Valves

(PLUG, BALL, GATE & GLOBE)

Process Valves

- Types
- Operations
- Identification
- Uses and Limitations
- Classification
- Materials of Construction
- Variations

What are Valves used for ?

- **Regulating – Control of flow, pressure or volume**
- **Isolation – Complete shut off**
- **Non return – Allow flow in one direction and prevent back flow**
- **Safety relief – Safe discharge to prevent over pressurisation of equipment (eg: boilers and compressed air systems)**

Valve selection criteria

- **Temperature** – Refrigeration, superheat, ambient
- **Pressure** – Positive, vacuum,
- **Volume** – Amount of product flow
- **Product** – Liquid, gaseous, slurry, powder, solid – acidic, abrasive, corrosive

Valve selection criteria

- **Operation** – Manual, automatic
- **Environment** – Access to operate, position (horizontal vertical)
- **Size** – May restrict access or operability, space availability
- **Weight** – May require extra or independent support

Types Of Valves

- Globe Valves
- Gate Valves (Parallel)
- Gate Valves (Taper Wedge)
- Diaphragm Valves (A Series) (KB Type)
- Needle Valves
- Ball Valves
- Lubricated Plug Valves
- Non Lubricated Plug Valves
- Non Return Valves (Check Valves)
- Safety Relief Valves
- Rotary - Star

Typical Gate Valve

Gate valves are no use for throttling (wedge vibration, seat damage and wear)
Small length between the face to face.

Big sizes, but with less weight

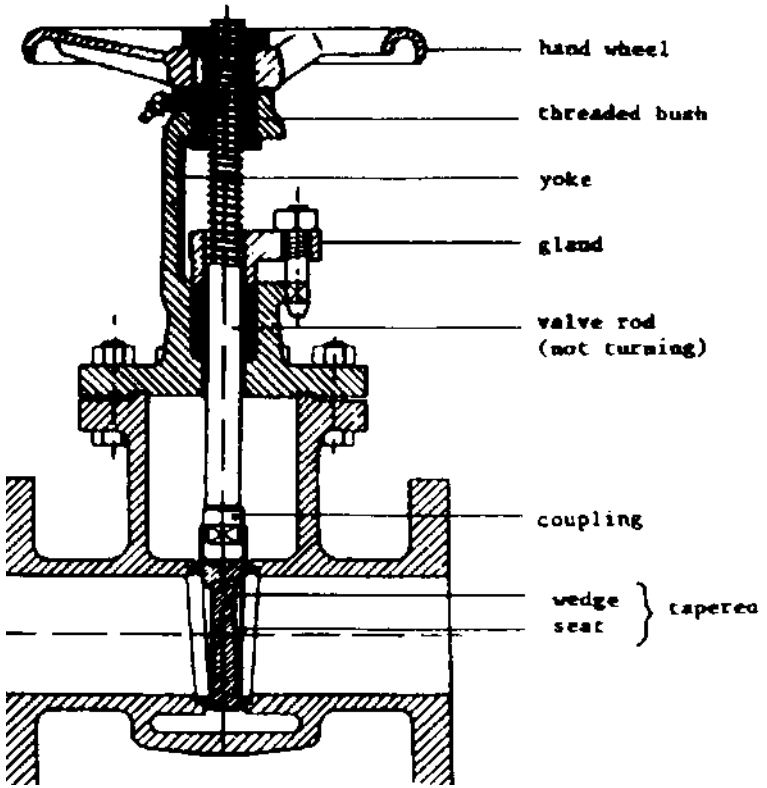
High space is needed because of valve lift.

Flow path: straight pattern

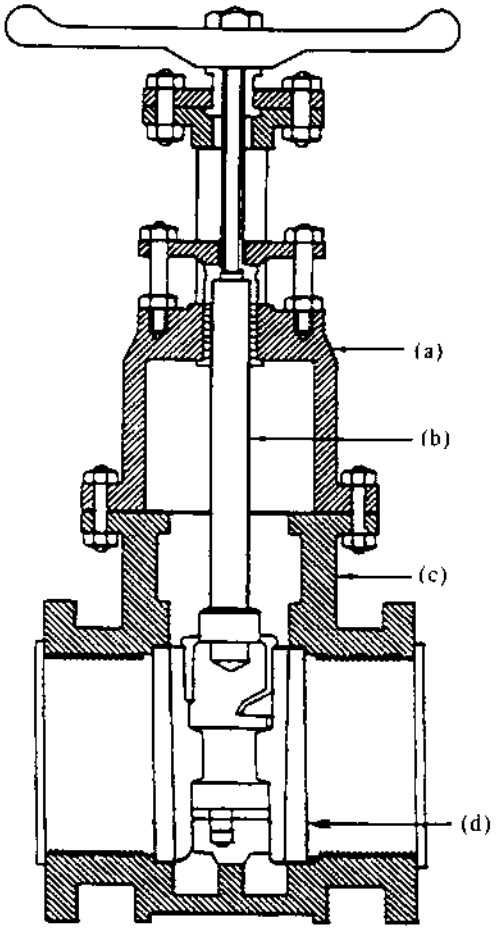
Pressure loss: small

GATE VALVE

Shown opposite is a gate valve, (wedge gate) which is widely used as on ON/OFF or Isolation valve, not generally recommended for throttling of flow and should only be used in either the fully open or closed position

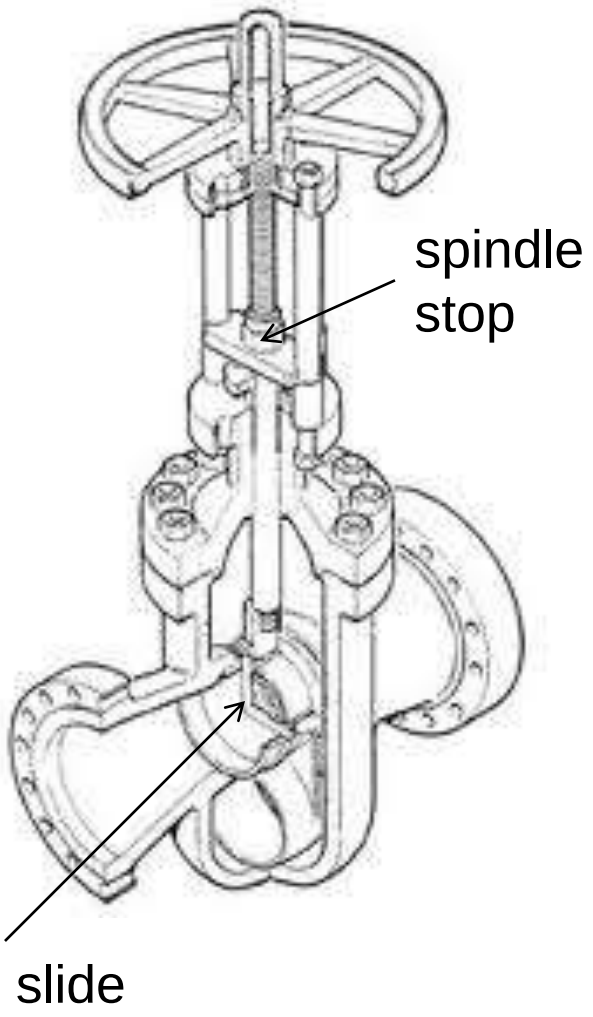


The gate valve provides a straight through passage for the flow of fluid with negligible pressure loss, the body ends being in line with each other. The various points shown are (a) bonnet, (b) spindle, (c) body, (d) wedge shaped seat and gate.



PARALLEL SLIDE VALVE

Shown opposite is the parallel slide gate valve, which again should only be used in either the fully open or closed position as an isolation valve, the difference to the wedge gate is the seats move freely and are pressure sealed on the down-steam side seat also they are fitted with a spindle stop to prevent damage.



The following slides show valves being inspected and repaired, most vales can be overhauled depending on cost, larger valves being more cost effective to repair.

Note the small valve mounted on the side of the large, this is used for worm-up purposes and very often they use both a gate and a globe valve fitted together.

Typical Globe Valve

Globe valves are only used for throttling,(flow control) they can be a high pressure valve and are used to remove or minimize the damage of seat and disc but do not form a good isolation.

Less operating time over a gate valves

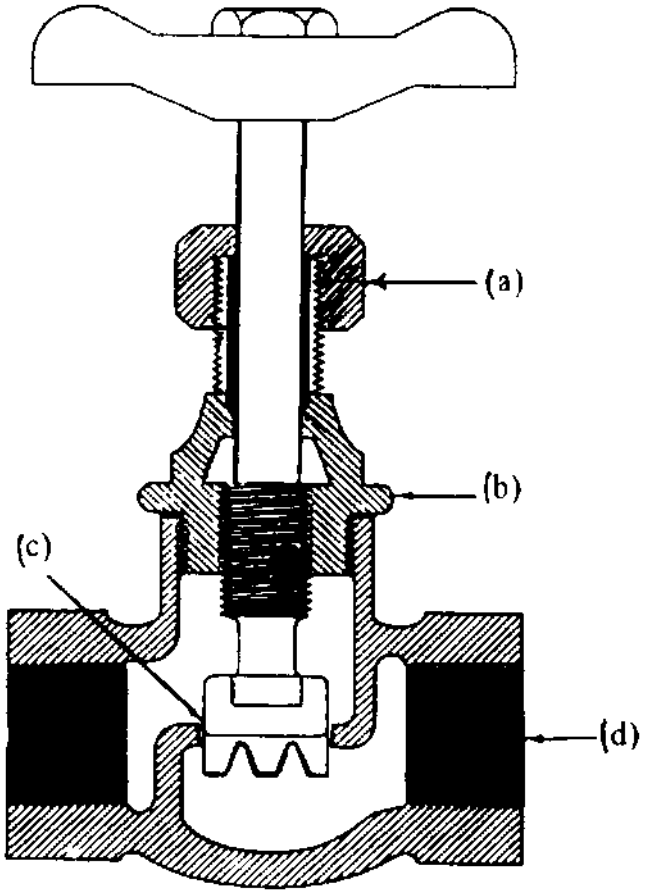
Flow path: turbulent

Pressure loss: usually very high

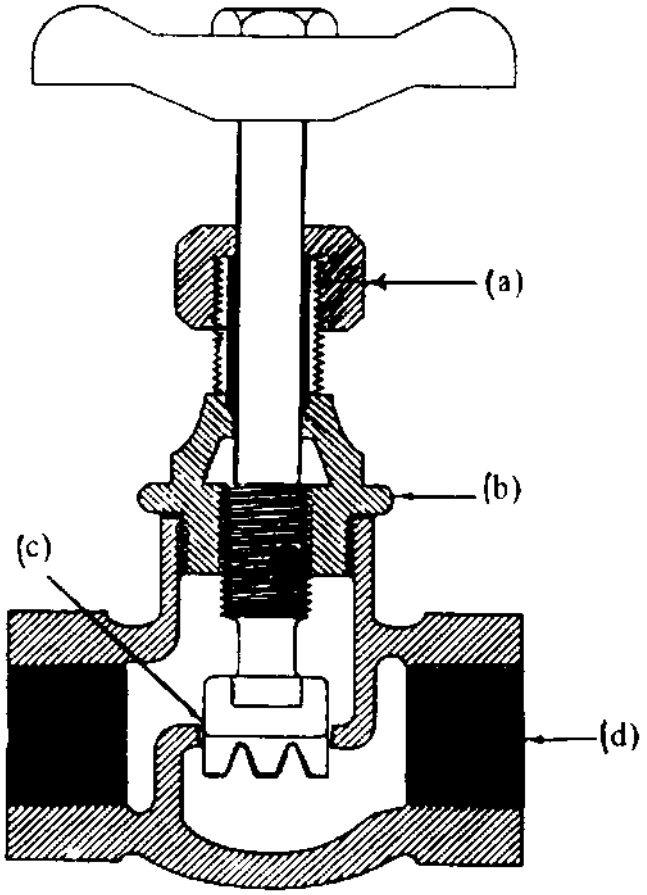
Note: Use for flow control.

