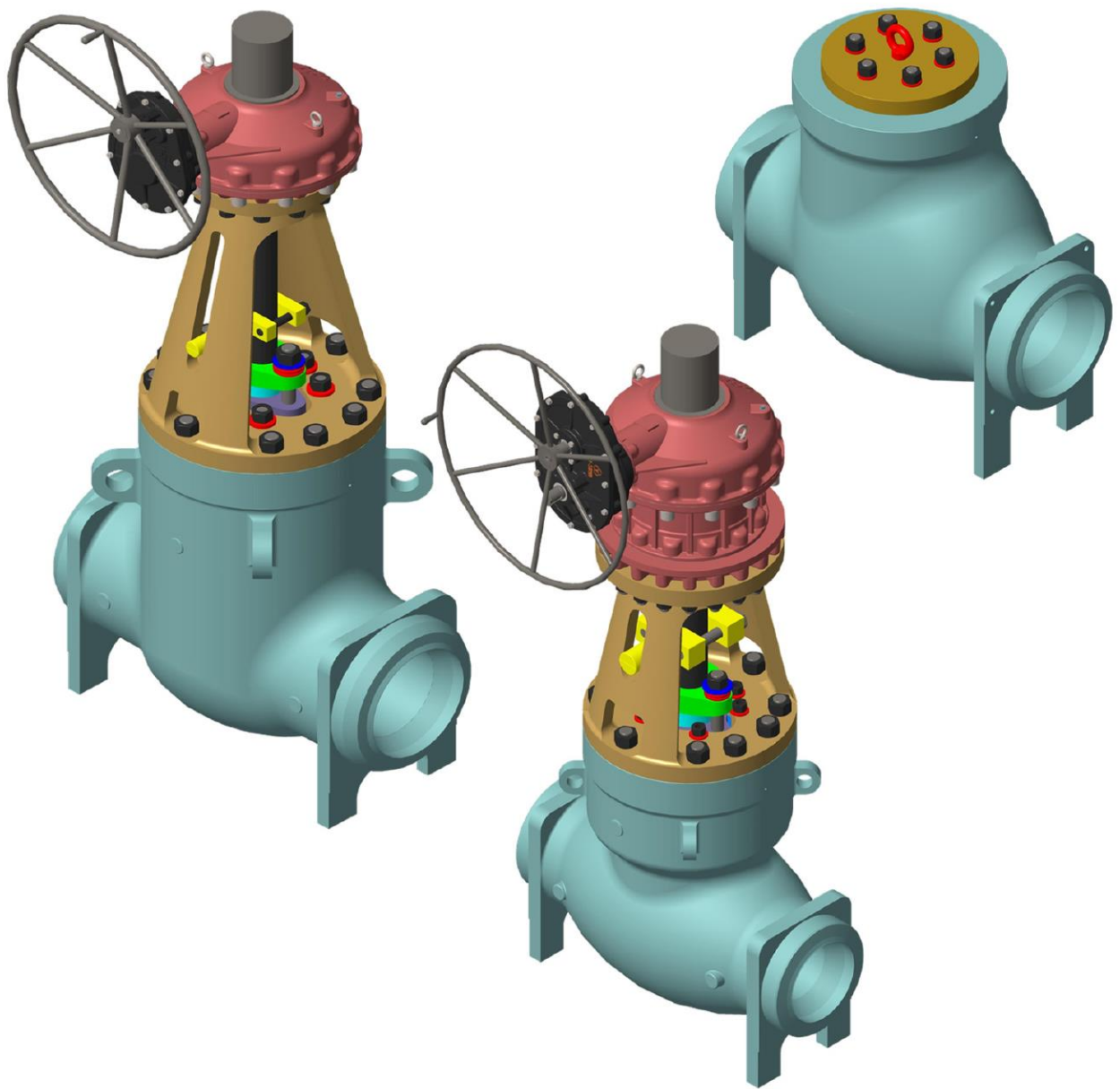


**Installation, Operation and  
Maintenance Manual of  
Pressure Seal Gate, Globe & Check Valves**



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**Note**

This manual shall be read in conjunction with manual LTV-566, “Instruction, Operation and Maintenance Manual - Important Points”.



