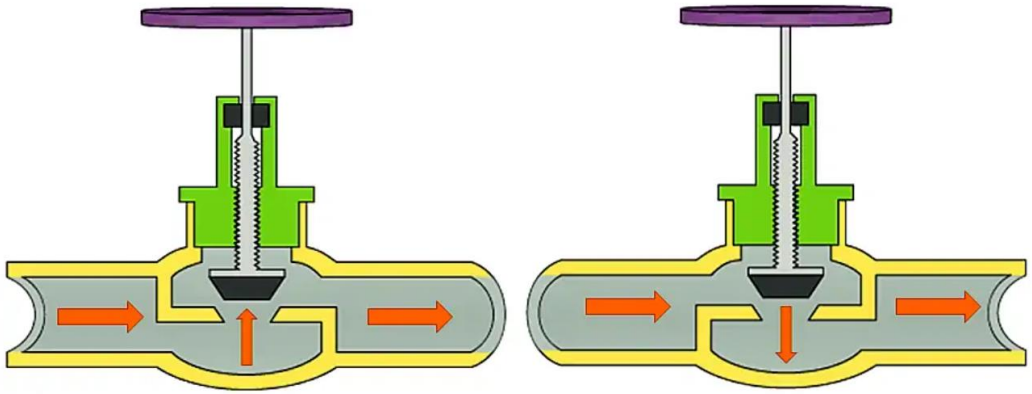
Is comprised of a shoulder on the stem and a mating surface on the underside of the bonnet.

Gland packing replacement



Globe Valve

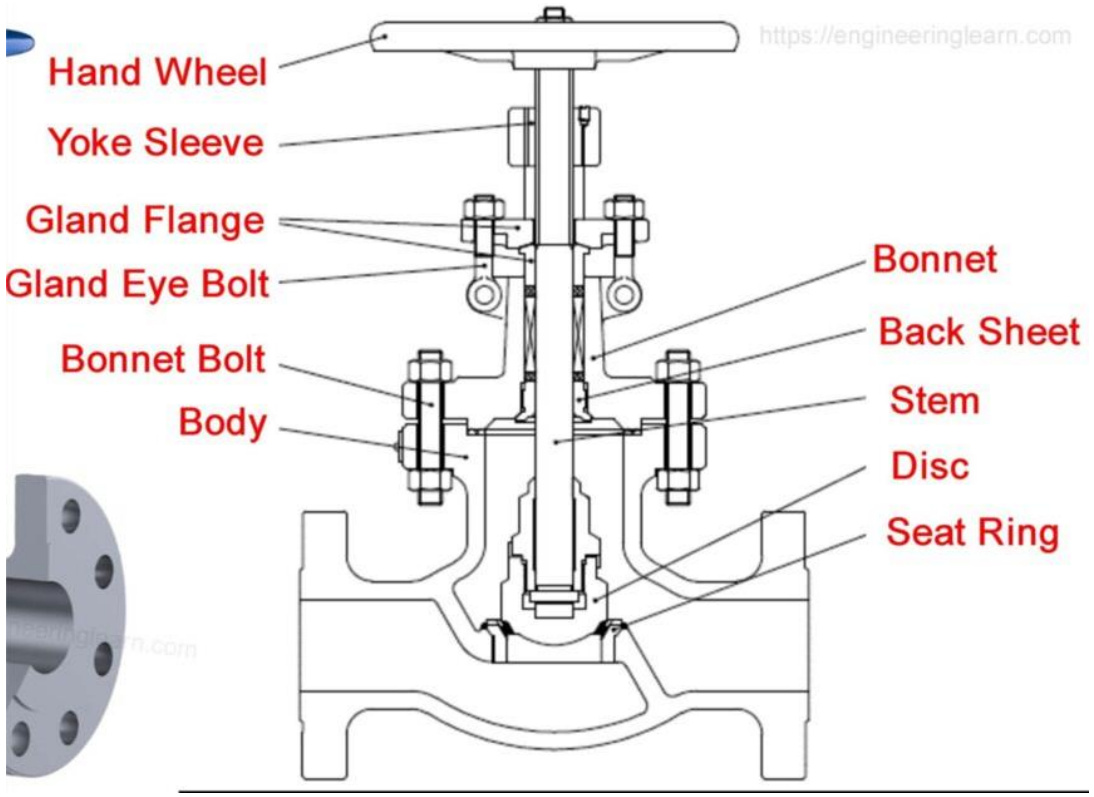
- A linear motion valve that stops, starts, and regulates fluid flow
- During the opening and closing of the valve, the disc moves perpendicularly to the seat.
- Globe valves are used where flow control is required, and leak tightness is also important.



Disk Close Against the Flow Direction

Disk Close In Flow Direction

Globe Valve



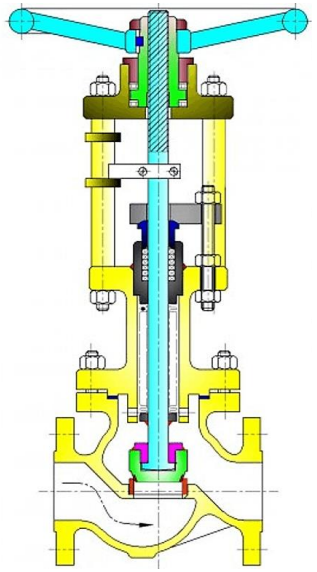
- Disk types
  - Ball type
  - Needle type
  - Composite type