Potential Leak Points on a Common Type Globe Valve

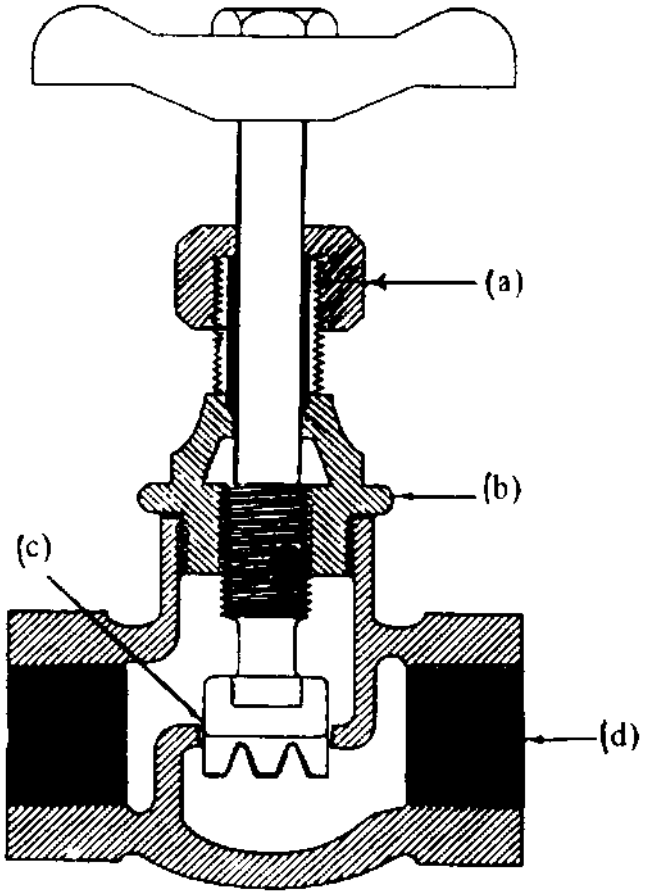
- Shown opposite are certain part of a valve where leaks are most likely to occur:
- The stem of the valve spindle is a very common place because the spindle is a part which is frequently turned so this makes it difficult to seal.



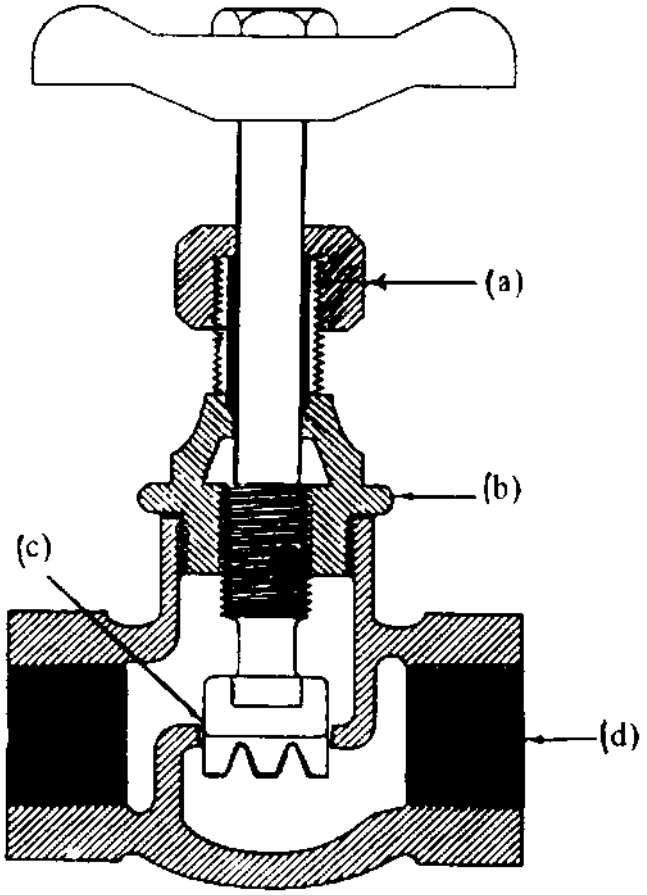
Sealing is usually achieved by means of wrapping soft packing around the spindle and compressing them with a Gland-Follower, this is known as the “Stuffing Box” which has proved to be most effective.



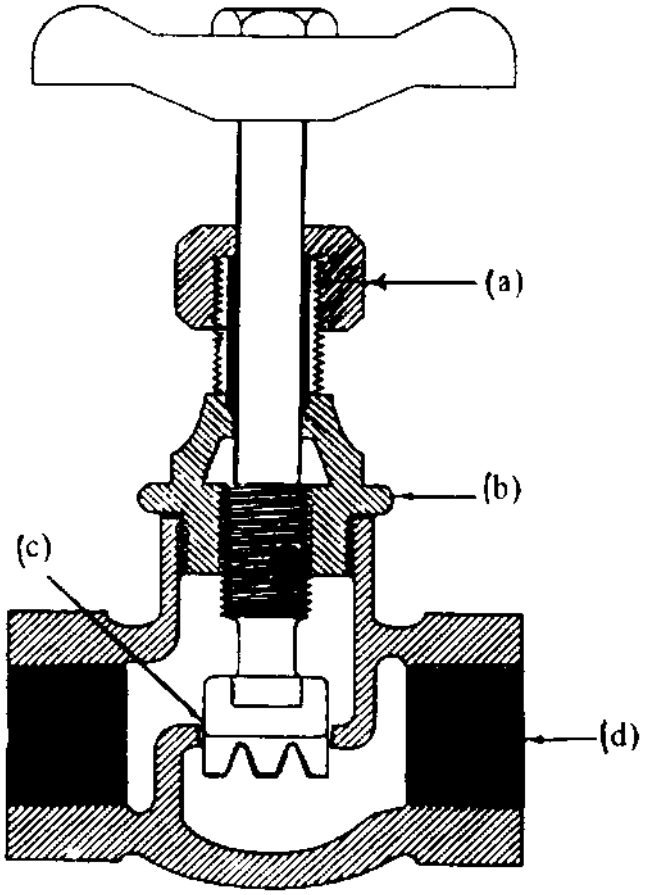
The Bonnet, which can be screwed or bolted, is a leak point and is sealed by means of a Gasket between the body and the bonnet, known as the “bonnet-joint”.



The valve seat which is used for sealing against downstream leakage when the valve is closed. Over a period of time this seat disc is subject to wear and tear and can be repaired or replaced during routine overhaul.

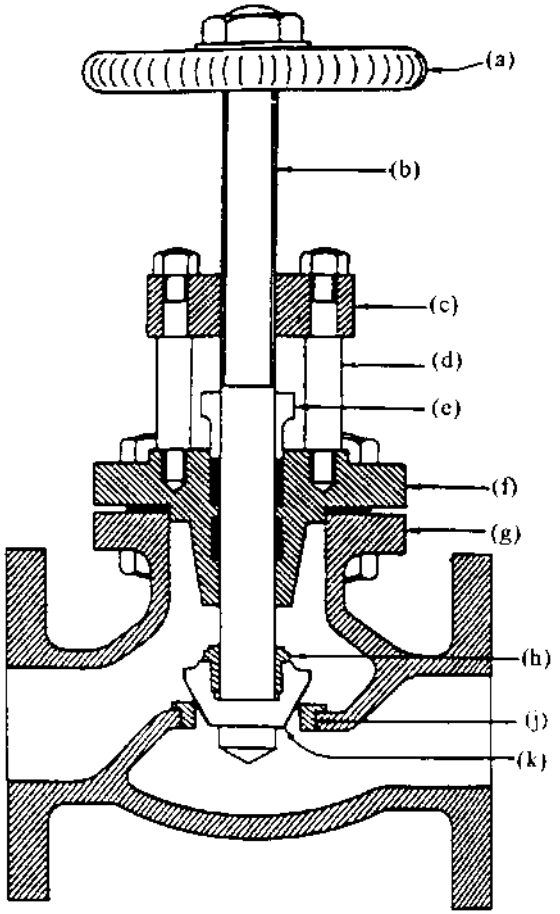


The valve end-connections can be screwed or flanged and are subject to leaks for the same reasons as any other screwed or flanged connection.