## L&T Valves

L&T Valves Limited (formerly Audco India Limited) is a wholly-owned subsidiary of L&T and one of the largest valve manufacturers in the world.

The company has three modern manufacturing facilities, in Chennai, Coimbatore and Kancheepuram, in Tamil Nadu, India. The company leverages its world-class capabilities in design, quality assurance and manufacturing to ensure that their products consistently meet customer expectations.

### **Product Range:**

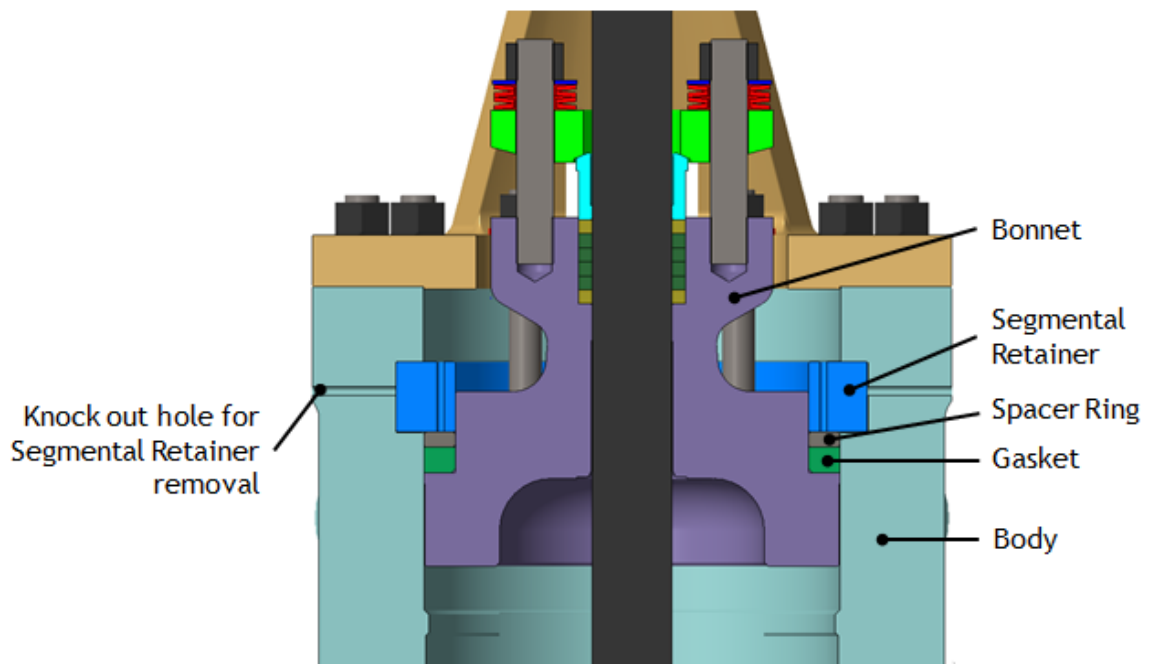
- Gate, Globe & Check Valves
- Valves for Power
- Pipeline & Process Ball Valves
- Triple-offset Butterfly Valves
- Rubber lined Butterfly Valves
- Valves for Water Service
- Double Block & Bleed Valves
- Control Valves
- Customized Solutions

Designs for the valves are created by an experienced team of valve experts who have deep understanding of user-industry processes. Extensive manufacturing and quality assurance infrastructure ensure that world-class designs are transformed into high performance products. Every phase of manufacture is governed by an institutionalized environment, health and safety policy.

L&T Valves distribution network spans across the globe, partnering some of the largest valve distribution companies in the world. In India, L&T Valves has a presence in every industrial centre through a network of offices, stockists, automation centres and service franchisees.