Ball Type Disc

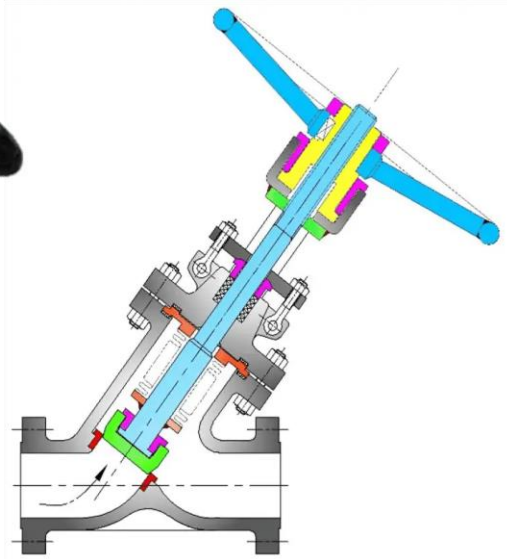
Needle Type Disc

Globe Valve

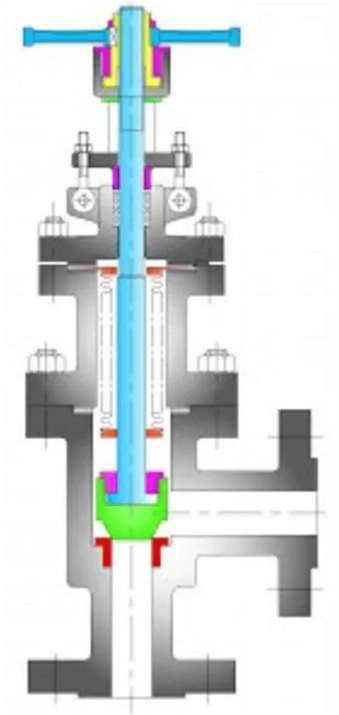
- Z Type



- Y Type



- Angle Type



Globe Valve

ADVANTAGES

- Better shut off as compared to gate valves
- Good for frequent operation as no fear of wear of seat and disk
- Easy to repair, as the seat and disk can be accessed from the valve top
- Fast operation compares to gate valve due to shorter stroke length
- Usually operated by an automatic actuator.

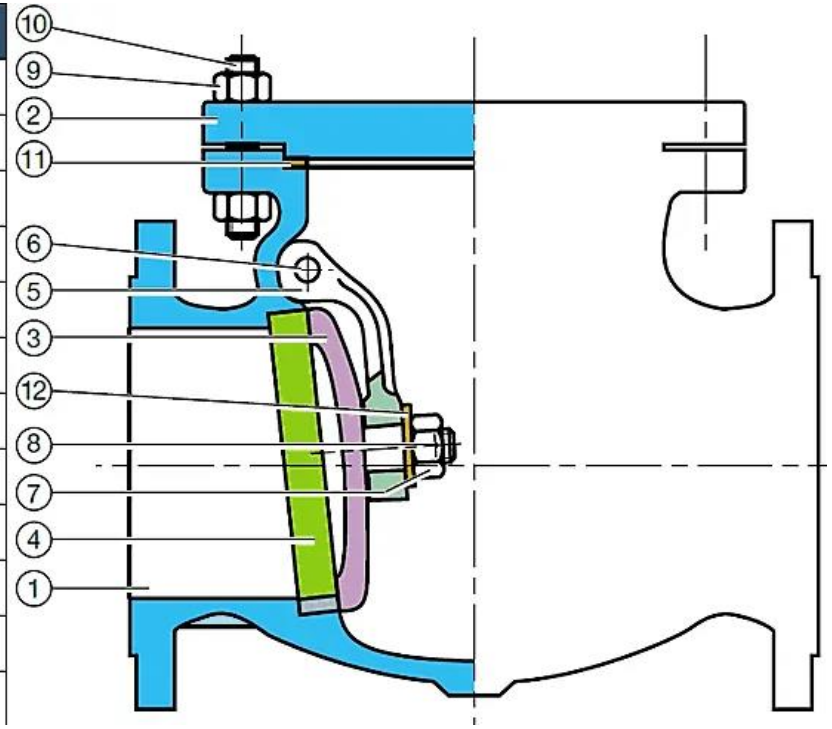
DISADVANTAGES

- High head loss from two or more right-angle turns of flowing fluid within the valve body.
- Obstructions and discontinuities in the flow path lead to a high head loss.
- In a large high-pressure line, pulsations and impacts can damage internal trim parts.
- A large valve requires considerable power to open and create noise while in operation
- It is heavier than other valves of the same pressure rating.

Check Valve (or non-return valve)

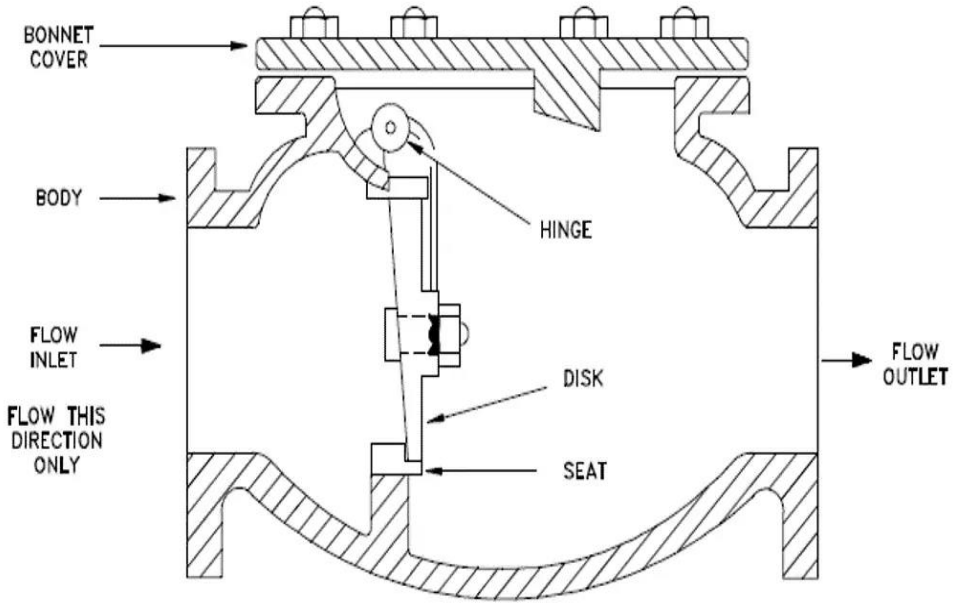
- Used to prevent backflow in a piping system is known as a check valve.
- The pressure of the fluid passing through a pipeline opens the valve, while any reversal of flow will close the valve.

