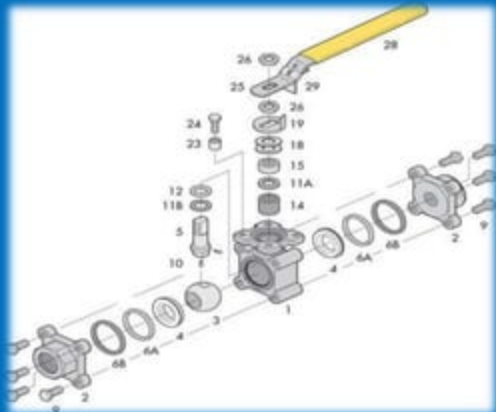


INDUSTRIAL VALVES



Valve Definition and Function

Valve Definition:

Valve is a mechanical device that regulates and controls the flow of fluid within a system or process.

Function of Valves:

1. Stopping and starting fluid flow.
2. Regulating the amount of flow.
3. Controlling the direction of fluid.
4. Regulating downstream pressure.
5. Relieving overpressure in the pipe or component.

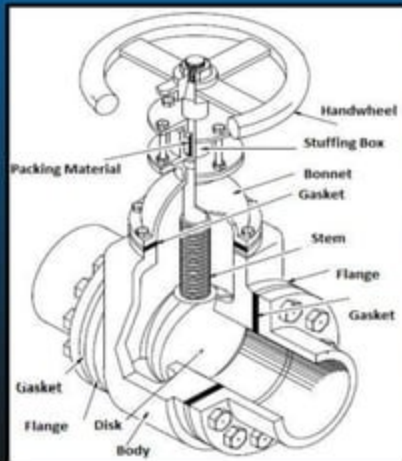
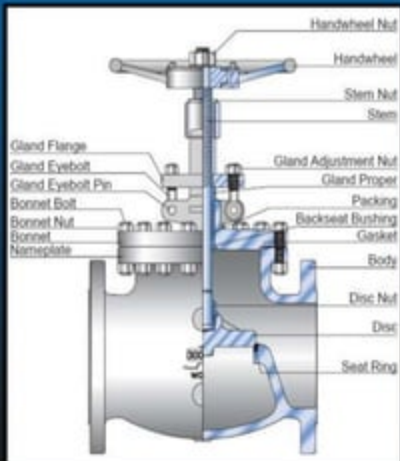
Classification of valve



Parts of the Valve

Main valve parts are:

- Actuator.
- Body.
- Bonnet.
- Stem.
- Disc.
- Seat.
- Stuffing Box.
- Packing.



Parts of the Valve

ACTUATOR

- The actuator operates the stem and closing element (disk) assembly.
- An actuator may be a manually operated hand wheel, manual lever, motor operator etc.



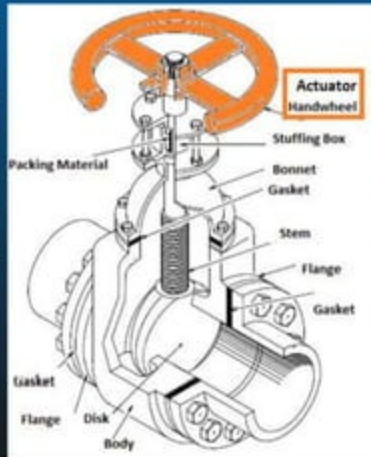
Manual lever valve



Pneumatic valve



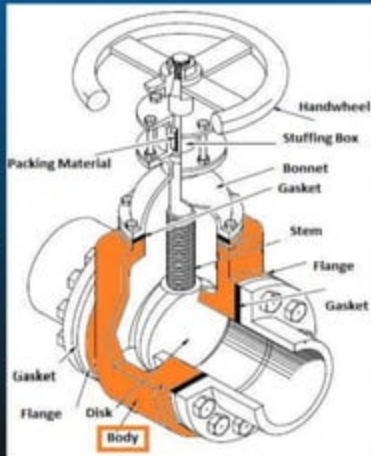
Motor operated valve



Parts of the Valve

BODY

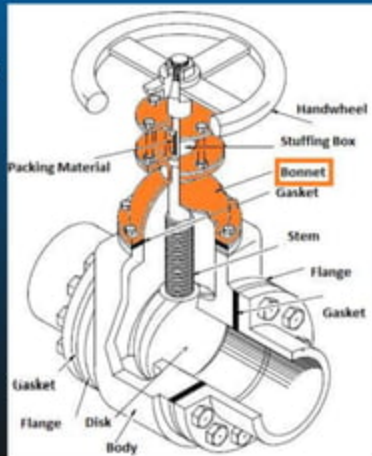
- It is the framework that contains valve trim.
- It is usually cast or forged structure made.
- Inlet and outlet pipes fit onto the valve body.
- Valve body must be strong enough to take the maximum pressure of the process fluid.
- Valve body must be made of a material that is not attacked by the fluid.



