Valves Training

Sections

- S1: Introduction - Road Map
- S2: Fundamentals of Valve - Classification of Valve
- S3: Components of Valve (Body, Stem, Bonnet, Actuator, Internal and External parts)
- S4: Type of Valve (Gate, Globe, Check, Ball, Butterfly)
- S5: Pressure Relief Devices (Relief, Safety)
- S6: Different Types of Material - Selection Criteria
- S7: Ends connections
- S8: Standard - Specification - Inspection Certificates for Quality Control

SECTION 2

Valves Fundamentals

What is Valves?

- Mechanical Device
  - Regulates
  - Directs
- Controls the flow by
  - Opening
  - Closing
  - Partially obstructing

Valves Functions

- Stopping and starting a fluid flow
- Regulate the fluid flow and pressure
- Controlling the direction of a fluid flow.
- Regulating a flow or pressure within piping system.
- Relieve pressure or vacuum from the piping system and equipment.

Classification

- Function (On/Off, Control, etc.)
- End connection (Flanged, Welded, etc.)
- How it operates (Handwheel, lever, actuator, etc.)
- Valve Opening motions (Liner, rotary, etc.)

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

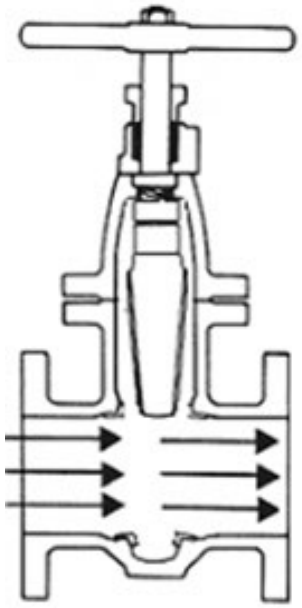
Special Purpose

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

Valve Opening Motions

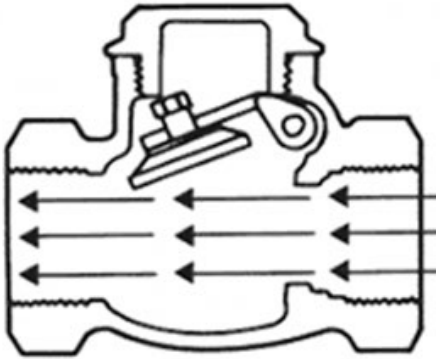
Linear Motion

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



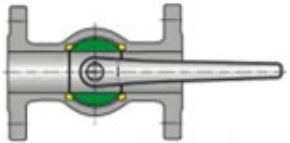
Rotary Motion

- Swing Check
- Tilting Check
- Folding-disc Check
- Stop check
- Butterfly
- Plug

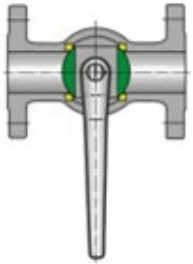


Quarter Turn

- Ball
- Butterfly
- Plug



ON POSITION



OFF POSITION

Type of Actuator

Manual

- Hand wheel
- Hand lever
- Gear wheel
- Chain

Power

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

Automatic

By Pressure

ANSI Class

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

Nominal Pressure (PN)

- PN 8
- PN 10
- ...

SECTION 3

Components of the Valves

VALVE TRIM

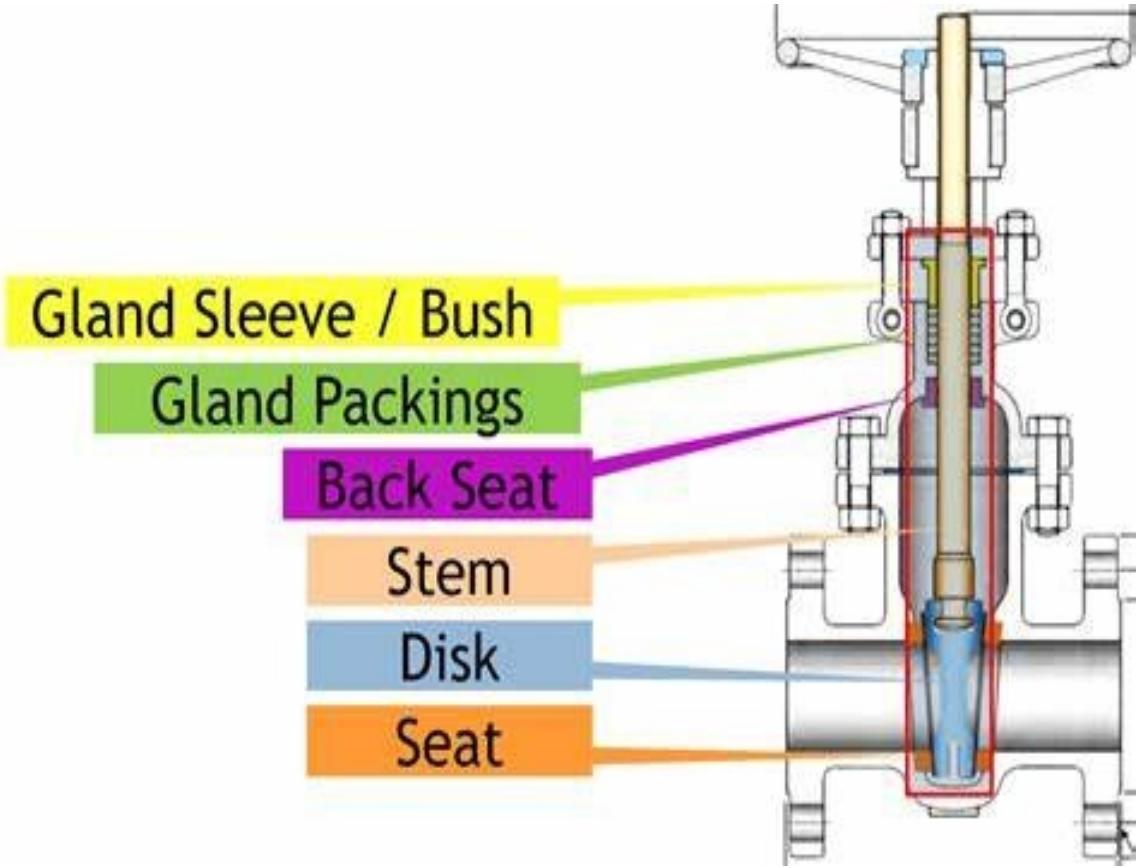
Trim is internal and replaceable parts of the valves