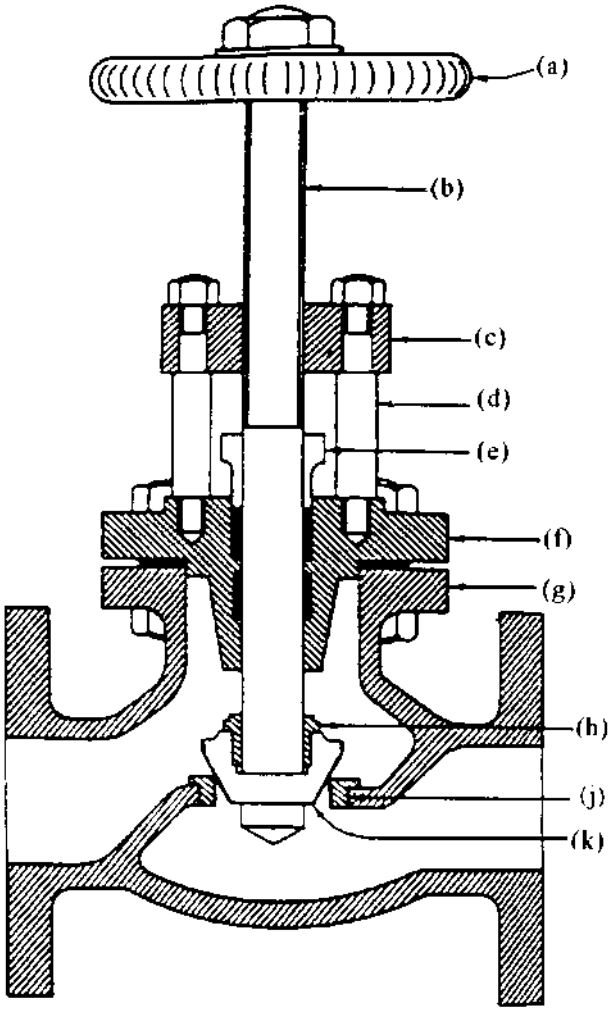


High Pressure Type Globe Valve

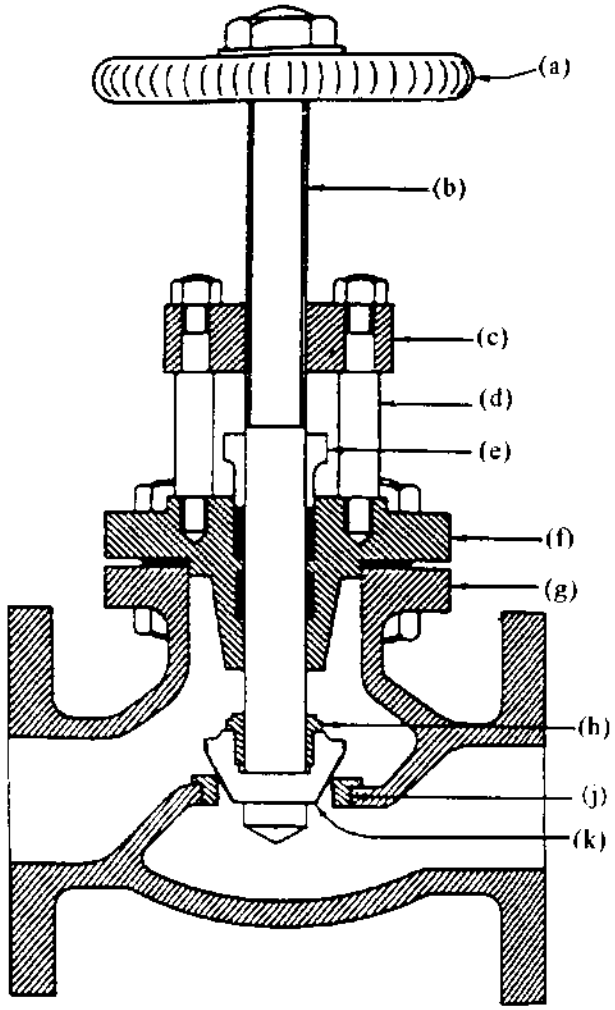
Shown opposite is a Globe type valve which is used extensively for the control of steam flow. A disc is lowered onto a mating seat which is usually spherical in shape and seats in an orifice perpendicular to the axis of flow.



The flow path is “up and over” which makes it necessary to observe the flow indication arrow so that shut-off position isolates the service pressure under the disc and not against the soft packing in the stuffing box.

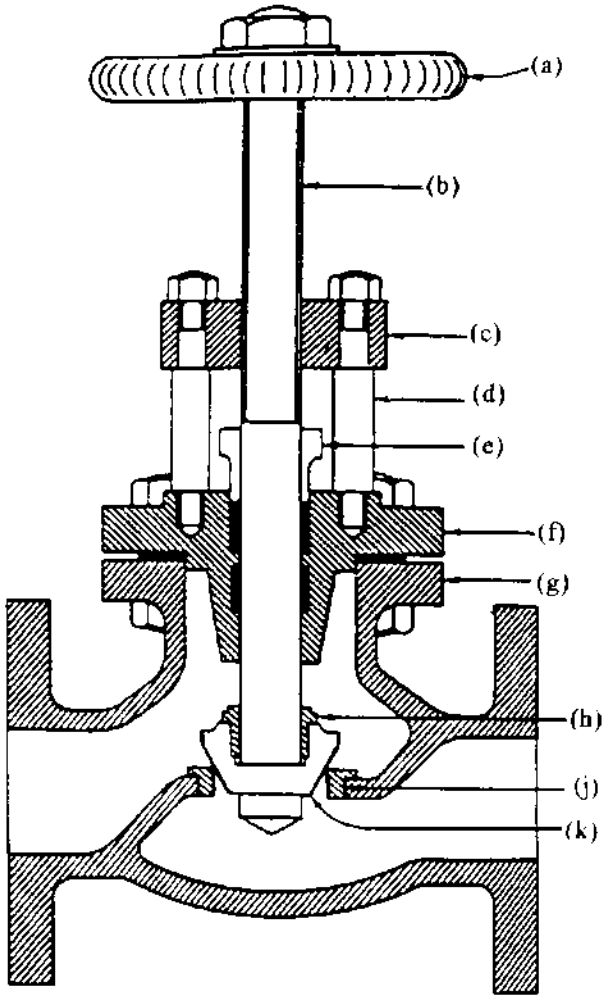


The seat of the valve is replaceable and the shape can be varied to give different flow characteristics, but due to the up and over design of the flow passage high viscosity fluids, such as slurries, are not recommended for this type of valve design.



Indicated at the various positions are:

(a) handwheel, (b) stem, (c) bridge, (d) column, (e) gland, (f) cover, (g) body, (h) lock-nut, (j) seat ring, (k) disc.



Safety Precautions When Commissioning High Pressure Steam Lines

Opening a steam isolation has to be done in a very controlled manner, the steam has to be brought in to the line slowly, to warm it up and avoiding steam hammer.

A high pressure steam valve catastrophic failure due to steam hammer caused by no or poor warm-up procedure

Because gate valves have to be either open or closed, this presents a problem as when the valve is cracked of its seat. It will be seriously damaged in a very short time and tight shut-off will no longer be possible.

If a globe valves is used instead of the gate valve, the line flow becomes turbulent and produces back pressure

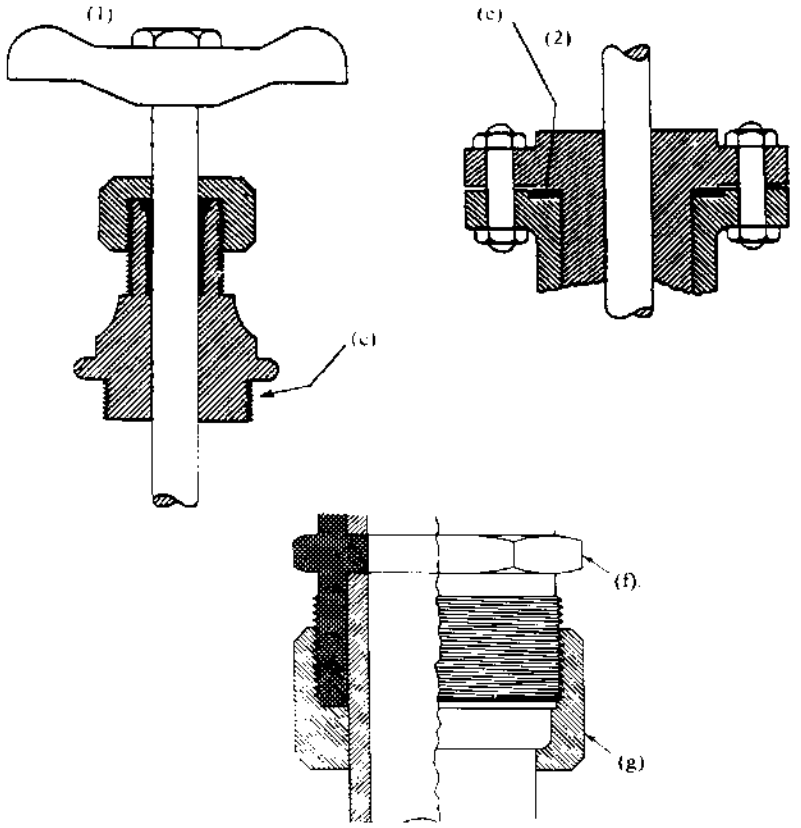
The solution is to provide a small bypass valve system to allow the steam in to the line. But again a similar problem exists as with the main gate valve. So the bypass system has to have both a small gate and globe valve. The gate to provide tight shut-off and the globe to provide flow control for the warm-up sequence.

It follows that if the valves are operated in the wrong sequence and the small gate valve is damaged, a tight shut-off isolation of a system will be compromised.

Therefore when commissioning high pressure, high temperature steam lines make sure you open the small gate valve against the closed small globe valve first, and then use the globe valve to control the warm-up. Only when the line is up to temperature and pressure can the main isolation gate valve be opened and both the small bypass valves be tightly shut-off ready for the next time.

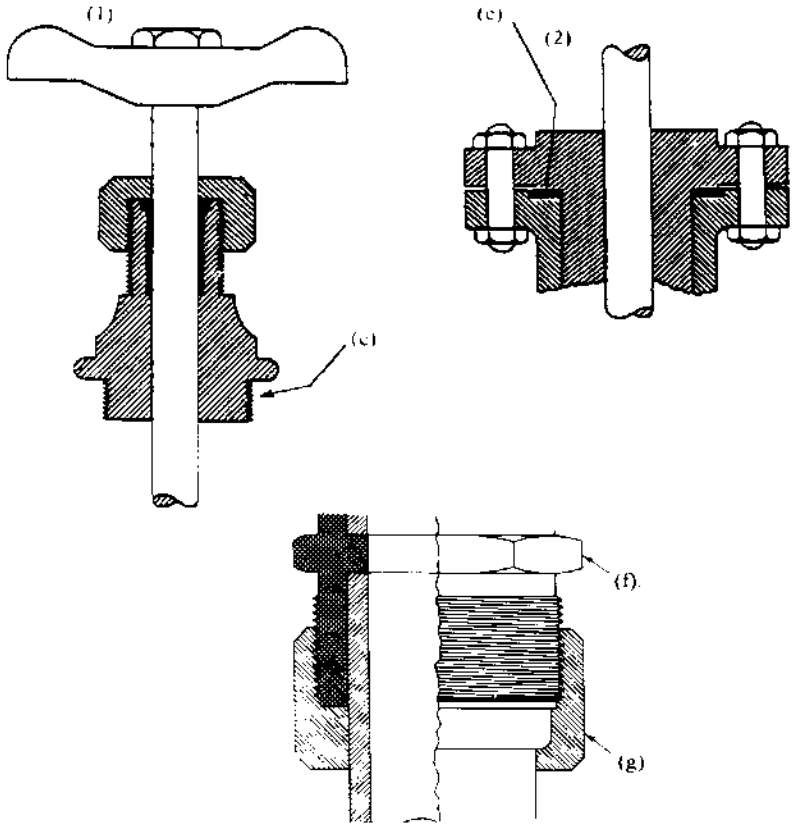
VALVE BONNET TYPES

The valve bonnet houses the packing box or gland of the valve which contains a deformable material to seal the moving stem, the three most used types of connections are screwed, bolted flange and union compression type coupling connection.