Parts of the Valve

BONNET

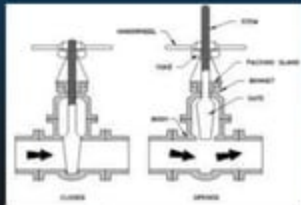
- Bonnet contains packing, gland and stem.
- The bonnet is attached to valve body by screws or bolts.



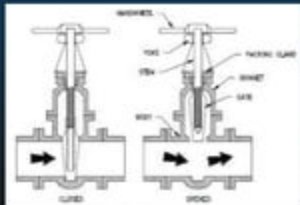
Parts of the Valve

STEM

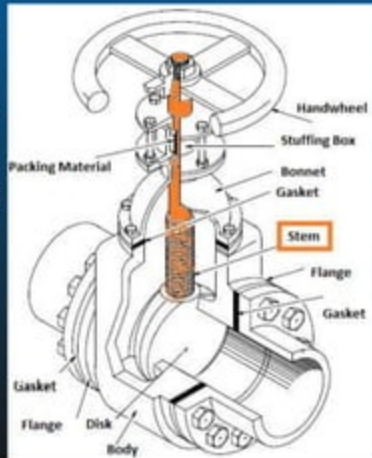
- The stem, which connects the actuator and disc, is responsible for positioning the disc.
- Stems are typically forged and connected to the disc by threaded or welded joints.
- There are two types of valve stems: rising stems and non-rising stems.



Rising stem valve



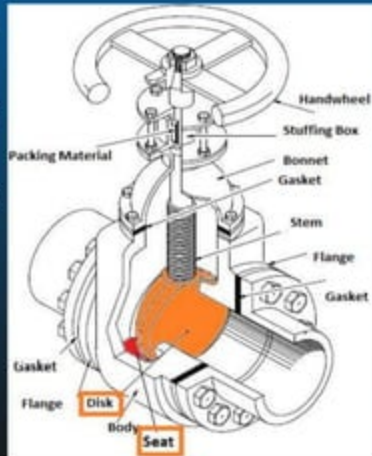
Non-Rising stem valve



Parts of the Valve

DISC & SEAT

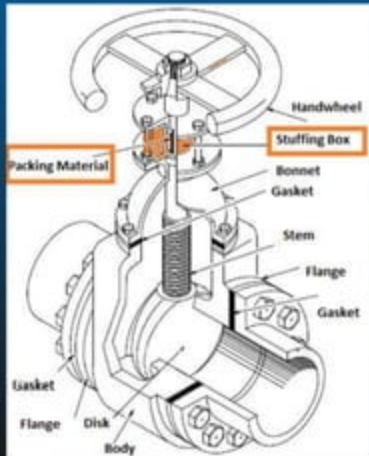
- Disc provides the capability for permitting and prohibiting fluid flow.
- The seat or seal rings provide the seating surface for the disc.
- A fine surface finish of the seating area of a disk is necessary for good sealing when the valve is closed.



Parts of the Valve

STUFFING BOX & PACKING

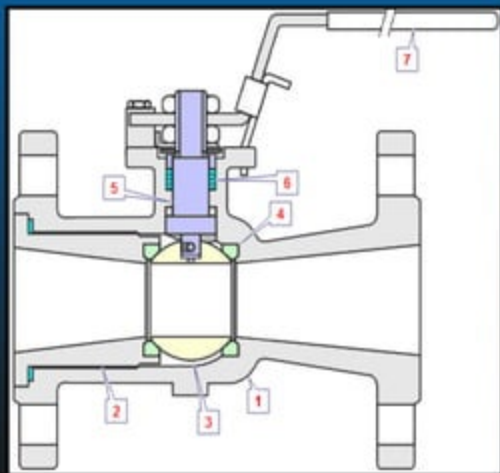
- Stuffing box is a chamber that holds anti-seal material (packing).
- Most valves use some form of packing to prevent leakage from the space between the stem and the bonnet.
- Packing is commonly a fibrous material that forms a seal between the internal parts of a valve and the outside.



Valve Types

- Block Valve- stop and start flow.
- Flow Control Valve- control flow rate.
- Non-Return Valve- prevent flow reversal.
- Pressure Control Valve- prevent fluid pressure exceeding a set maximum.
- Pressure relief valve to protect against over pressure in vessels and piping system.