## Pressure Seal Bonnet Valves

Pressure seal bonnet valves are a compact alternative to bolted bonnets, especially for high pressure applications. Pressure seal valves have a valve bonnet closure assembly in which internal fluid pressure-force on the bonnet increases the compressive loading on the sealing gasket creating a self-sealing closure. In contrast to bolted bonnets, the sealing ability of the pressure seal bonnets increases with increase in pressure. A typical pressure seal bonnet construction for gate and globe valves is shown below in figure 1.



**Figure1 - Typical Pressure Seal Bonnet Construction**

## Pressure Seal Gate Valves

Gate valves are multi-turn valves with rising stem i.e. they require a number of rotation of handwheel for full close or full open of the valve. All gate valves shall be used only in full open or full close position. If used in slight or half open position, the gate may vibrate/chatter and also cause wire drawing at the seating area. Therefore gate valves shall not be used for flow regulation.

All gate valves close by rotating the handwheel clockwise and open by rotating counter-clockwise.

For handwheel operated valves the projection of stem above the handwheel indicates whether the valve is in open or close position. In gear operated valves as the stem top may not be visible, a separate indicator is provided to indicate the position of valve.

The valve is closed by driving the disc down into the gap between seat rings. The disc and body seat rings are matched and lapped for perfect sealing. When the valve is fully open the stem back seats in the bonnet.

Based on disc design, gate valves are classified into two types.

- 1) Pressure Seal Flexible Wedge Gate Valve
- 2) Pressure Seal Parallel Slide Gate Valve

Typical exploded view of gate valves are shown in figures 2 and 3. For actual construction details of valves supplied, please refer General Assembly Drawing (GAD) submitted.

### Range\*

Size (Flexible Wedge)	Size (Parallel Slide)	Pressure Rating
2" to 36"	20" to 40"	Class 600
2" to 36"	2" to 30"	Class 900
2" to 30"	2" to 30"	Class 1500
2" to 28"	2" to 30"	Class 2500
2" to 28"	2" to 30"	Class 3100
--	2" to 30"	Class 3500

\*subject to change due to new developments

### Pressure Seal Globe Valves

Globe valves are multi-turn valves with nonrotating stem and nonrising hand wheel. Globe valves can be used for normal flow regulation. However if it is used in slightly opened position when the differential pressure is very high, the seating may erode. It is advisable not to use a Globe valve for flow control below 10% of full opening

All globe valves close by rotating the handwheel clockwise and open by rotating counter-clockwise.

For all globe valves, stem guide is used for position indication and open and close indication is available in valve yoke. For handwheel operated valves the projection of stem above the handwheel also indicates whether the valve is in open or close position.

Globe valves shall be either Y-Pattern or T-Pattern based on body profile. Typical exploded view of globe valve is shown in figure 4. For actual construction details of valves supplied, please refer General Assembly Drawing (GAD) submitted.

### Range\*

Size	Pressure Rating
2" to 18"	Class 600
2" to 18"	Class 900
2" to 18"	Class 1500
2" to 18"	Class 2500

Size	Pressure Rating
2" to 12"	Class 3100
2" to 12"	Class 3500

\*subject to change due to new developments

## Pressure Seal Check Valves

Pressure Seal Check Valves automatically open by velocity of medium and close by the gravitational force when the flow reverses or stops.

Based on disc design, check valves are classified into two types.

- 1) Swing type
- 2) Tilting Disc type

Tilting disc check valves are non-slam type which are used in application involving multiphase & high turn down ratio.

### Range\*

Size (Swing Check)	Size (Tilting Disc)	Pressure Rating
2" to 28"	--	Class 600
2" to 28"	2" to 24"	Class 900
2" to 28"	2" to 24"	Class 1500
2" to 28"	2" to 24"	Class 2500
2" to 28"	--	Class 3100
2" to 28"	--	Class 3500

\*subject to change due to new developments

## Exploded Views

Typical exploded views are provided for following types of pressure seal valves. For actual construction details of valves supplied, please refer General Assembly Drawing (GAD) submitted.