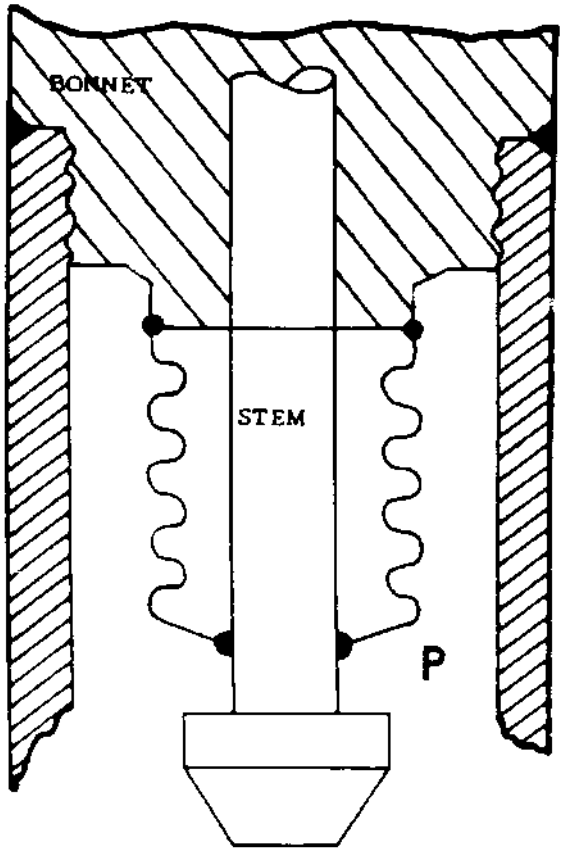
Screwed bonnets are used mainly on small valves where dismantling is less frequent.

The bolted flange is used on longer valves where high pressure and temperature conditions are encountered, this connection bears a similarity to a pipe flange connection with a gasket sandwiched between the bonnet and body flanges.



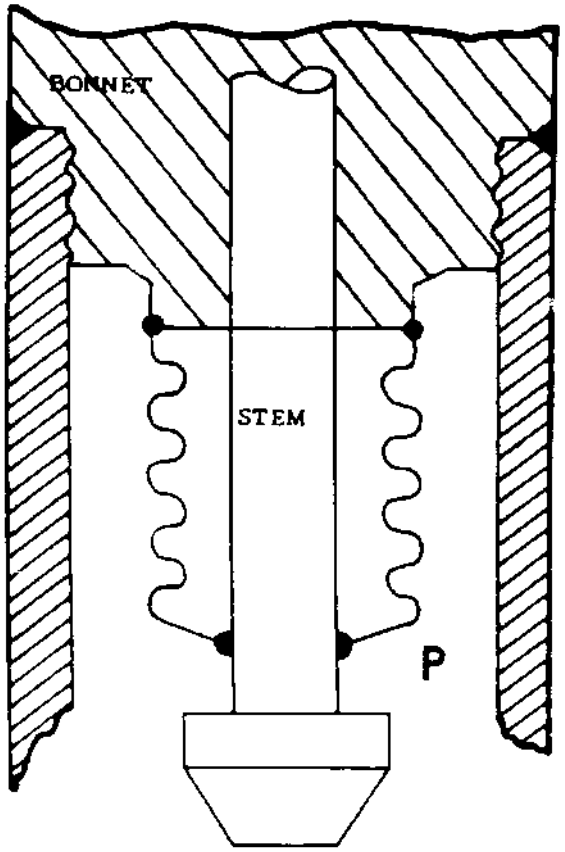
BELLOWS SEALED VALVES SPINDLES

When a situation of nil leakage from valve to atmosphere is desired as in the case of critical services such as caustic solutions, toxic liquids and certain gases in the nuclear power industry, then the ideal valve is the bellows sealed type valve.



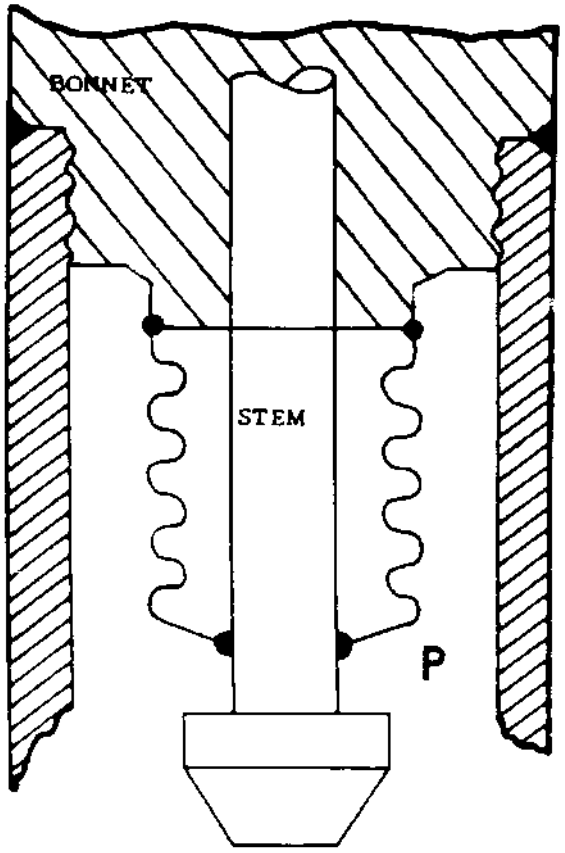
P = PRESSURE

This type of valve is also extensively used on steam service lines where wet steam can play havoc with conventional valve stuffing boxes and glands. The heart of the valve is the hollow steel bellows which is welded to the bonnet at the top and the stem at the bottom, so that the pressure is always kept on the outside of the bellows and isolated from the valve stem.

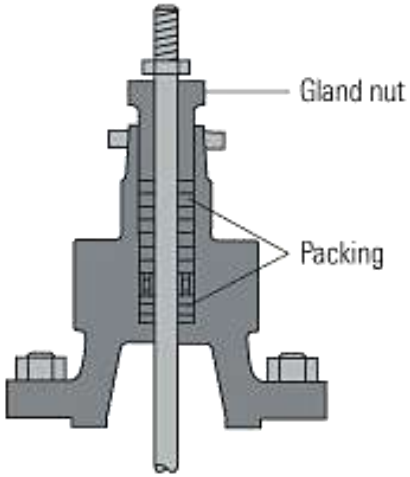


P = PRESSURE

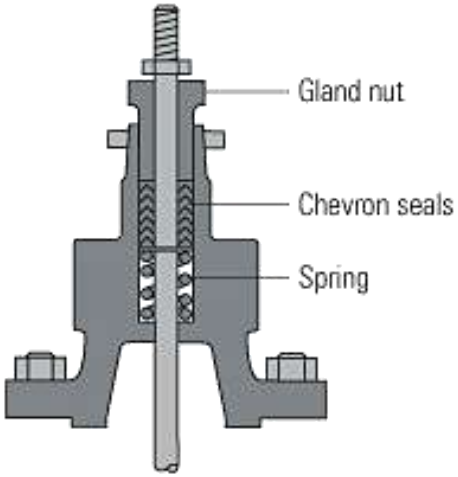
The valve sealing can be either gate or globe type and the ends can be screwed, flanged or welded. A sealing gland is incorporated in the design for the main purpose of preventing the ingress of dust and water into the space between the bellows and stem.



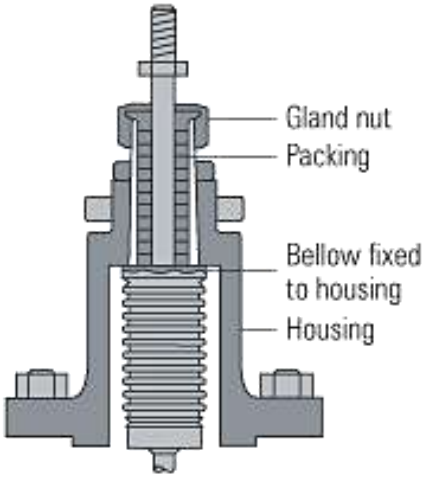
There are many different types of gland sealing arrangements, some are serviceable and some require the vales to be removed for specialist overhaul or replacement