- **Includes:**
  - Disk
  - Seat
  - Stem

} Common for all valves

- **Includes:**
  - Back seat
  - Glands
  - Spacers
  - Guides
  - Bushings
  - Retaining pins
  - Internal Springs

Gate valve Trim



DISK

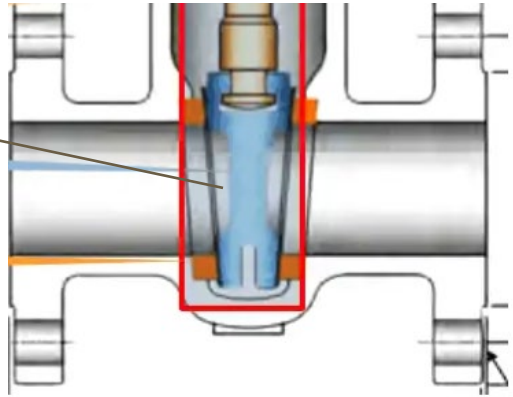
Fluid movement Control
- Start / Allow
- Reduce
- Stops flow

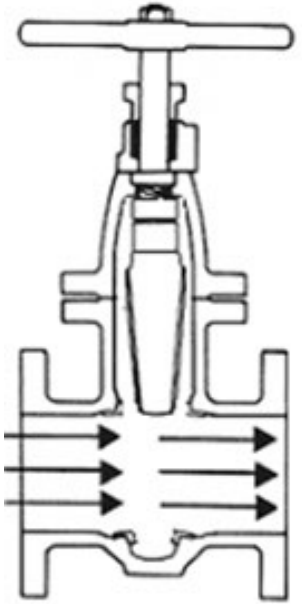
Types of disk define the name of the valve

Made of:
- Cast
- Forged
- Fabricated
- Hard facing

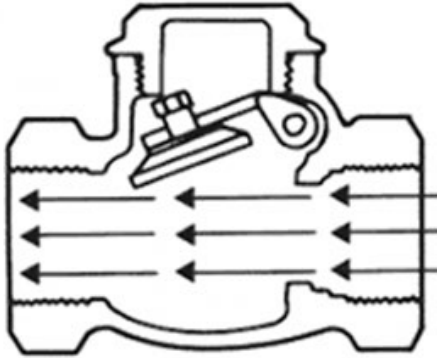
Fine surface finish

Pressure retaining part





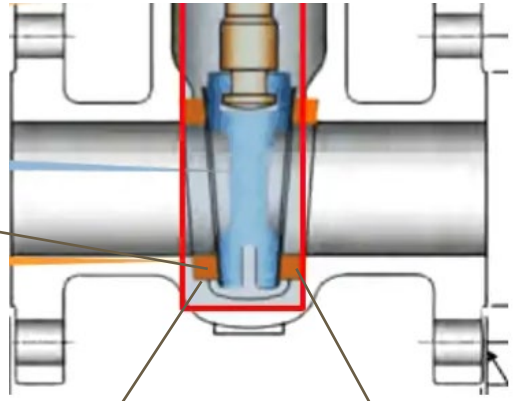
Disk movement by stem



Disk movement by flow

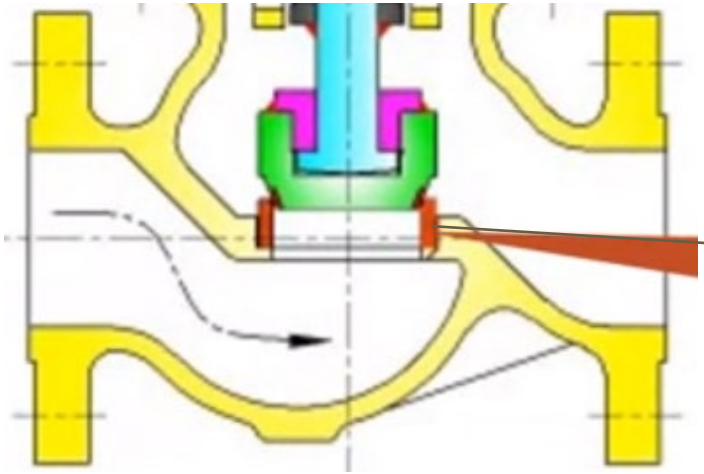
SEAT

Seating surface for the disk
Integral to valve body
Forged metallic rings
Hard facing
Non-metallic rings