- 1) Figure 2 - Pressure seal flexible wedge gate valve
- 2) Figure 3 - Pressure seal parallel slide gate valve
- 3) Figure 4 - Pressure seal globe valve
- 4) Figure 5 - Pressure seal swing check valve
- 5) Figure 6 - Pressure seal tilting disc check valve

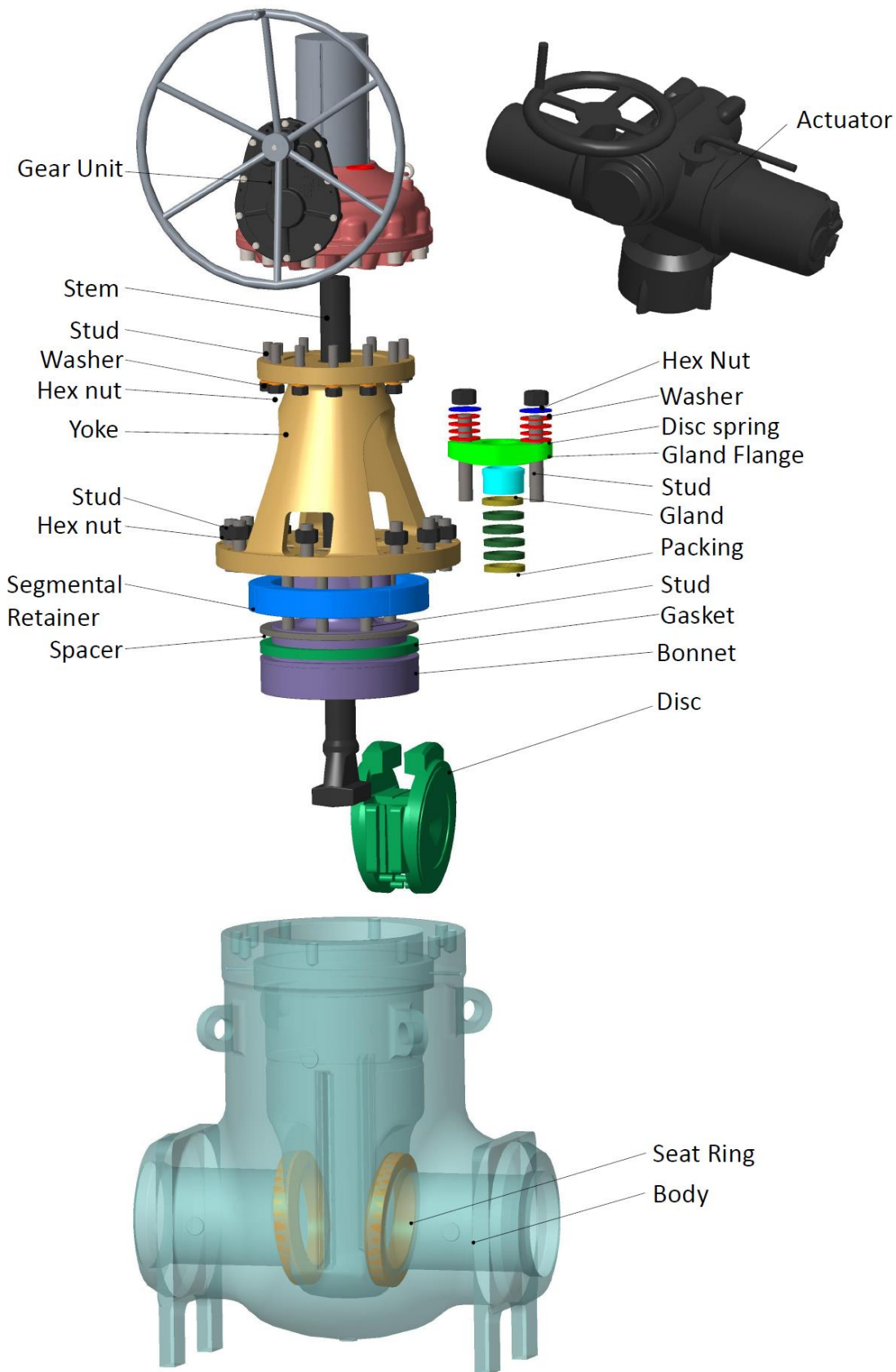
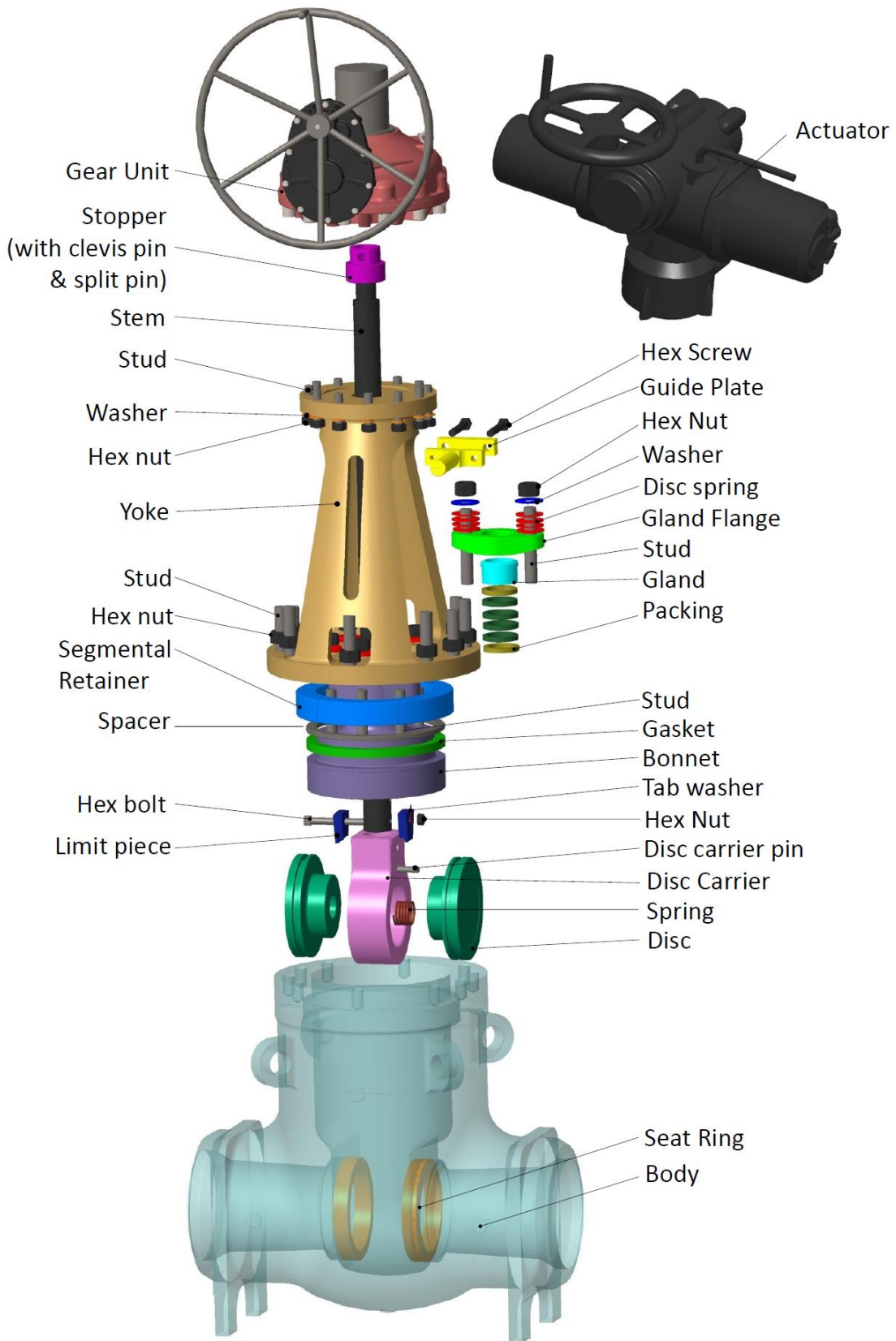