Sr No	Check Valve
1	Body
2	Cover plate
3	Disc
4	Body seats
5	Hinge
6	Hinge pin
7	Nut
8	Cotter pin
9	nuts
10	Stud bolts
11	gasket
12	Washer

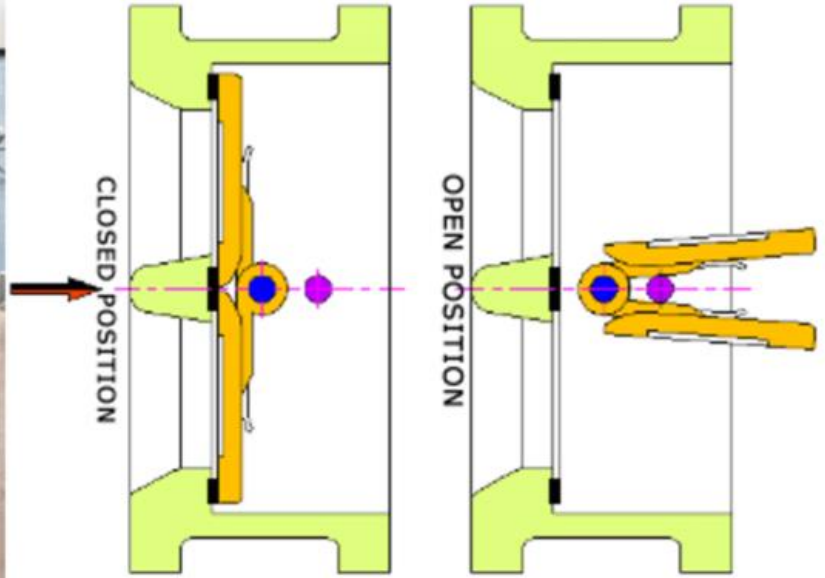


Check Valve - Types

- Swing



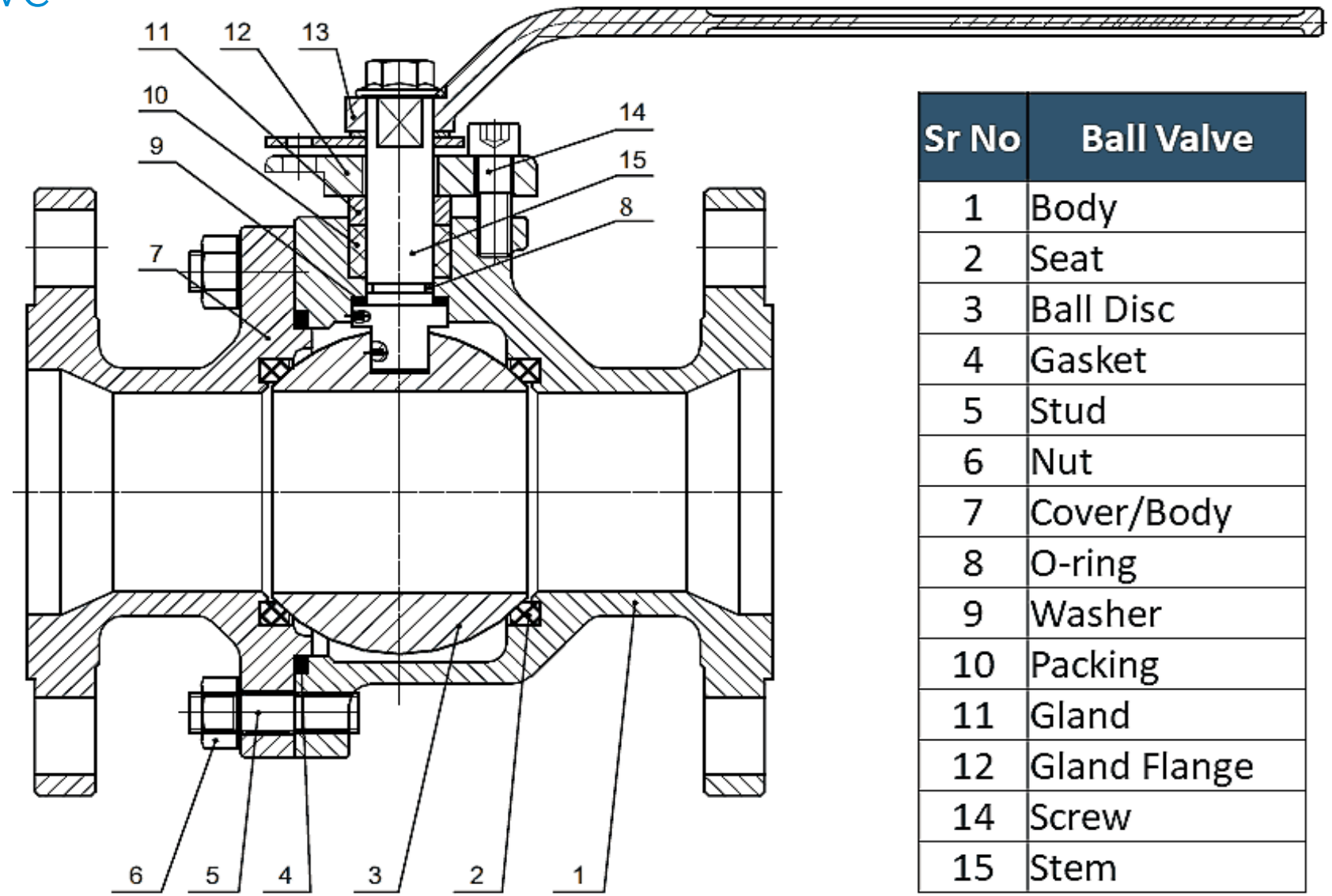
- Dual plate



Ball Valve

- Is a quarter-turn motion valve that uses a ball-shaped disk to stop or start the flow.
- Most ball valves are quick-acting.
- It can be used in different types of fluid services as an on-off stop valve that provides bubble-tight shutoff.
- It can be used in air, gaseous, and vapor services as well as hydrocarbon services.
- Metal seated valves can be used in high-pressure and temperature applications.