Stuffing box packing

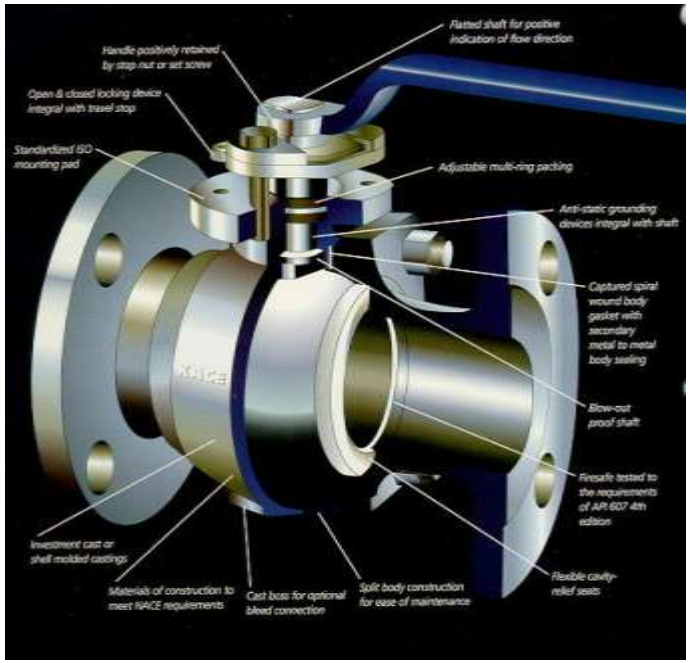


PTFE chevron V-ring spring loaded packing



Bellows sealed packing

Typical Ball Valve

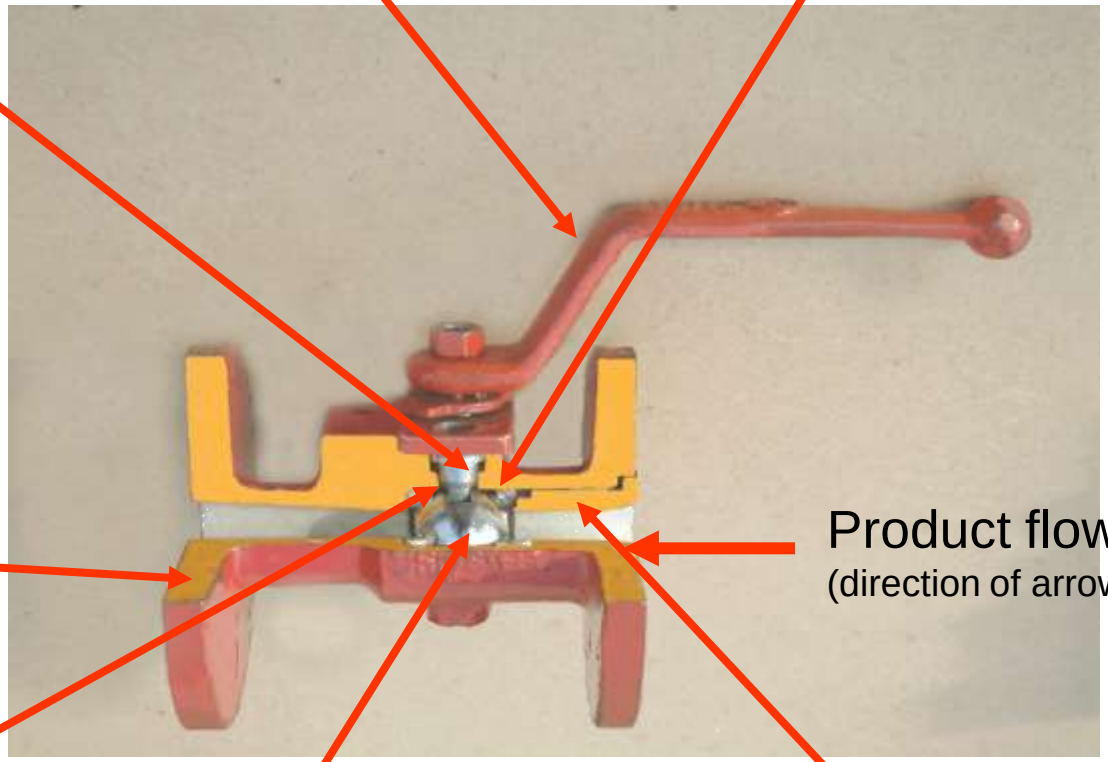


Ball valves are no use for throttling (turbulent, vibration, noise, water hammer)
Limit use for high pressure & temperature
Multi Port (L port: Diverting, T Port: Diverting & Mixing)
Quick operation (Quarter Turn)
Flow path: straight pattern
Pressure loss: small

Note: Use for on-off, not for flow control

Ball Valve

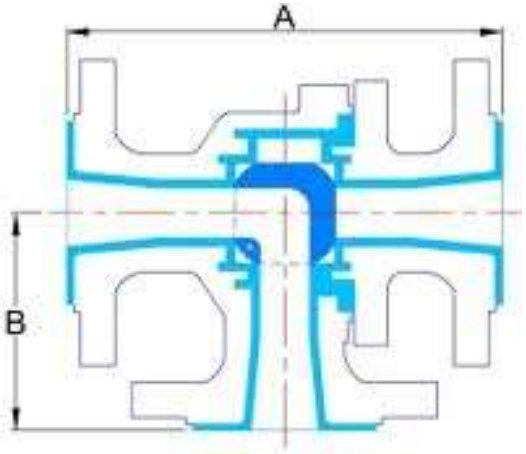
Used for :-
Liquids and gases
Low – med temperature
Uninterupted flow



The 3 piece full port valves are used in industrial and commercial applications for a wide range of fluids. The 3 piece construction with swing out center section is designed for easy maintenance and cleaning.

L & T Ported flow patterns

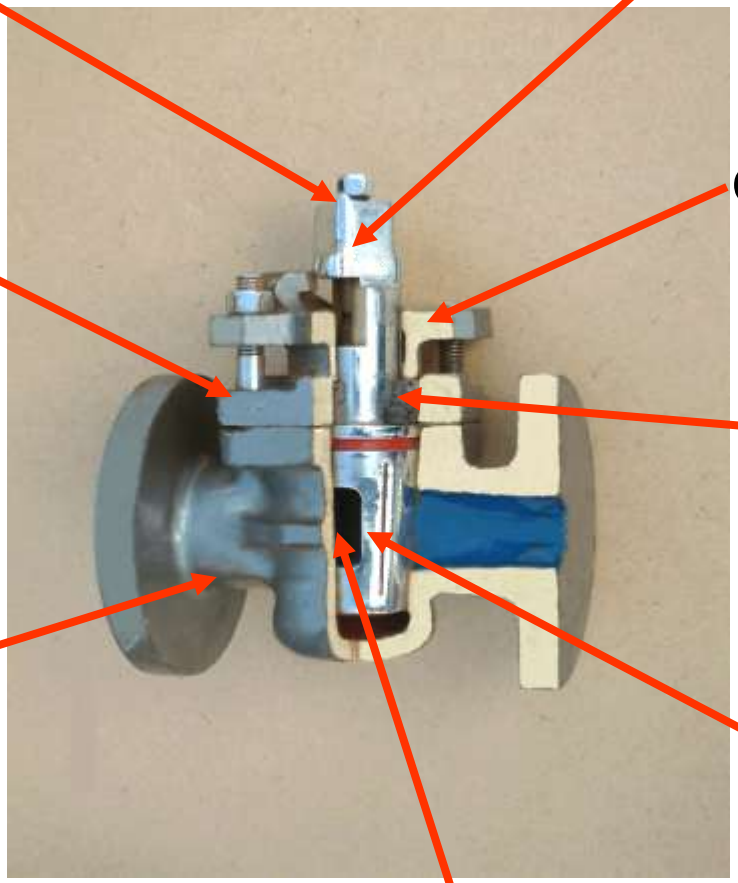
3-way ball valves are specifically designed for shutoff and directional control in a single valve. In some systems, a single valve can be used for recirculation, mixing, and blending requirements



Plug Valve

Used for :-

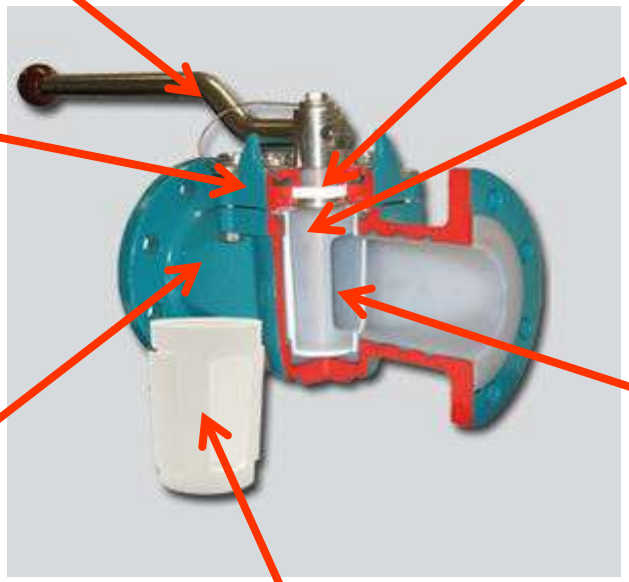
Quick isolation
High pressure
High temperature
Hazardous materials
Flow direction - any



Lined Plug Valve

Used for :-

Quick isolation
Medium pressure
Low temperature
Corrosive materials
Flow direction – any



Lined Plug Valve Continued

An important feature found on some tapper plug valves is the inclusion of a plug vent hole. This is to allow the plug centre cavetti to vent upstream of the valve.

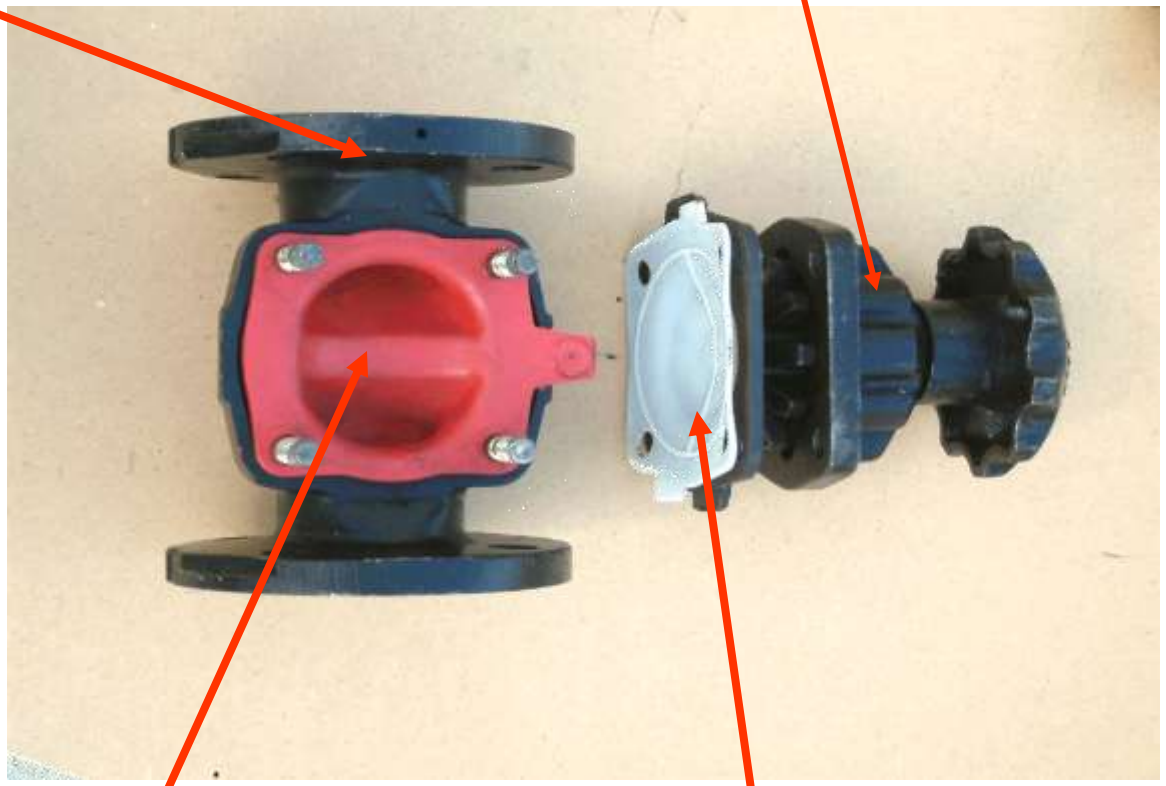
It is important therefore this type of valve if fitted with the vent hole has now a flow direction and should be fitted accordingly.