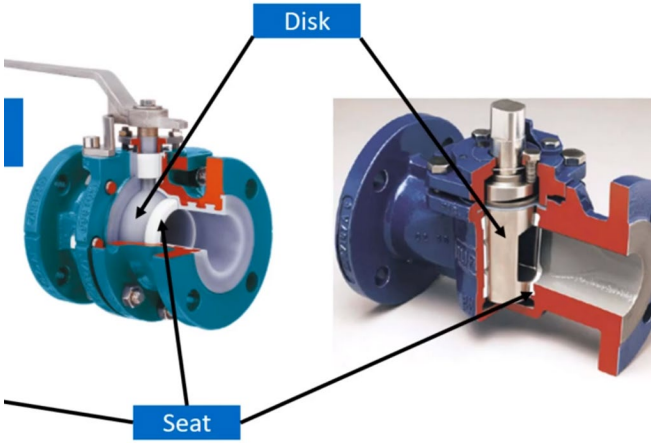


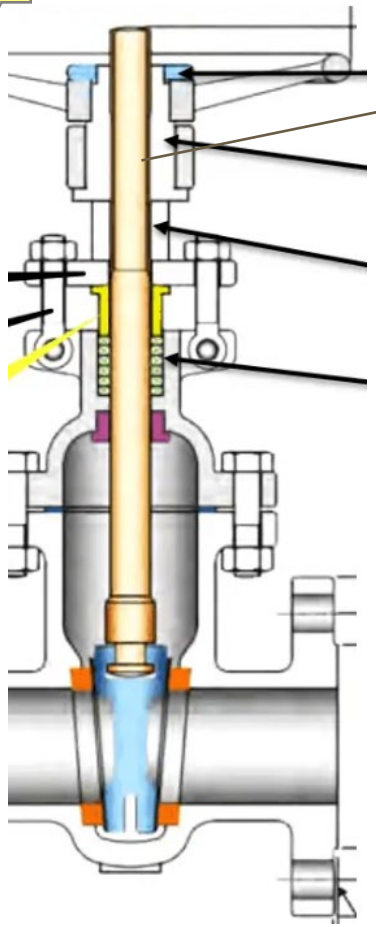
Up Stream Seat

Down Stream Seat



Single Seat





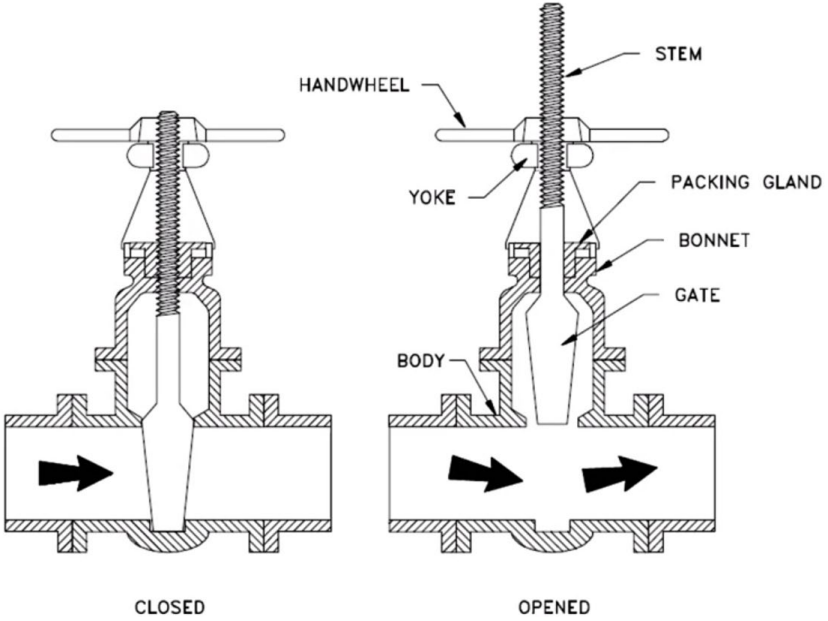
STEM

Connect the handwheel/ actuator and the disk.

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

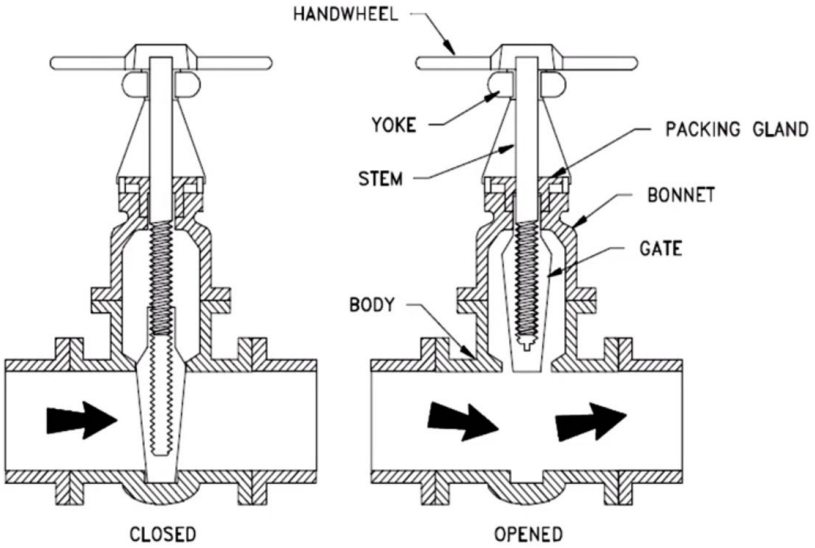
STEM TYPES

Rising: stem move up or down while opening and closing



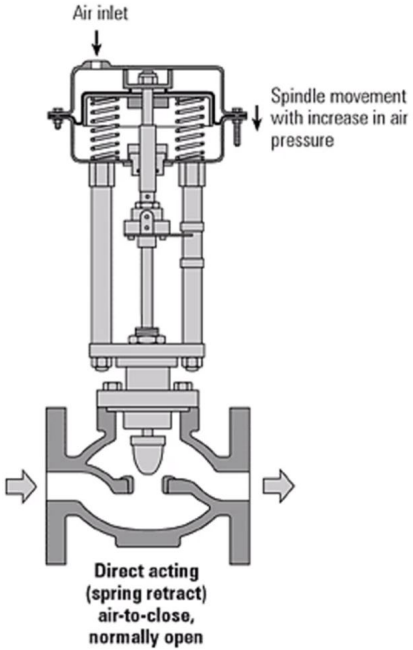
STEM TYPES

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



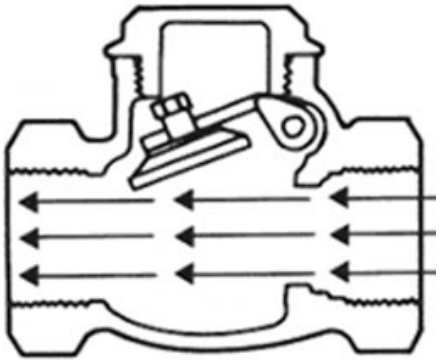
STEM TYPES

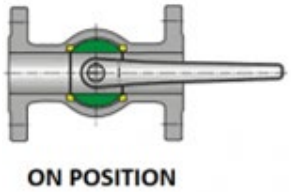
Sliding Stem: does not rotate or turn.
Slides in and out like lever (hand-operated lever, control valves)