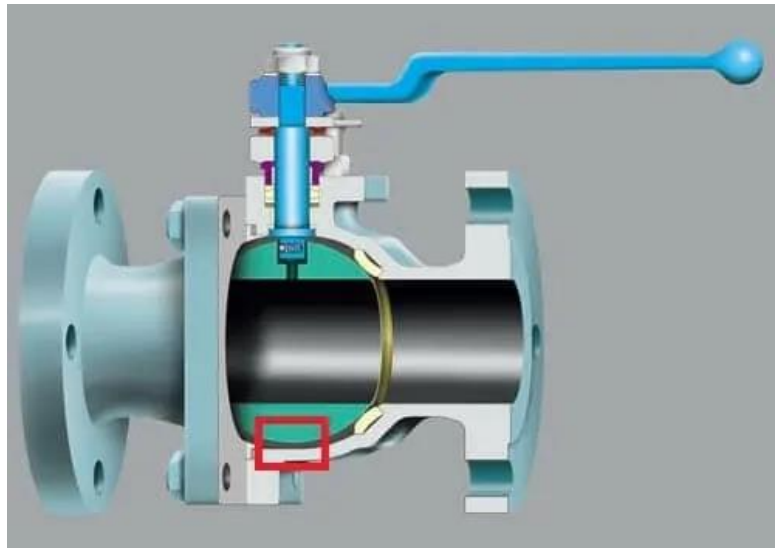
Ball Valve



Sr No	Ball Valve
1	Body
2	Seat
3	Ball Disc
4	Gasket
5	Stud
6	Nut
7	Cover/Body
8	O-ring
9	Washer
10	Packing
11	Gland
12	Gland Flange
14	Screw
15	Stem

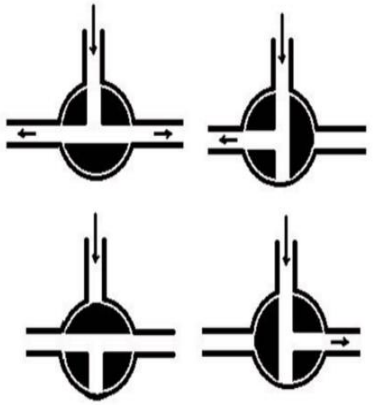
Ball Valve - Types

- Floating



- Trunnion Mounted

- 3 Way Ball



Ball Valve

ADVANTAGES

- It is a quick open and close type that provides bubble-tight reliable sealing in high-pressure temperature applications.
- Several designs of ball valves offer the flexibility of selection so that you can choose the valve that suits your requirements.

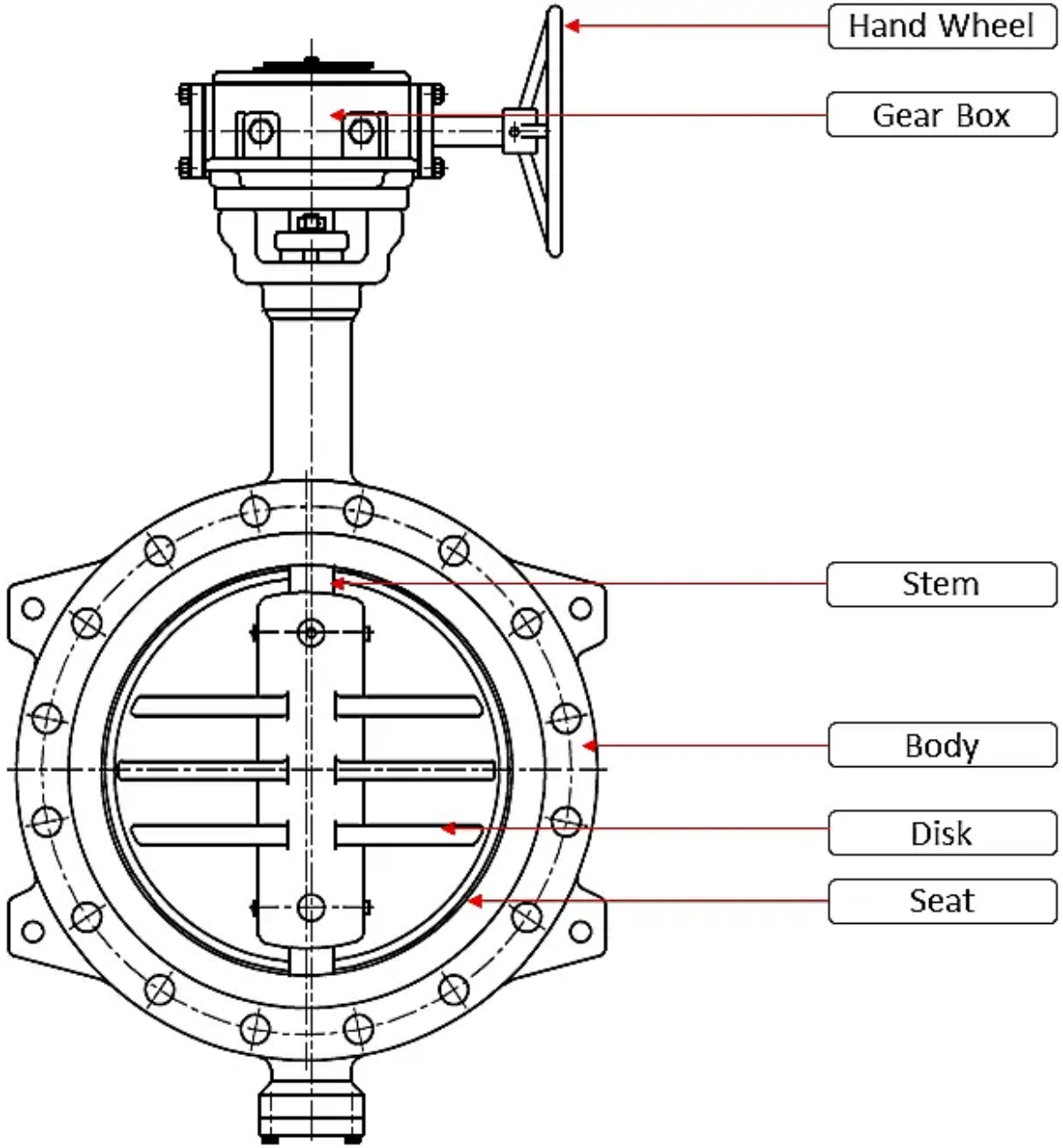
DISADVANTAGES

- It cannot be used in services that require throttling.
- In slurry or the other similar applications, the suspended particles can settle and become trapped in body cavities causing wear, leakage, or valve failure.
- Due to rapid opening and closing, suge pressures may arise, damaging downstream equipment.