Figure 2 - Pressure Seal Flexible Wedge Gate Valve - Exploded View



**Figure 3 - Pressure Seal Parallel Slide Gate Valve - Exploded View**



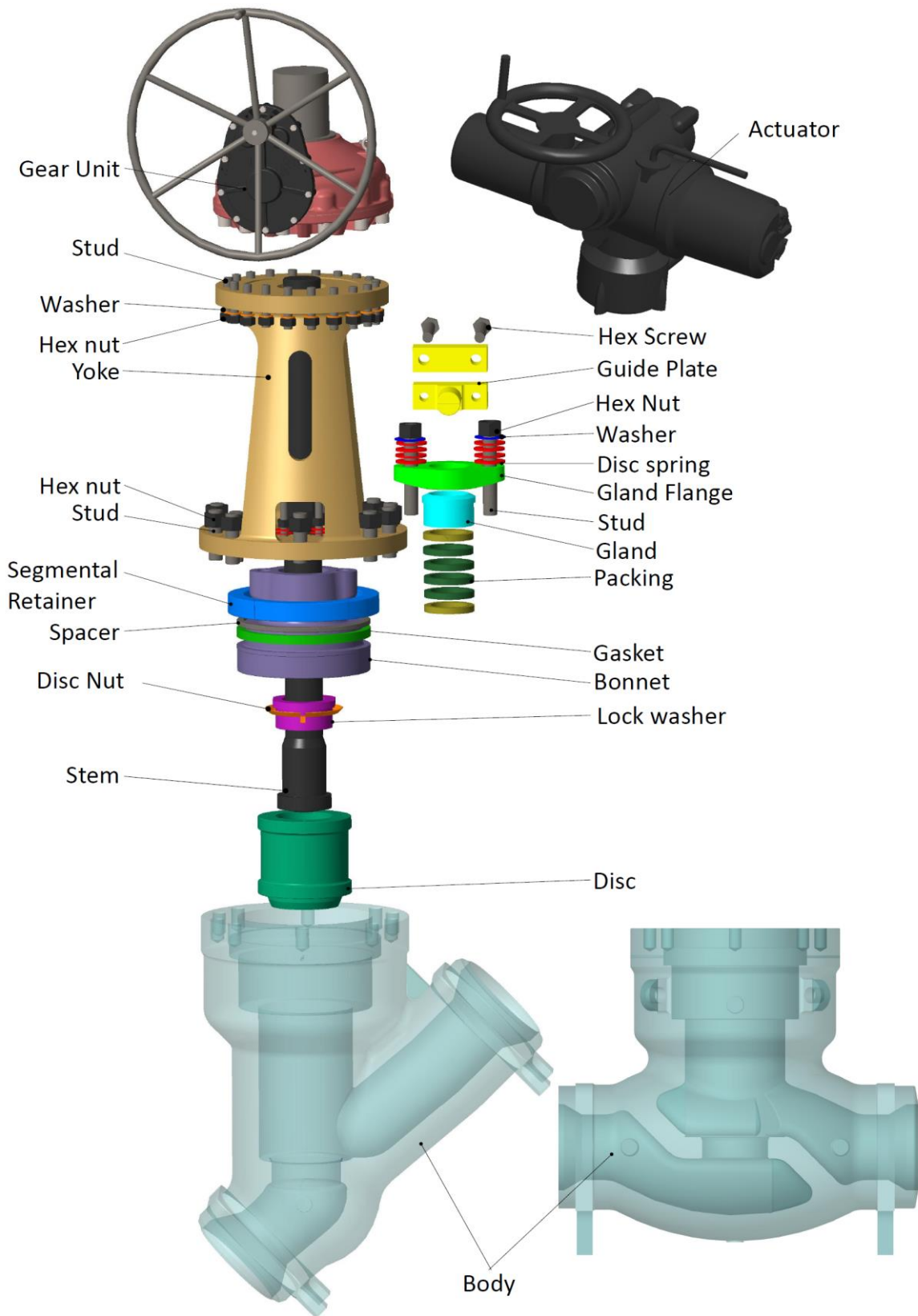