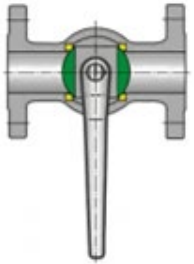
STEM TYPES

Rotary Stem





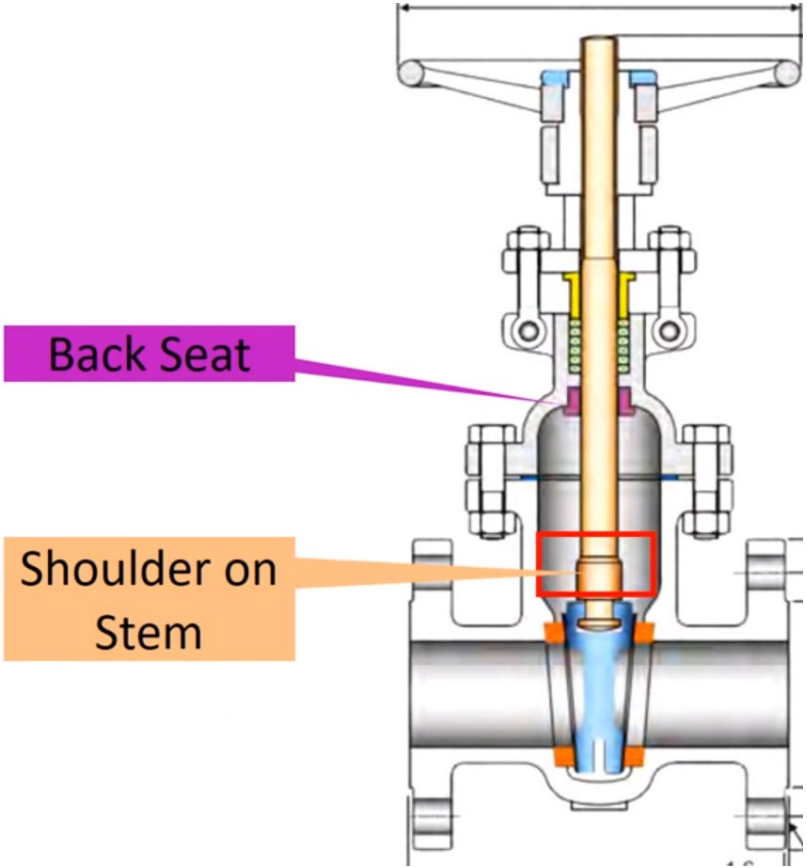
ON POSITION



OFF POSITION

BACK SEAT

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

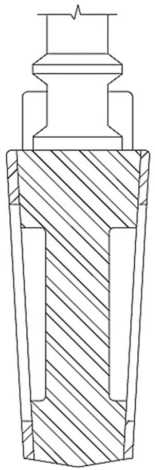


SECTION 4

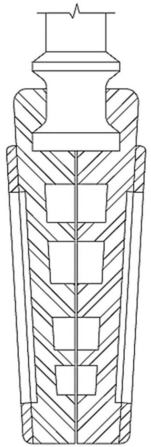
GATE VALVE

- 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

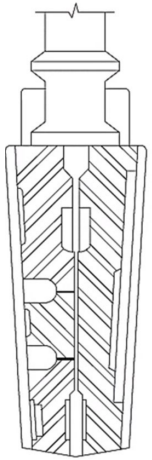
- Construction of the valve:
  - Body
  - Bonnet
  - Stem
  - Seats (Seat Ring)
  - Disk/Wedge
    - Solid wedge
    - Flexible wedge
    - Splid wedge or parallel disk



Solid wedge



Flexible wedge



Split wedge

ADVANTAGES

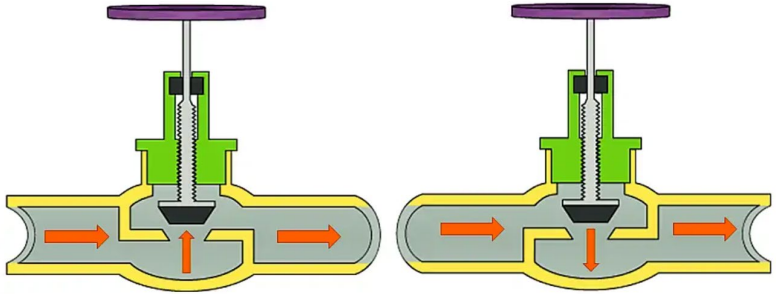
- Good shutoff
- Very low pressure drop during operation.
- Most of the gate valve can be used as bidirectional valve
- Suitable for high pressure and temperature application
- Less maintenance

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.

GLOBE VALVE

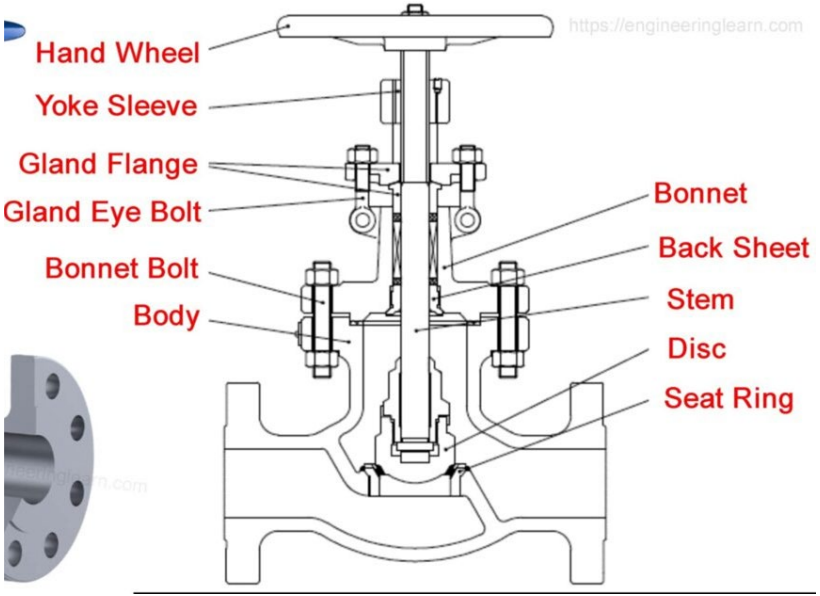
- A linear motion valve that stops, starts, and regulates fluid flow
- During the opening and closing of the valve, the disc moves perpendicularly to the seat.
- Globe valves are used where flow control is required, and leak tightness is also important.