Butterfly Valve

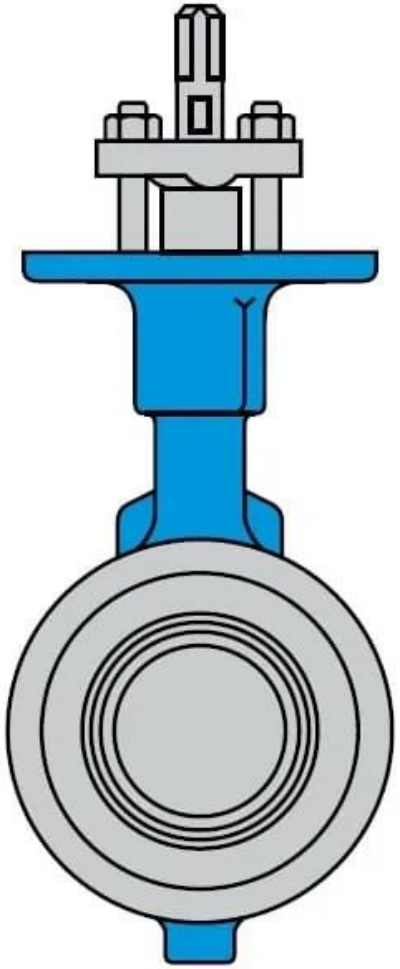
- Is a quarter-turn motion valve used to stop, regulate, and start the flow.
- Normally, they are used systems where a positive shut-off is not required.
- Is used in many different fluid services and performs well in slurry applications.
- Liquids, steam, cryogenics, cooling water, air, gasses, firefighting and vacuum services.
- Is used in all types of industries, even in High-pressure and temperature services.