Ball Valve



Sectional Drawing

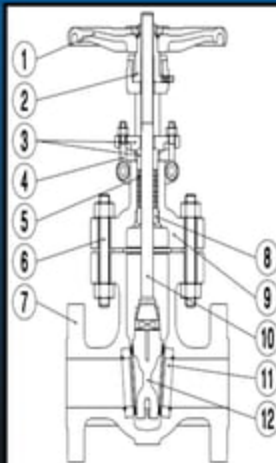


P&ID Symbol



Photo

Gate Valve



IT.	DESCRIPTION
1	HANDWHEEL
2	YOKE SLEEVE
3	GLAND FLANGE
4	GLAND EYE BOLT
5	PACKING
6	BONNET BOLT
7	BODY
8	BONNET
9	BACK SEAT
10	STEM
11	SEAT RING
12	WEDGE



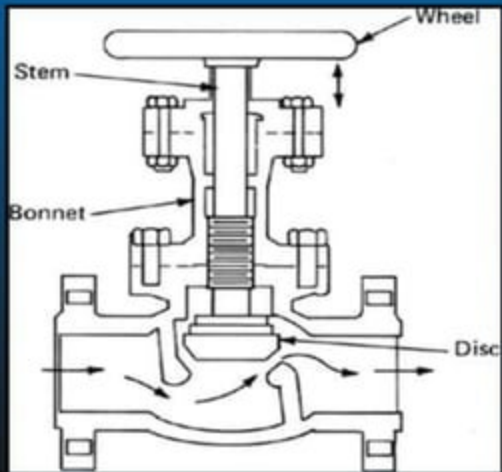
P&ID Symbol



Sectional Drawing

Photo

Globe Valve



Sectional Drawing

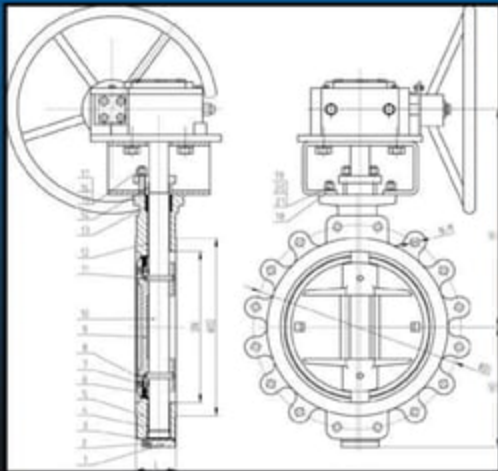


P&ID Symbol

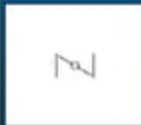


Photo

Butterfly Valve



Sectional Drawing

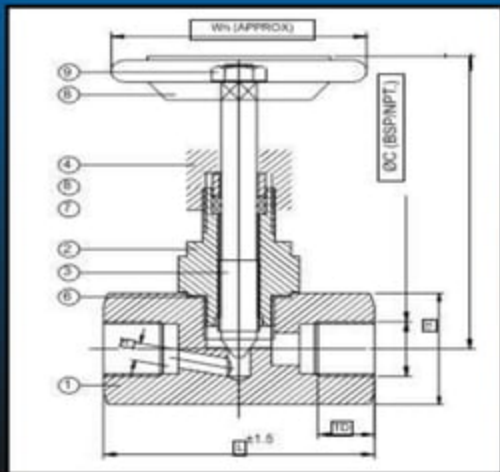


P&ID Symbol



Photo

Needle Valve



Sectional Drawing

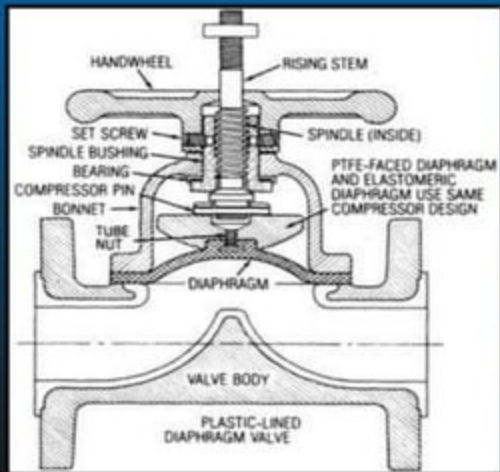


P&ID Symbol

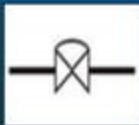


Photo

Diaphragm valve



Sectional Drawing

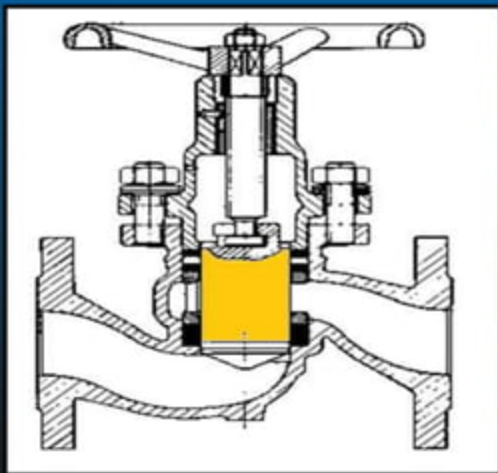


P&ID Symbol

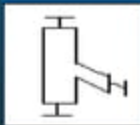


Photo

Piston Valve



Sectional Drawing

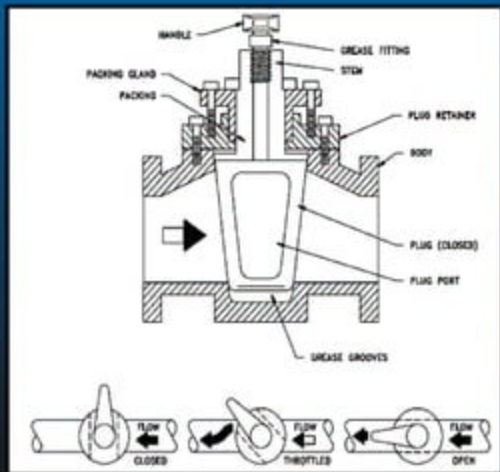


P&ID Symbol



Photo

Plug Valve



Sectional Drawing



P&ID Symbol



Photo

Diverter Valves



3-way valve



4-way valve



Rotary diverter
valve

Protection Valves

Types of protection valves:

- Overpressure relief valves.
- Pressure vacuum relief valves.
- Check valves or Non-return Valve (NRV)

Overpressure Relief Valve

Overpressure relief valves are devices used to discharge over pressure from system or piping to protect personnel and property against explosion.

Spring-loaded valve

Valve which after reaching set pressure, start to lift up in pop action then close by spring force when lifting pressure is less than spring force



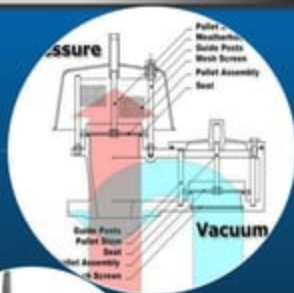
Pilot operated valve

The system pressure is applied to the pilot valve via the pressure pickup, the pilot valve then uses the dome above the main valve piston to control the opening and closing of the main valve



Pressure Vacuum Relief Valve