Disk Close Against the Flow Direction

Disk Close In Flow Direction

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

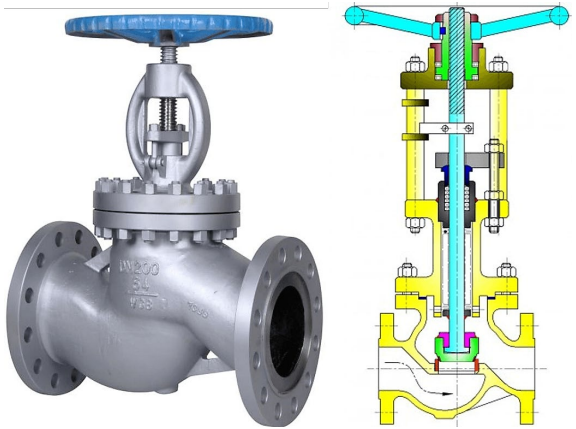


Ball Type Disc

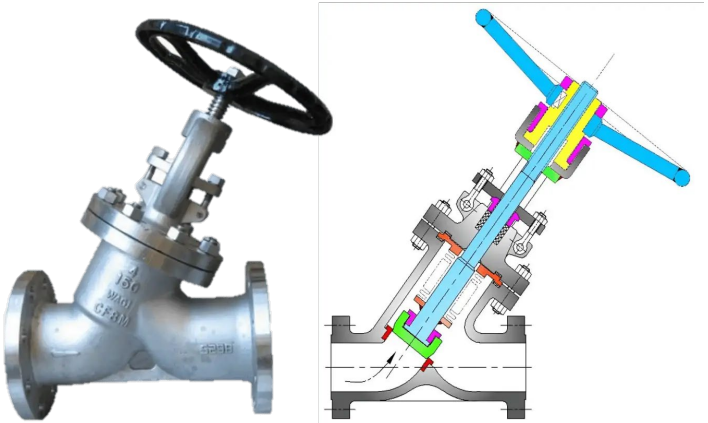
Needle Type Disc

TYPES

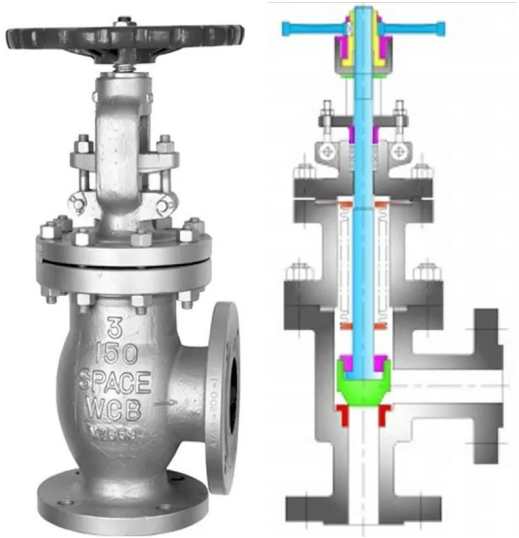
- Z Type



- Y Type



- Angle Type



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

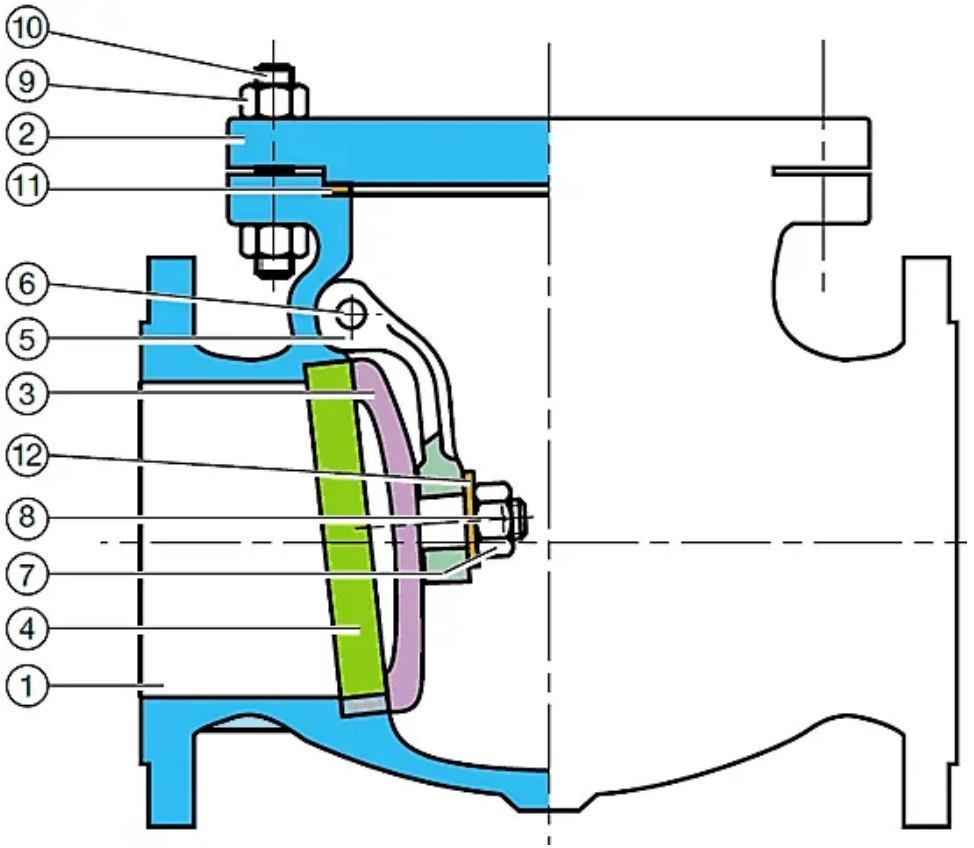
- High head loss from two or more right-angle turns of flowing fluid within the valve body.
- Obstructions and discontinuities in the flow path lead to a high head loss.
- In a large high-pressure line, pulsations and impacts can damage internal trim parts.
- A large valve requires considerable power 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.

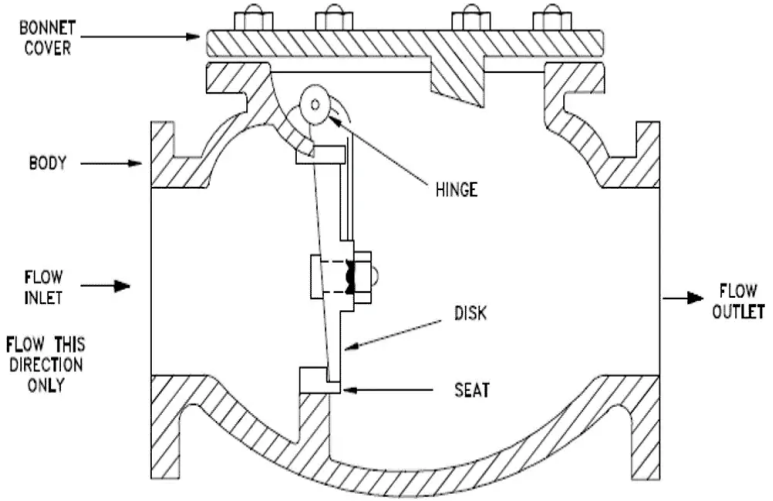
- Construction of the valve:

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

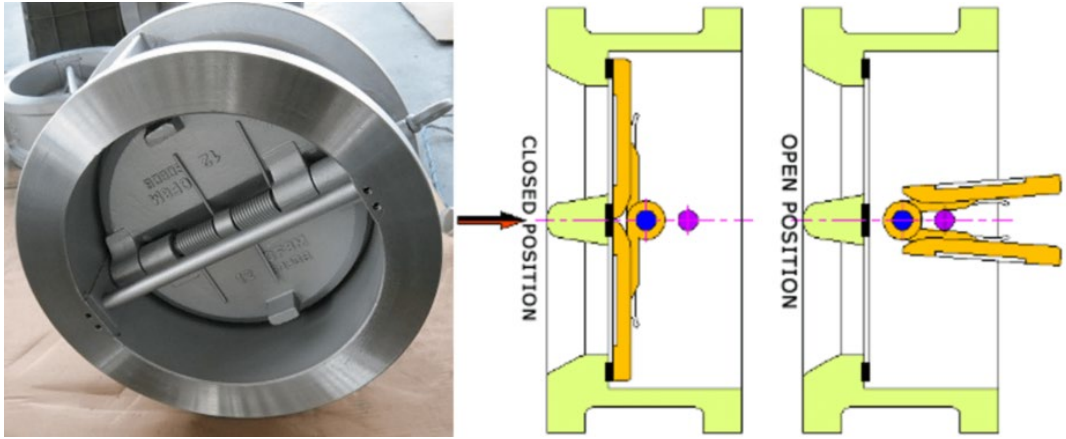


TYPES

- Swing

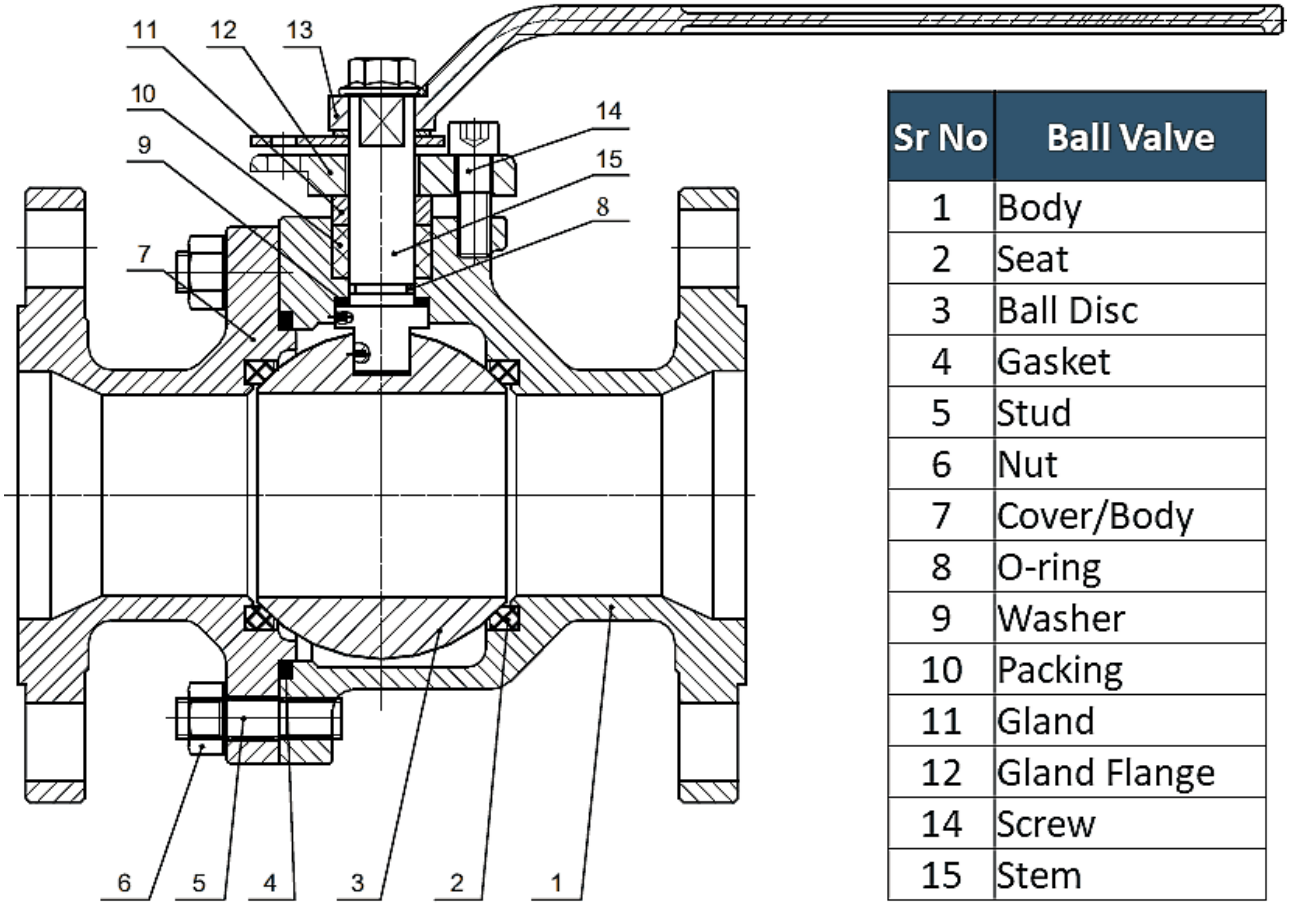


- Dual plate



BALL VALVE

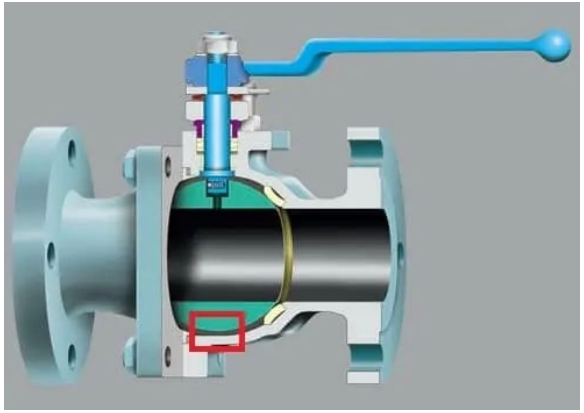
- Is a quarter-turn motion valve that uses a ball-shaped disk to stop or start the flow.
- Most ball valves are quick-acting.
- It can be used in different types of fluid services as an on-off stop valve that provides bubble-tight shutoff.
- It can be used in air, gaseous, and vapor services as well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