Butterfly Valve



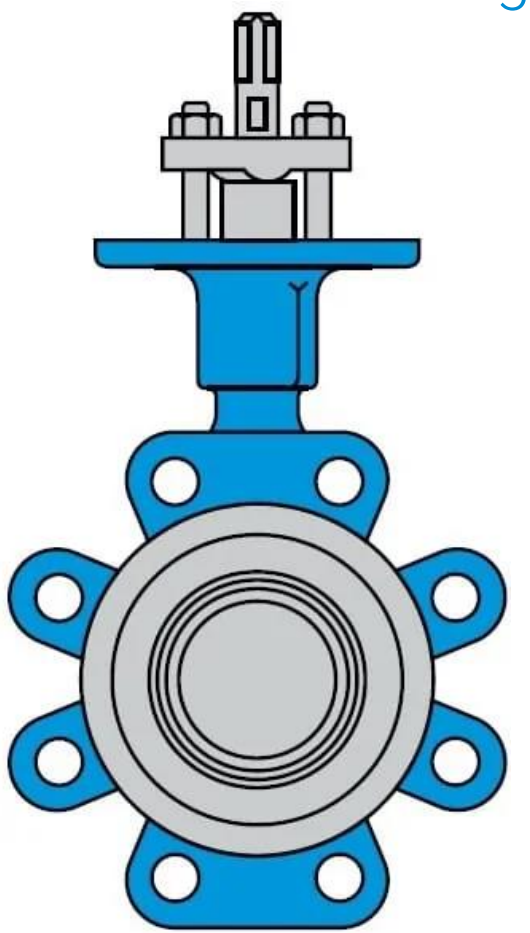
Butterfly Valve - Types

- Wafer



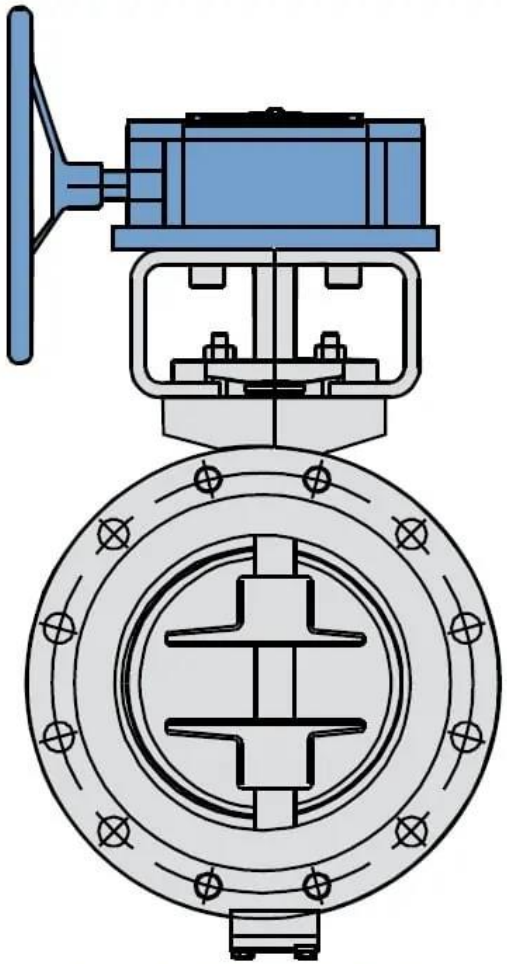
Wafer Type Butterfly Valve

- Lug



Lug Type Butterfly Valve

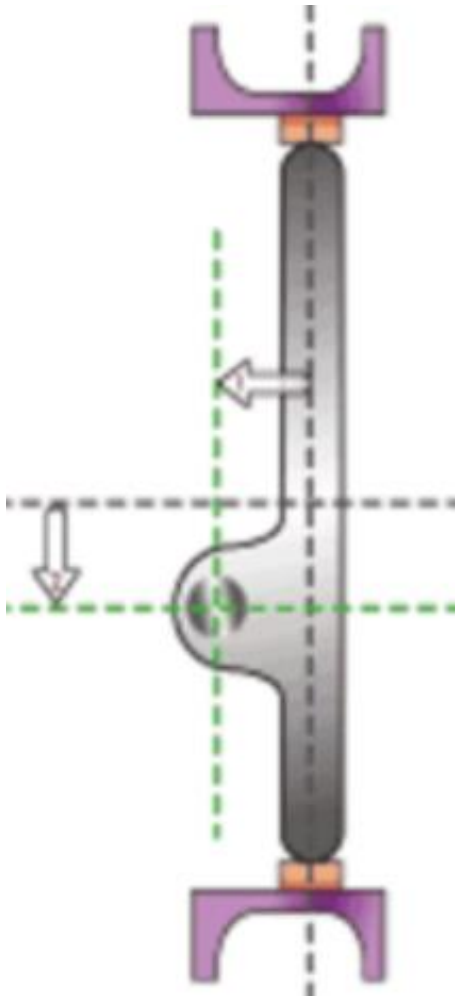
- Flanged



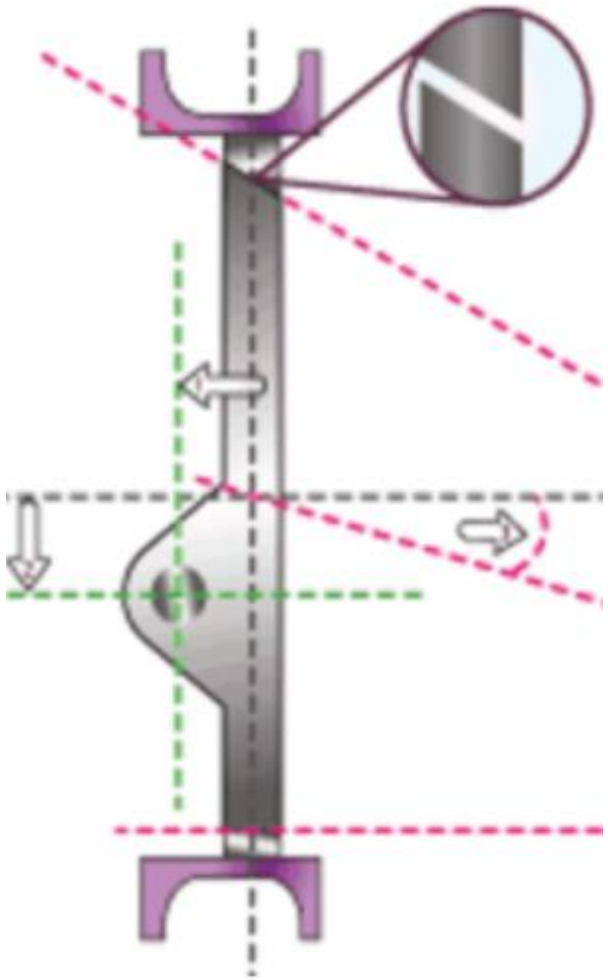
Double Flanged Butterfly Valve

Butterfly Valve - Types

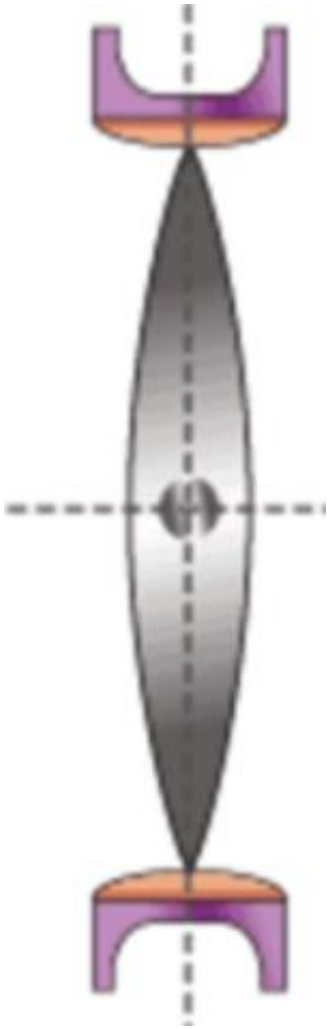
- Double Offset



- Triple Offset



- Zero Offset



Butterfly Valve

ADVANTAGES

- Is suitable for large valve applications due to its compact, lightweight design that requires considerably less space as compared to other valves.
- Due to a quick operation, it needs less time to open or close.
- The maintenance cost are usually low compared to other valves types.
- Non-metallic seating can be used in chemical or corrosive media.

DISADVANTAGES

- Throttling is limited to low differential pressure services and that too with a 30-80 degree disc opening.
- There is a chance for cavitation and choking as the disk is always in the flow turbulence flow can affect the disc movement.

Pressure Relief Valve

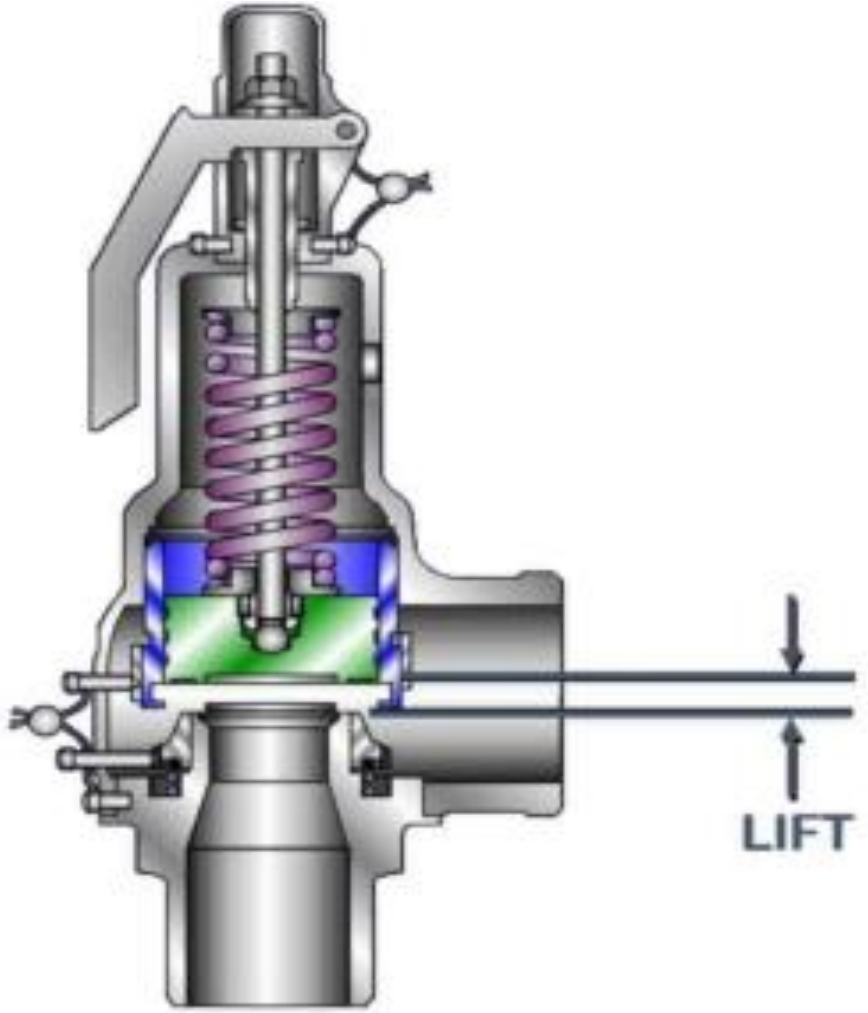
- Is a safety device designed to protect pressurized equipment or system during an overpressure event or in the event of a vacuum.
- The primary purpose of a pressure Relief Valve is to protect the life and property venting fluid from an over-pressurized system.