If this is not done then the active side of the plug sleeve has a potential leak path

Diaphragm valve

Body Cast iron,
Steel, Alloy, Plastic

Bonnet houses working parts and handwheel

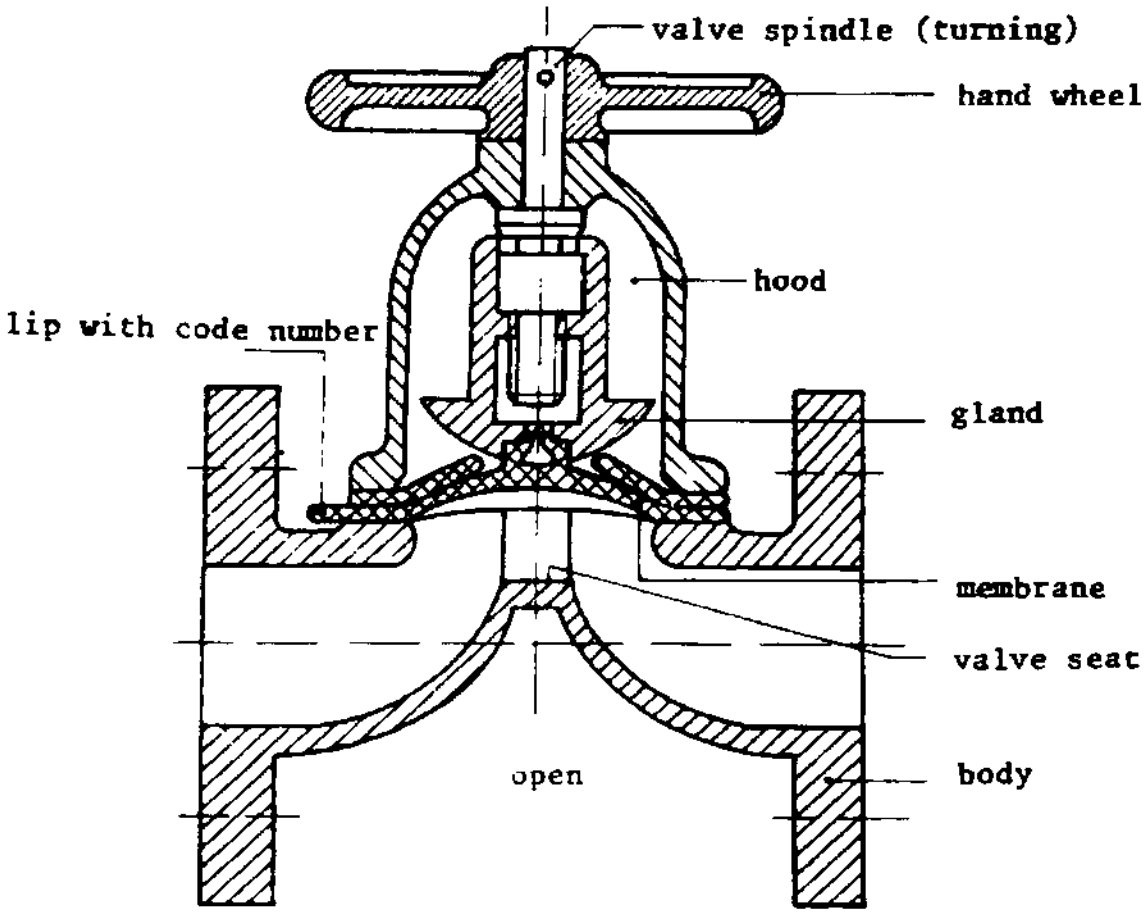


Used for:-

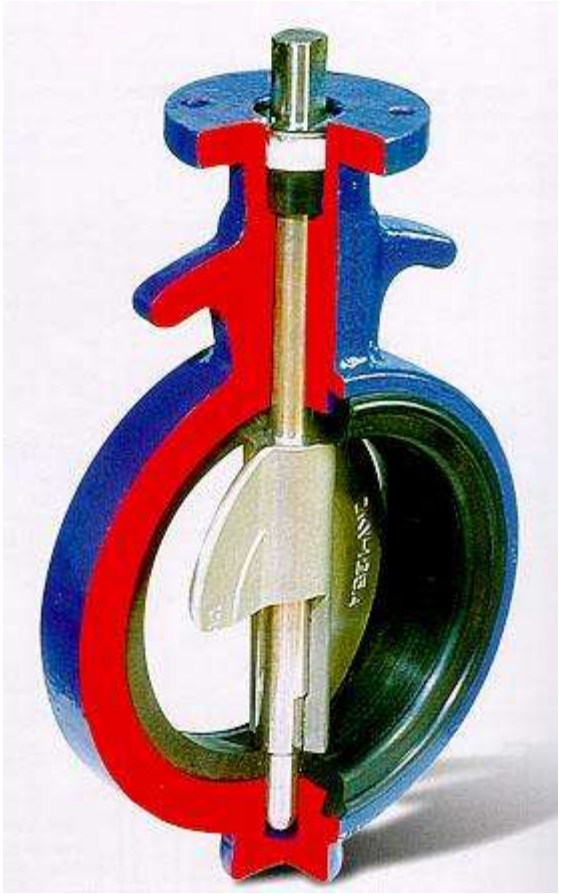
Flow control
Wide range of products
Temperature and pressure limited
Flow direction - any

Lining optional

Flexible diaphragm can be two materials


valve spindle (turning)
hand wheel
hood
lip with code number
gland
membrane
valve seat
open
body

Typical Butterfly Valve



Butterfly valves used for Throttling
Limit for high pressure and temperature
Flow path: straight pattern
Pressure loss: small

Note: Use the flow control valve because of the good flow capacity

Butterfly Valve

Used for :-

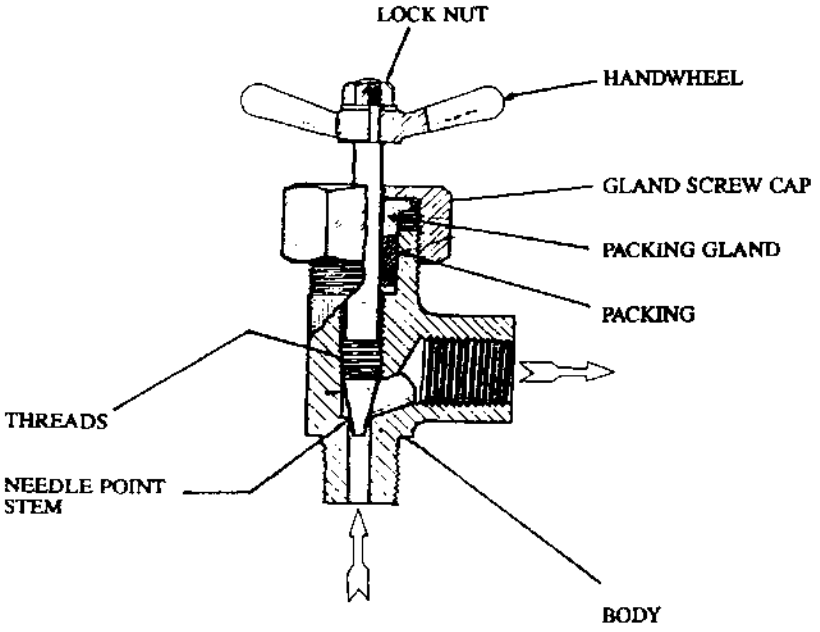
Regulation of flow
good flow characteristics
Slimline body
90deg operation
High volume
Temp and pressure restricted
Correct alignment important

Needle Valve

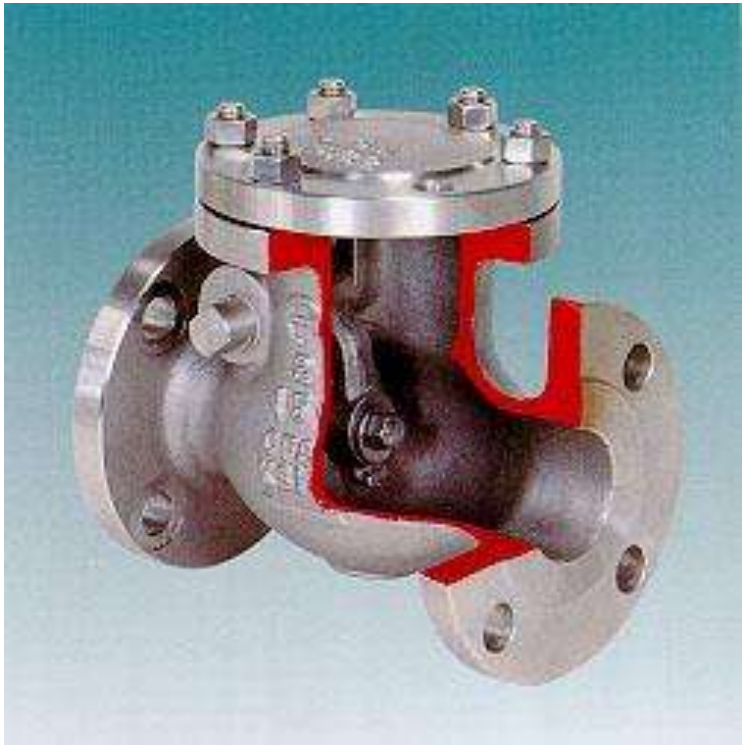
A screw cap is used to prevent dirt getting into the thread of the gland.

A needle valve has the same principle characteristics as the globe valve and is mainly used to control small amounts of gas or liquids flows through the valve.

It has a perfect shut-off position and operates under high pressure.