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

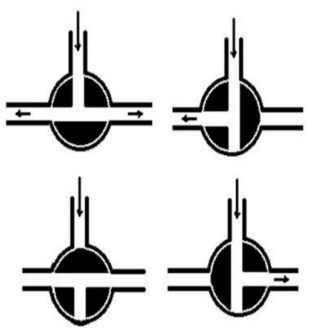
TYPES

- Floating



- Trunnion Mounted

- 3 Way Ball



ADVANTAGES

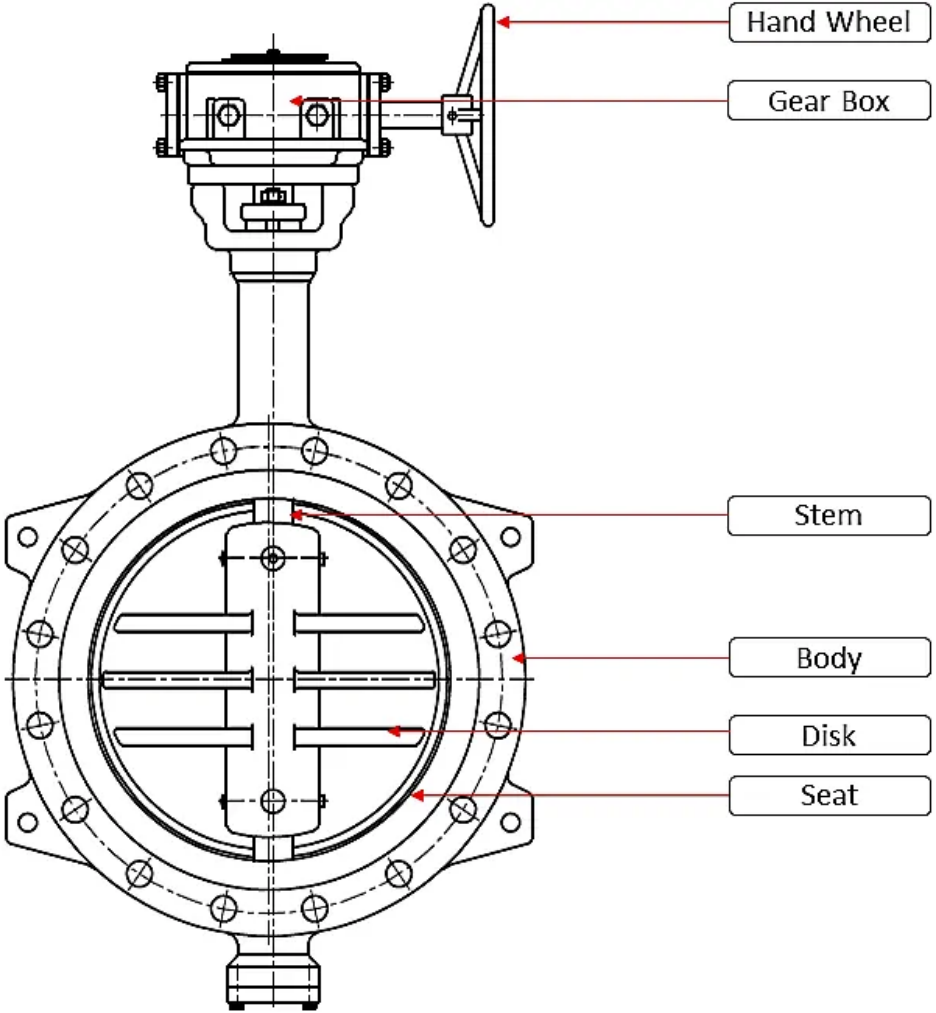
- It is a quick open and close type that provides bubble-tight reliable sealing in high-pressure temperature applications.
- Several designs of ball valves offer the flexibility of selection so that you can choose the valve that suits your requirements.

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.