RELIEF VALVES

- Is a gradual lift pressure relief device actuated by inlet static pressure.
- An opening is proportional to the increase inlet pressure over the opening pressure of the valve.
- Are commonly used with non-compressible liquid system in chemical, petrochemical, and oil & gas industries.

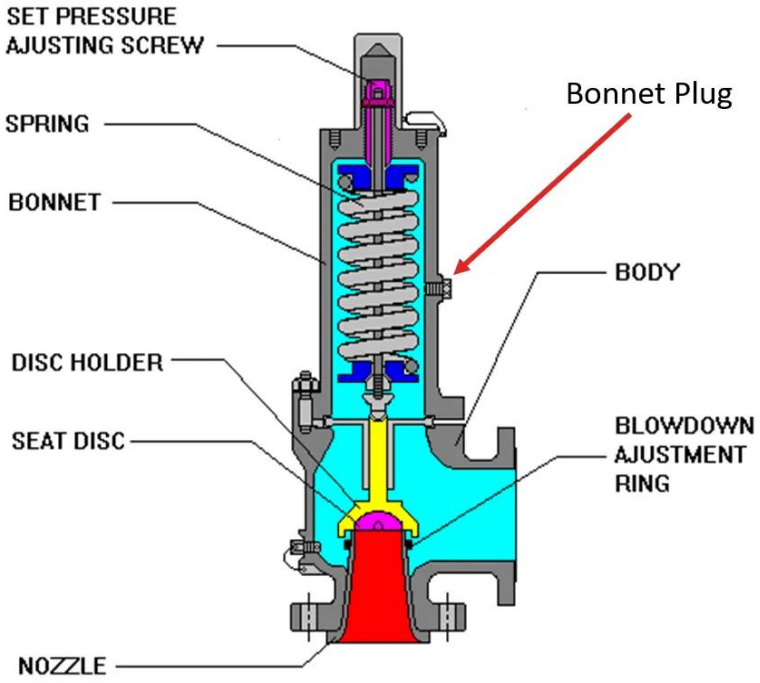
Safety Valve

- Is a rapid opening or pop-up action pressure relief valve actuated by inlet static pressure.
- Are used primarily with compressible gasses. Particularly for steam and air services.
- Are classified according to the lift of the disk and bore of the valve.
- In a low-lift safety valve, the disk lifts automatically such that the actual discharge area is determined by the position of the disk.



Safety Relief Valve

Have combined characteristic of both. It performs as a safety valve, open by pop-up action when used in a compressible gas system and performs like a relief valve, opens in proportion to the overpressure when used in liquid systems.



PRESSURE RELIEF VALVES

Is characterized by a rapid pop action or by opening proportionally to the increase in pressure with respect to the opening pressure of the valve.

Pressure Relief Valve

ADVANTAGES

- It can be used in all kinds of Gas and Liquids services.
- Suitable for high pressure and temperature services
- The low cost compares to other types.

DISADVANTAGES

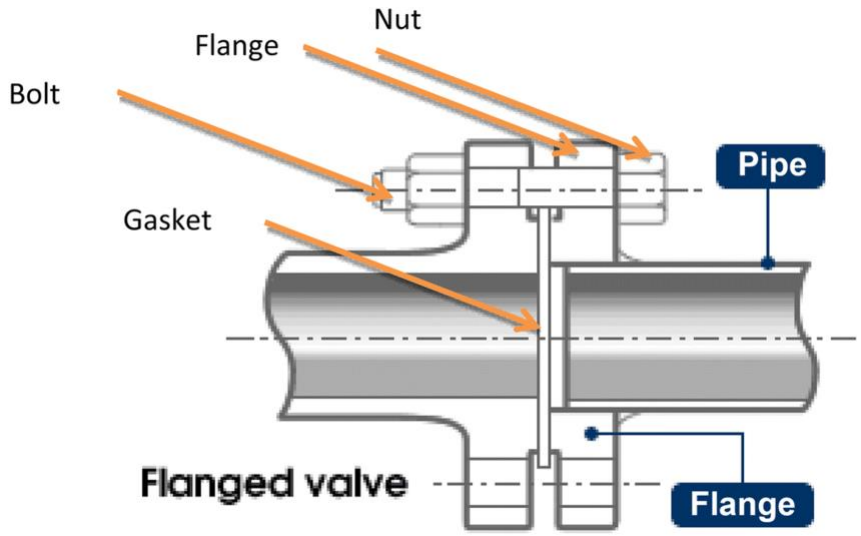
- Backpressure can affect the functioning of the valve
- Spring is subjected to corrosion if service material is corrosive
- Not suitable for hazardous services.

End Connections

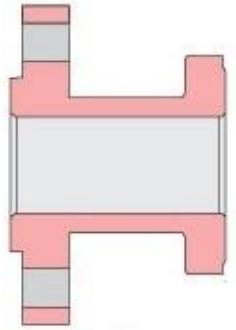
Flanged End

- Flanged ends typically have holes for bolts, which are used to secure the valve to the piping system, creating a leak-proof seal.

- Flanged connections are common in industrial and high-pressure applications because they provide a strong, reliable joint.