Pressure vacuum relief valves (also known as breather valve) are used to prevent over pressure or/and vacuum in pressure vessel or tanks.



Check Valve

Check valves (also known as non-return valves) are valves that allow fluids to flow in only one way/direction.



Swing check valve



Dual plate check valve



Ball check valve



Lift check valve

Valve Rating

Valve rating definition:

The rating of valves defines as the **pressure – temperature** relationship within which the valve may be operated.

➤ **WOG** (Water, oil, gas).

Rating used for small valves.

➤ **WSP** (Working Steam Pressure).

The high temperature rating.



	ANSI Pressure Class No. / Mpa rating						
	150 / 2.0	300 / 5.0	400 / 6.3	600 / 10	900 / 15	1,500 / 25	2,500 / 42
Temp (F°)	Pressure Rating (PSI) at specified temperatures						
-20 to 100°	290	750	1,000	1,500	2,250	3,750	6,250
200°	260	750	1,000	1,500	2,250	3,750	6,250
300°	230	730	970	1,455	2,185	3,640	6,070
400°	200	705	940	1,405	2,110	3,520	5,865
500°	170	665	885	1,330	1,995	3,325	5,540
600°	140	605	805	1,210	1,815	3,025	5,040
650°	125	590	785	1,175	1,765	2,940	4,905
700°	110	555	740	1,110	1,665	2,775	4,630
750°	95	505	675	1,015	1,520	2,535	4,230
800°	80	410	550	825	1,235	2,055	3,430
850°	65	320	425	640	955	1,595	2,655
900°	50	225	295	445	670	1,115	1,855
950°	35	135	185	275	410	685	1,145
1,000°	20	85	115	170	255	430	715

This chart is an example of ANSI pressure class ratings for specific grades of steel

Valve End Connection



Threaded



Welded



Flanged



Criteria of Valves Selection

Selection of valve type should take account of the following:

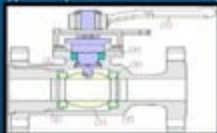
1. Required function.
2. Type pf fluid.
3. Pressure and temperature.
4. Flow consideration.
5. Isolation requirement.
6. Frequency of operation.
7. Maintenance considerations.
8. Environmental considerations.
9. Weight and size.
10. Cost.