Typical Check or N.R. Valve

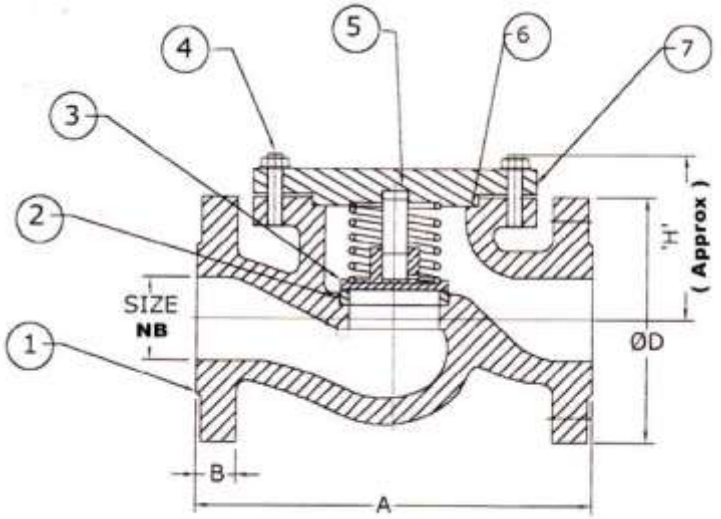


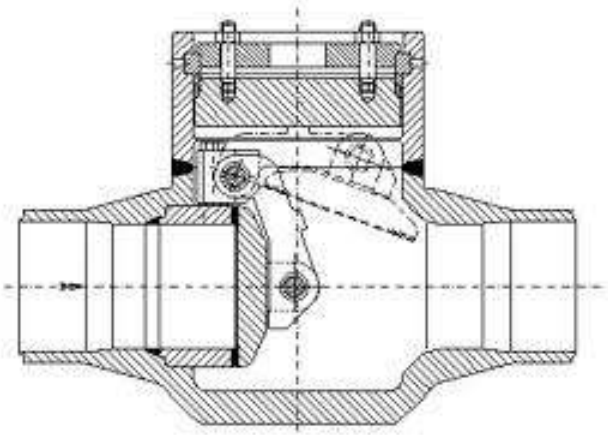
Check valves, if the system pressure and flow is constant the valve is open. If the system pressure and flow is reduced the valve will close.

Note: Use for safety valve that prevents the return of flow

Attention when fitting must be paid to the flow indication arrows.

Flow indicated at the various points are top cover, or main body.





Check or Non- return valve

Swinging disc type

Direction of flow indicated on body
This type only used horizontally
Slimline (alignment critical)

Disc open

Disc pivot

Body

Disc closed

Typical Relief Valve

Relief valves operate when the system pressure normal and constant the valve is close.
If the system pressure increases the valve will open.

Note: Use for safety valve prevents the overpressure of system.

Material of Valves

The materials for valves are divided into body, bonnet, trim and packing materials.

When choose the materials of valves, you should consider the following, corrosion resistance, wear resistance, high or low temperature.

Materials of Body & Bonnet

The materials for Body and Bonnet which are the pressure containing parts, and may be divided into forged steel, cast steel, stainless steel, brass etc.

Material of Trim

Because trim material is connecting with fluid and actually operation parts, consideration for corrosion resistance and wear resistance may be appropriate.

Materials of Packing

Packing will have the constant force for maintaining the sealing with fluid pressure and stem’s continuously operation.

It should not deform through fluid temperature and other effects.

Selection of Valve

It is difficult to select the valve that fits all your performance requirements. Valves are designed in accordance to international standard and this is very important design factor to satisfy the performance and reliability of valves.

<u>The performance standards cover</u>

Fluid, liquid & gas

Flammable, toxic, corrosive and ultra-clean flow media

Steam, high pressure and temperature

They also cover

Pressure

Pressure Ratings

Pressure ratings of valves are closely related with the temperature.

Temperature

Higher temperature, less pressure rating

They also cover

Flow

Type and size of valve.

On-Off Type: Gate Valve, Ball Valve, Plug Valve

Throttling Type: Globe Valve, Needle Valve, Butterfly Valve

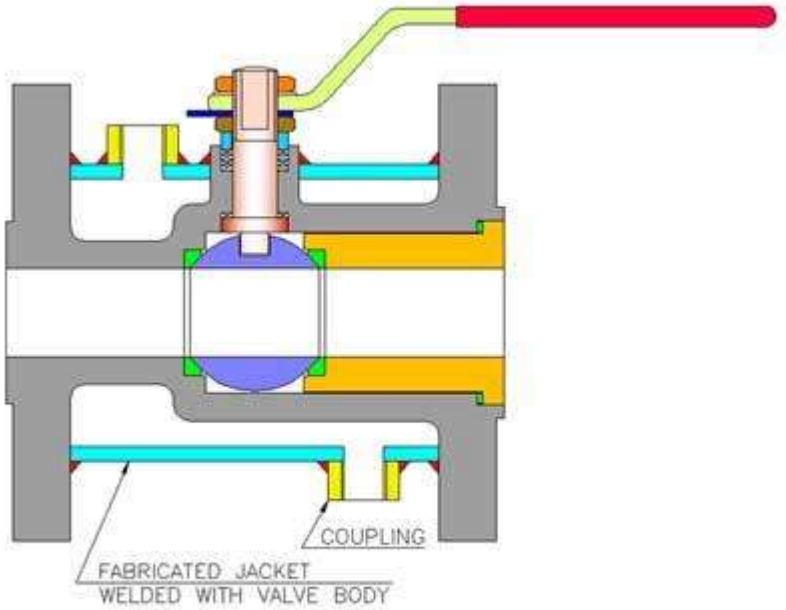
Direction Control Type: Non Return Valve (Check Valve)

Steam Jacketed Ball Valves

APPLICATIONS
Process specific.