Flanged end

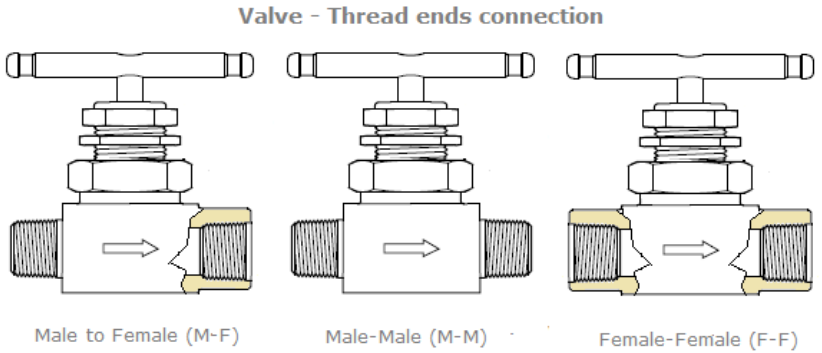


End Connections

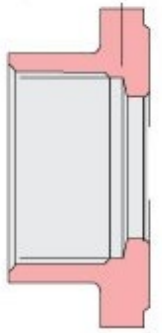
Threaded End

- This type of connection is commonly used for smaller valves and in applications where space or access is limited.
- Threaded ends provide a convenient way to connect and disconnect valves without the need for flanges or additional hardware.
- However, they may not be as suitable for high-pressure or high-temperature applications compared to flanged connections.

- Threaded options:
- NPT
- BSPT (tapered)
- BSPP (parallel)



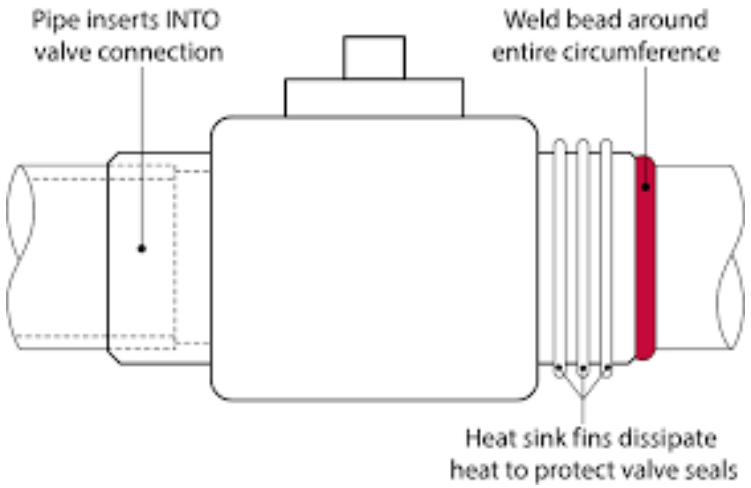
Threaded end



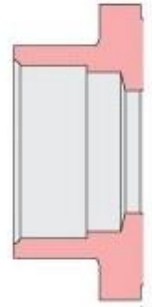
End Connections

Socket Weld End

- This connection method involves inserting the end of the valve into the socket of the pipe and then welding around the joint to create a strong, permanent bond.
- Socket weld connections are typically used for high-pressure and high-temperature applications, as they provide a robust and leak-proof seal.
- The welding process helps ensure the integrity of the connection by eliminating the need for threads or flanges, which can be points of potential weakness.



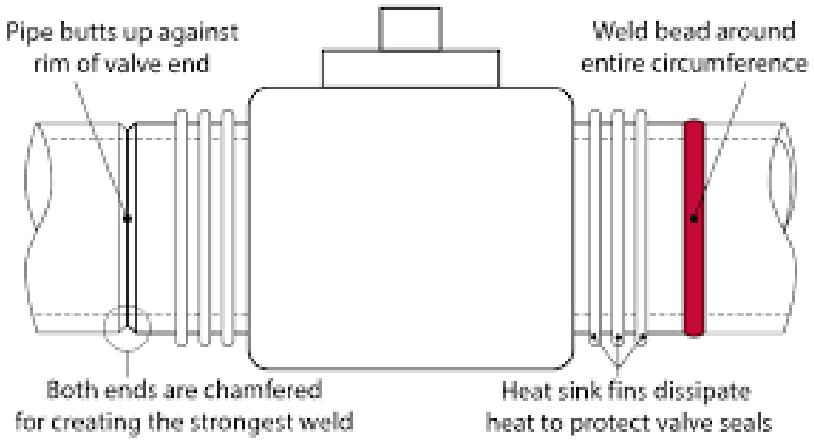
Socket weld end



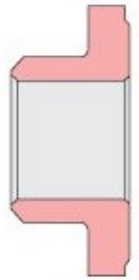
End Connections

Butt Weld End

- In a butt weld connection, the ends of the valve and the pipe are aligned and then welded along the joint, creating a continuous, smooth, and strong bond.
- Butt weld connections are commonly used in high-pressure and high-temperature applications because they provide a seamless, leak-proof connection and maintain the integrity of the pipeline's internal flow.
- This method is favored for its durability and strength, as well as its ability to handle extreme conditions.



Butt weld end



Standards

- A set of technical definitions and guidelines.
- “How to” instructions for designers and manufacturers.
- A common language for defining quality
- Establish safety criteria for the products
- Examples: ASTM, ISO, API, MSS, etc.

- Why are they required?

- Standards are documents that establish
  - Engineering requirements
  - Technical requirements
- For products, practices, methods or operations
- Build confidence about quality
- Lower the cost of production

Certifications According to EN 10204

- Ensuring the quality and compliance.
- Crucial information about the inspection and testing processes.
- The most recognized standard for types inspection certificates is EN10204 for "Metallic products - Types of inspection documents".

Type 2.1	Type 2.2	Type 3.1	Type 3.2
Declaration of Compliance No Test Report	Declaration of Compliance With Test Report Testing based on Internal Procedure Non-Specific Inspection	Inspection by Manufacturer's inspection Team Independent from Production. Certificate with Test Result Testing based on Standards requirement Specific Inspection	Inspection by independent Inspection Agency, not affiliated with Manufacturer. Certificate with Test Result Testing based on Standards requirement Specific Inspection

Valve Training

Any Questions?