Valve	Stop-start	Throttling	Frequent operation	Low pressure drop	Size range mm	Pressure range (bar)	Temperature range (°C)
Gate	✓			✓	3-1220	vac to 667	-270 to 680
Slide	✓				50-1900	atm. to 27	-18 to 650
Ball	✓		✓	✓	6-914	atm to 500	-55 to 500
Plug	✓		✓	✓	6-406	atm to 200	-70 to 200
Globe (Z)	✓	✓	✓		3-726	vac to 667	-270 to 540
Y-type	✓	✓	✓	✓	3-762	vac to 167	-270 to 540
Butterfly	✓	✓	✓	✓	50-914	vac to 80	-30 to 540
Diaphragm	✓	✓			3-610	vac to 20	-50 to 230
Needle		✓			3-25	vac to 667	-70 to 260

Valve Terminology

Bore (Port): The inside diameter of the smallest opening through a valve.

Full bore (Full Port): Describes a valve in which the bore (port) is nominally equal to the bore of the connecting pipe.



Reduced bore (Reduced Port): A valve port opening that is smaller than the line size or the valve end connection size.



Valve trim: Refers to the valve's working parts and to their materials. Usually includes seat ring sealing surfaces, closure element sealing surfaces, stems and back seats.

Face to face: The overall dimension from the inlet face of a valve to the outlet face of a valve (one end to another)

Valve Terminology

Resilient seat: A valve seat containing a soft seal such as an O-ring or plastic to assure tight shut-off.

Throttling: The intentional restriction of flow by partially closing or opening a valve.

Clapper: The hinged closure element of a swing check valve.

Class: A pressure rating expressed as a dimensionless number. The class rating charts give actual pounds per square inch maximum allowable pressure at a given temperature.

Cv: Flow coefficient expressed as the number of gallons of water that would flow through an opening, such as a valve port, in 1 minute under a differential pressure of 1 psi.

Fire safe: A valve design that is capable of passing a fire test with specified limits on leakage to the atmosphere and downstream after being closed subsequent to fire exposure.

Hard facing: A surface preparation in which an alloy is deposited on a metal surface usually by weld overlay to increase resistance to abrasion and or corrosion.

Valve Terminology

Cryogenic valve: A valve used in applications with fluid temperatures below -50F (- 45C).

Control valve: valve serving as a control element in a system, providing means for varying the rate of flow of the fluid passing through the valve.

Fail to close valve (FC): A control valve which should go to the close position in case of air failure.

Fail to open valve (FO): A control valve which should go to the open position in case of air failure.

Fail to last (FL): A control valve which should stay on last control signal and position in case of air failure .

Hydrostatic test: A pressure test in which a valve is tested with water to detect leaks - may be a shell test or a seat closure test.

Valves Standard and Specifications

American Petroleum Institute

- **API Q1** Specification for quality programs
- **API 6D** Specification for pipeline valves
- **API 6FA** Fire test for valves
- **API 598** Valve inspection and testing
- **API 600** Steel gate valves, flanged and butt-welding ends, bolted and pressure seal bonnets
- **API 602** Compact steel gate valves - flanged, threaded, welding, and extended body ends
- **API 607** Fire test for soft seated quarter turn valves
- **API 608** Metal ball valves - flanged and butt welding ends

Valves Standard and Specifications

American Society of Mechanical Engineers / American National Standards Institute

- **ASME/ANSI B16.34** Valves - flanged, threaded and welding end
- **ASME/ANSI B16.5** Pipe flanges and flanged fittings
- **ASME/ANSI B16.10** Face-to-face and end-to-end dimensions of valves
- **ASME/ANSI B16.11** Forged fittings, socket-welding and threaded
- **ASME/ANSI B16.25** Butt-welding ends
- **ASME/ANSI B16.47** Large diameter steel flanges

Note: This specification for flanges larger than 24" replaces MSS SP-44 and

- **API 605** with the designations of Series A (MSS SP-44) and Series B (API 605).
- **ASME B31.3** Chemical plant and petroleum refinery piping
- **ANSI B31.4** Liquid petroleum transportation piping system
- **ANSI B31.8** Gas transmission and distribution piping system