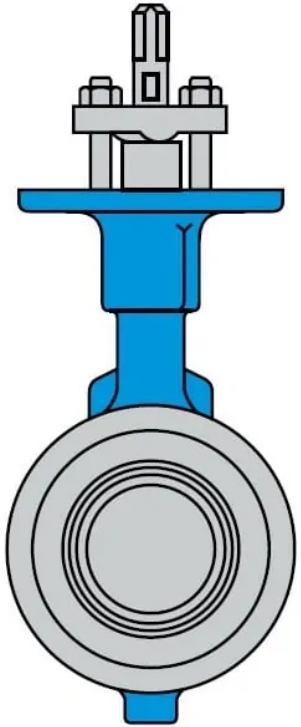
BUTTERFLY VALVE

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


Hand Wheel
Gear Box
Stem
Body
Disk
Seat

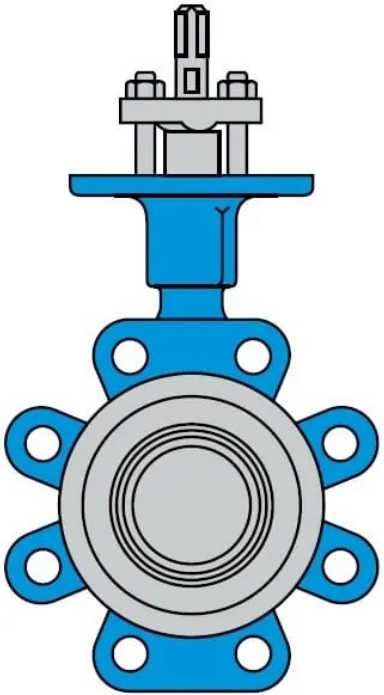
TYPES

- Wafer



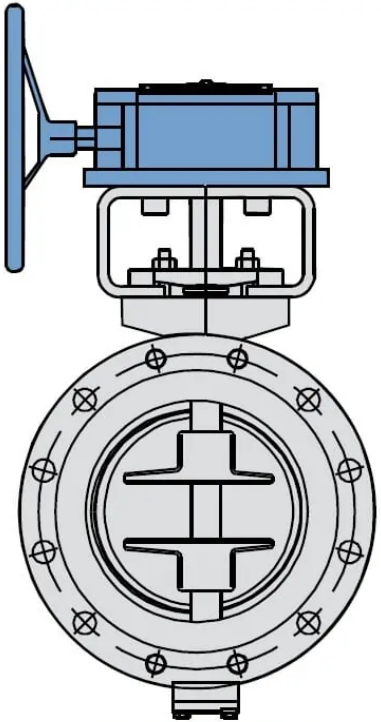
Wafer Type Butterfly Valve

- Lug



Lug Type Butterfly Valve

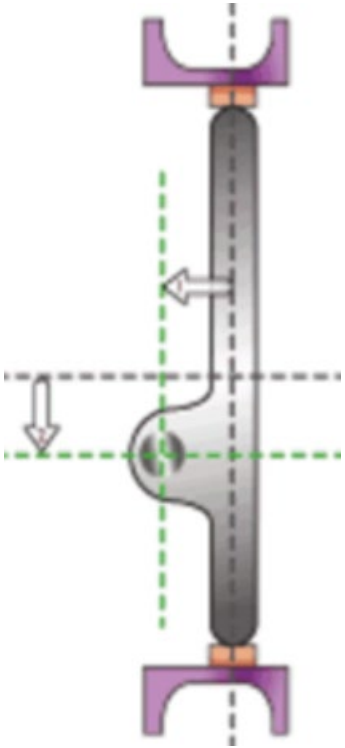
- Flanged



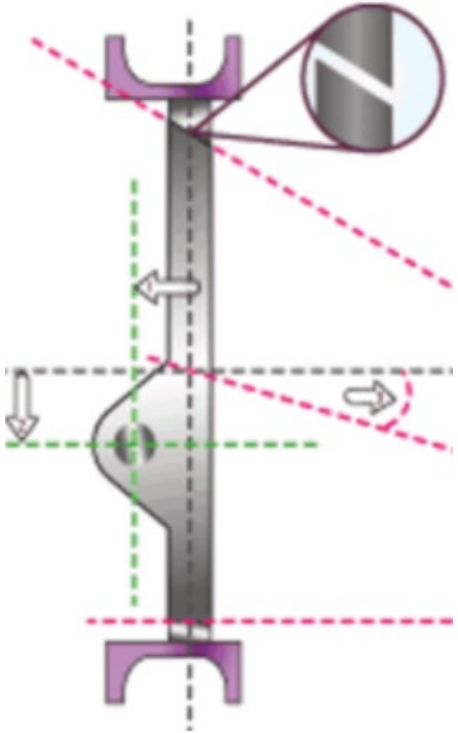
Double Flanged Butterfly Valve

TYPES

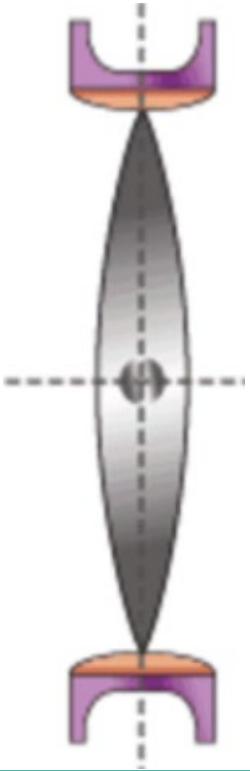
- Double Offset



- Triple Offset



- Zero Offset



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.

SECTION 5

PRESSURE RELIEF VALVE

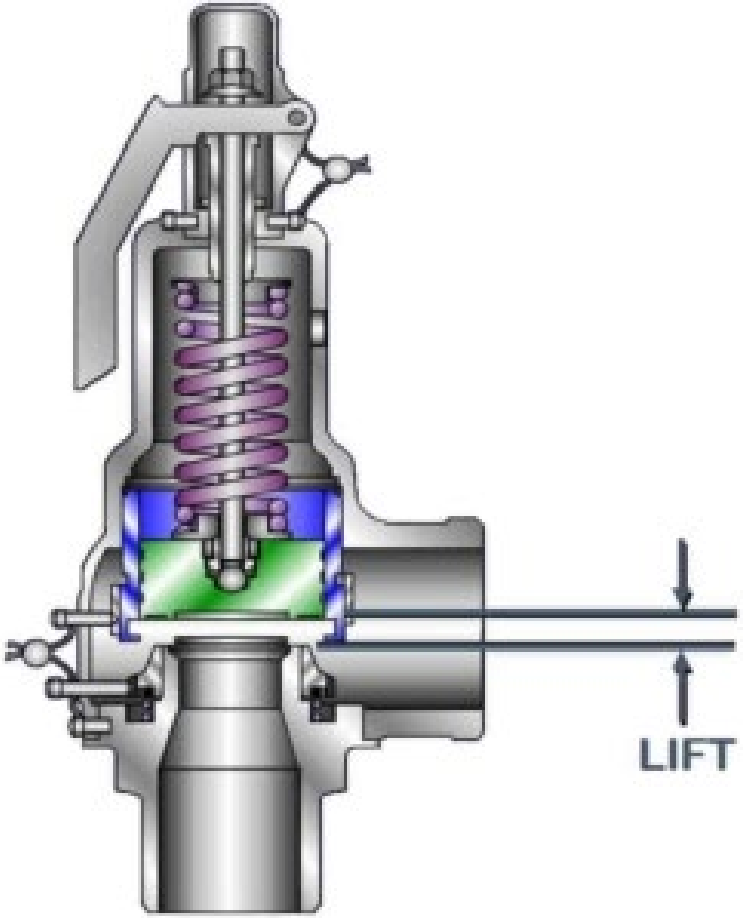
- Is a safety device designed to protect pressurized equipment or system during an overpressure event or in the event of a vacuum.
- The primary purpose of a pressure Relief Valve is to protect the life and property venting fluid from an over-pressurized system.

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.

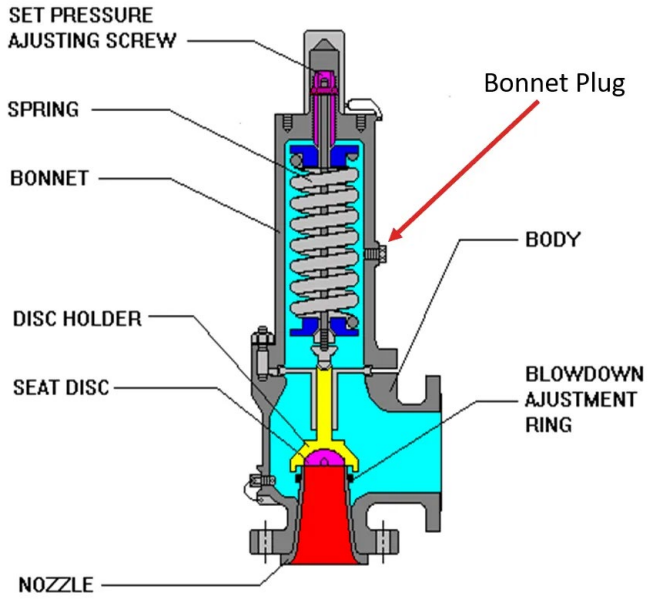
SAFETY VALVES

- 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 VALVES

- 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.

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.

SECTION 6

MATERIALS

CARBON STEEL

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

STAINLESS STEEL

- 304
- 316
- Duplex
- Super Duplex

LESS COMMON USED

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

SECTION 7

End Connection

Flanged end

Screwed/Threaded ends

Butt welded ends

Socket Welded ends

Wafer/Lug type ends

SECTION 8

Standard

- 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 standard require?

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

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