USED FOR :-
Phase change products

MAIN FEATURE
Steam jacketing and connections



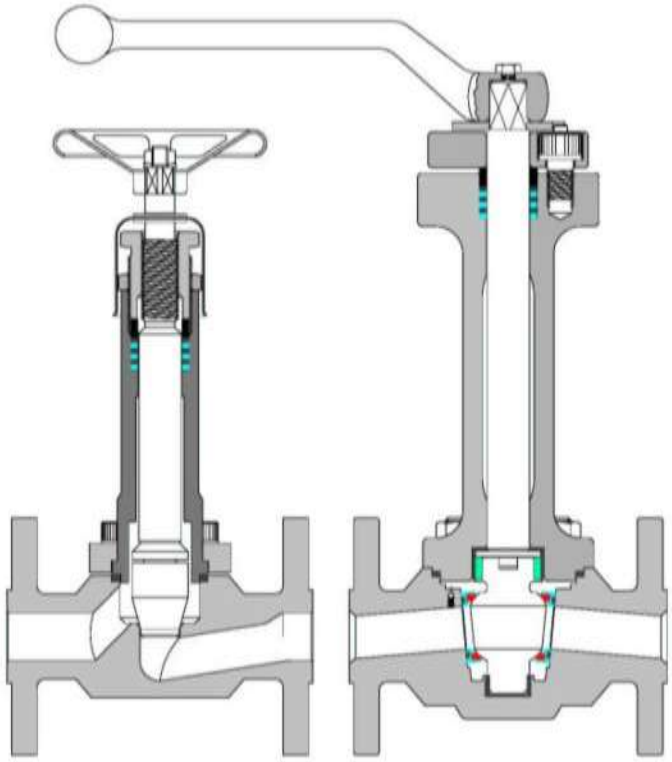
Jacketed Ball Valve

Cryogenic Needle & Ball Valves

APPLICATIONS
Cryogenic service

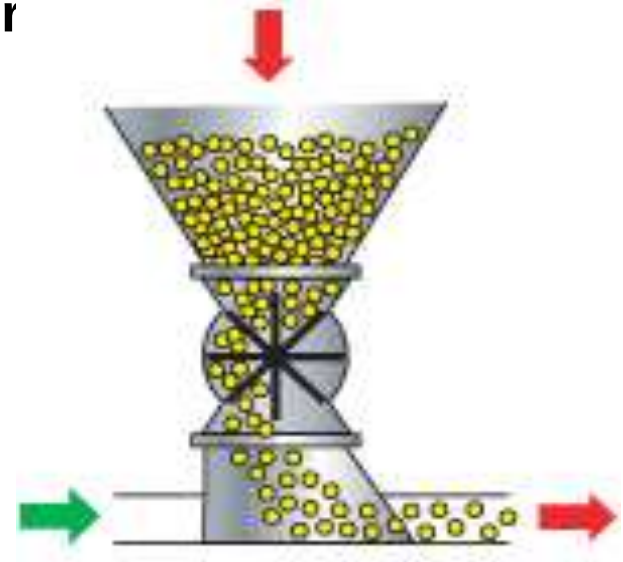
USED FOR :-
LNG, LPG, Liquid Nitrogen

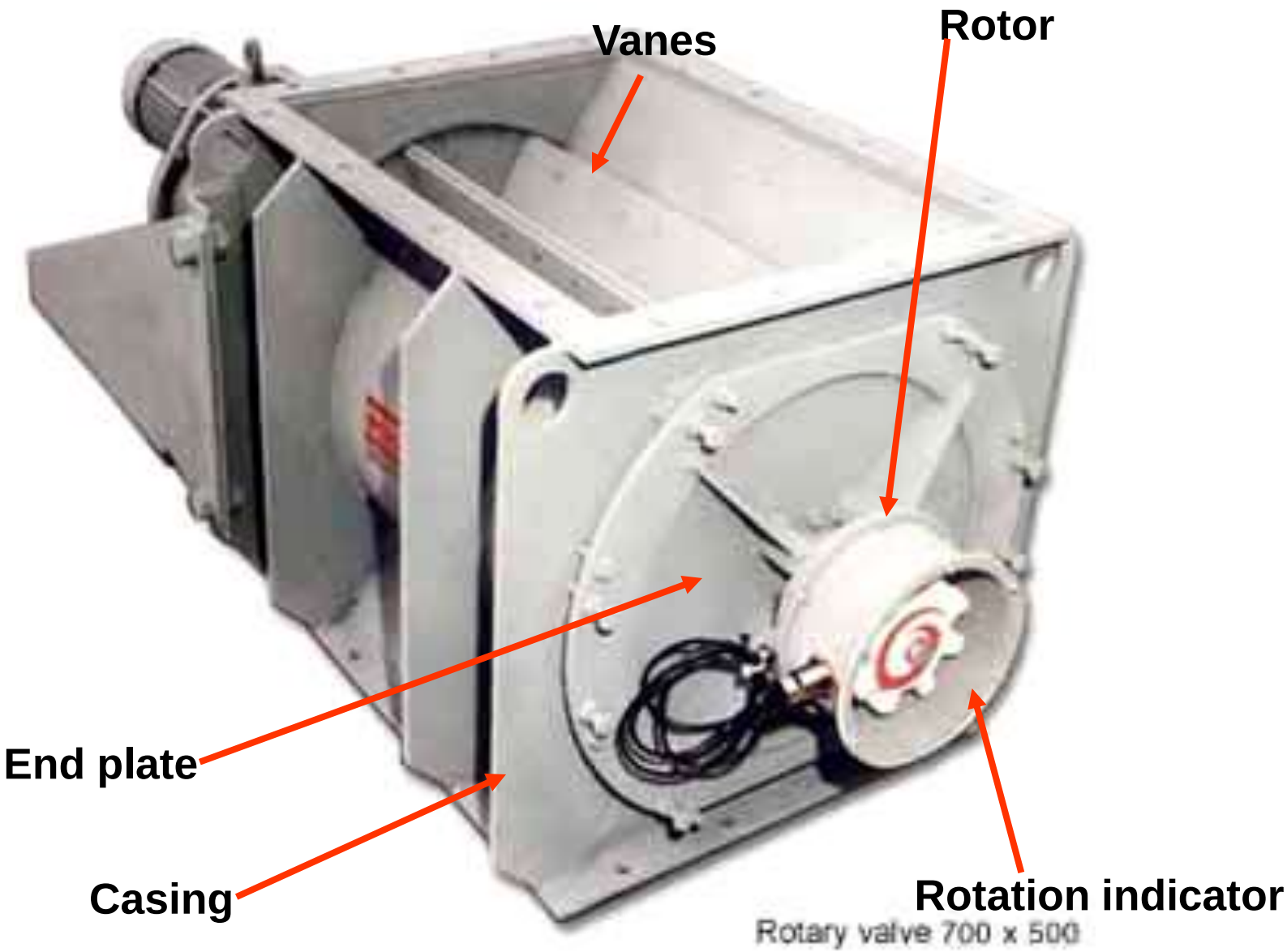
MAIN FEATURE
Bolted extension bonnet



ROTARY VALVES

Rotary valves are used in applications such as pneumatic conveying and dust filtration, particularly where air leakage needs to be minimised and the material requires metering at an even, quick speed.
They are ideally suited to control delivery or discharge of powder or pelletized products to and from conveying systems, bag filters and centrifugal separator




Vanes
Rotor
End plate
Casing
Rotation indicator
Rotary valve 700 x 500

Any Questions?

The Process Pigging System

The Benefits of the Process Pigging System Include:

Minimized (or eliminated) cross-contamination.

Decreased down-time for product changeover.

Recovering of “normally wasted” product.

Adaptable to your individual application.

Minimization of dedicated lines.

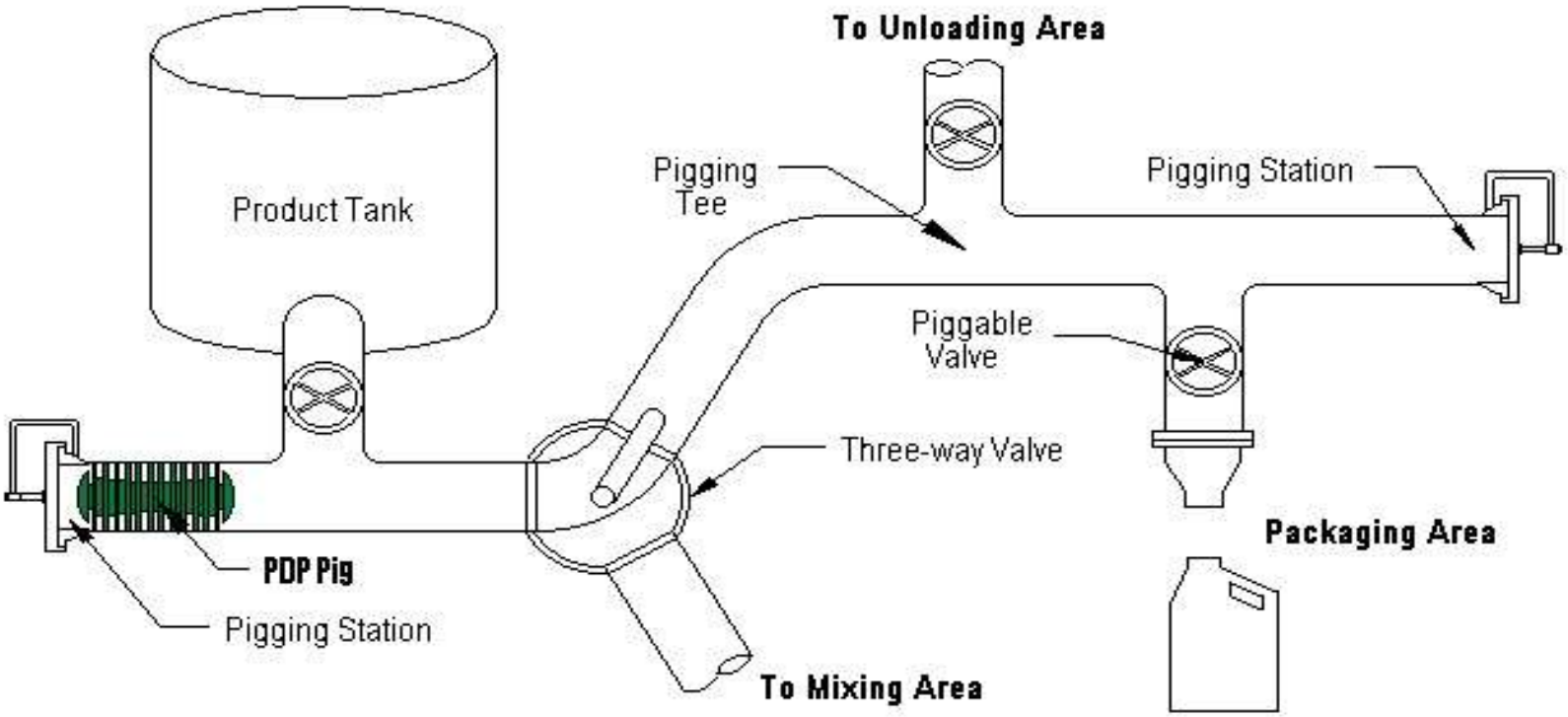
Increased product purity.

The key is in the design of the pig.

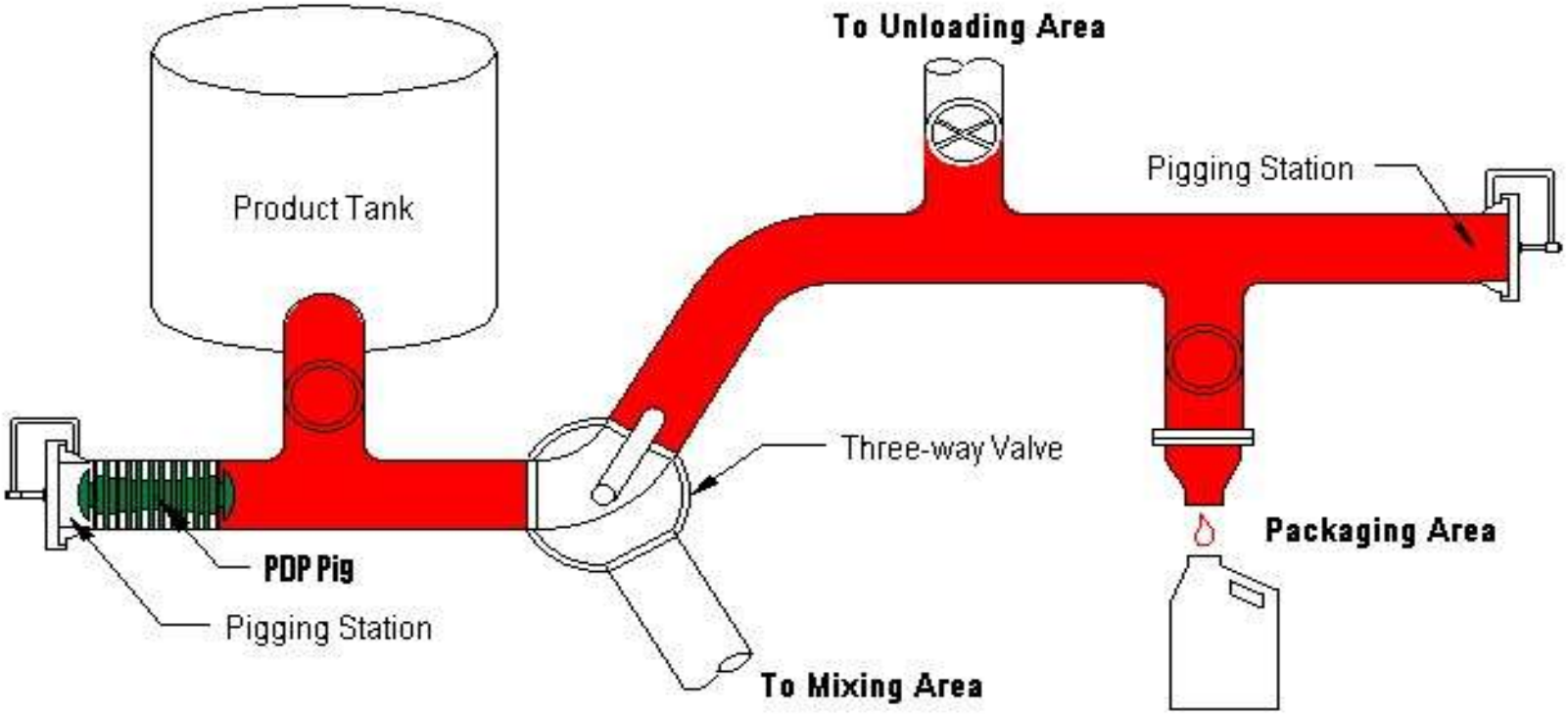
It’s design minimizes bypass, which equates to a purer product and less cross-contamination.

Typical Application

The following illustrates a typical process pigging application.



By utilizing 3-way valves, pigging tees, and standard valves, we have eliminated the need for dedicated lines.



We begin pumping product to the Packaging Area.

Notice the pig remains in the pigging station, waiting to be launched.