Figure 4 - Pressure Seal Globe Valve - Exploded View

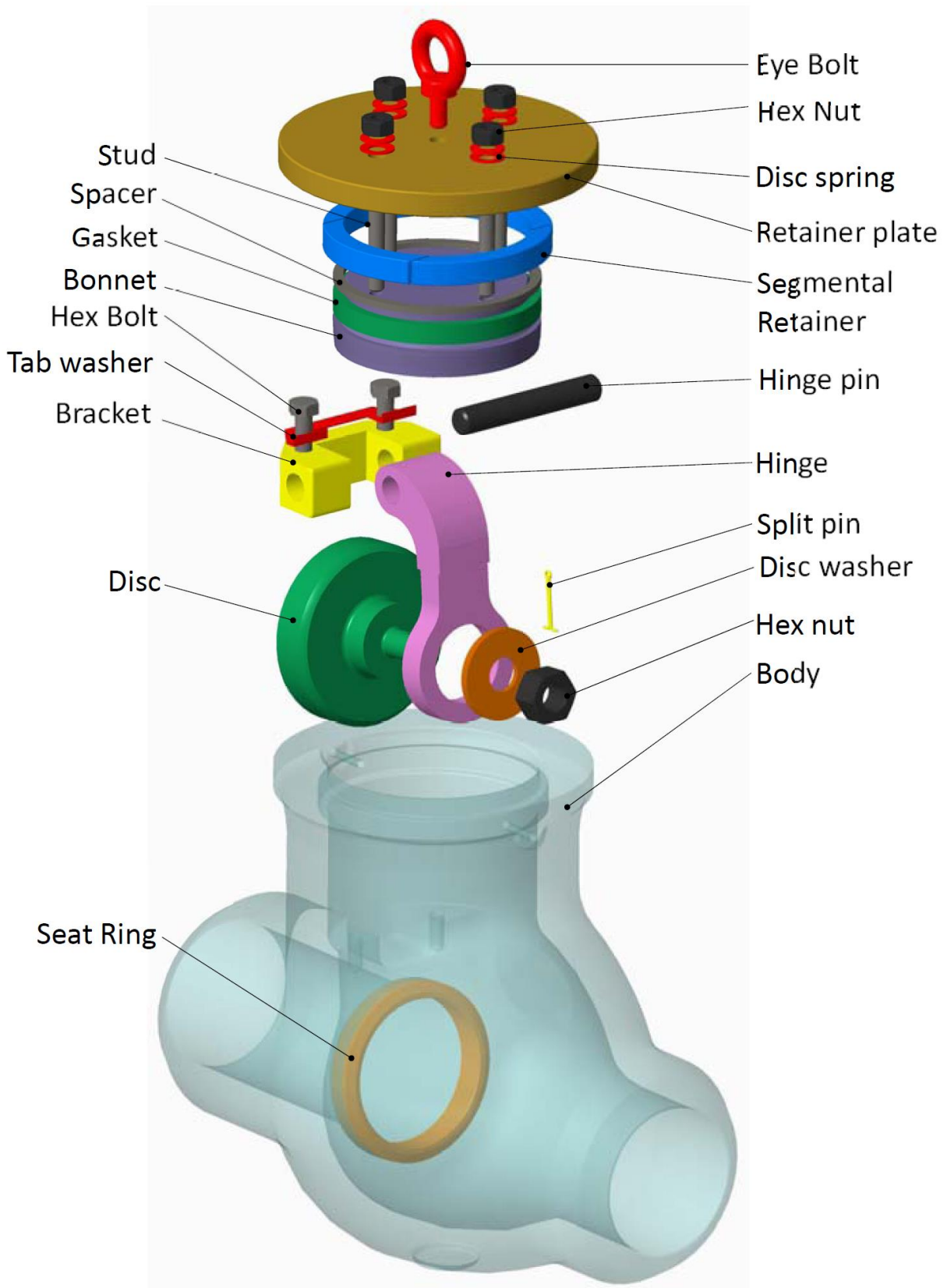


Figure 5 - Pressure Seal Swing Check Valve - Exploded View

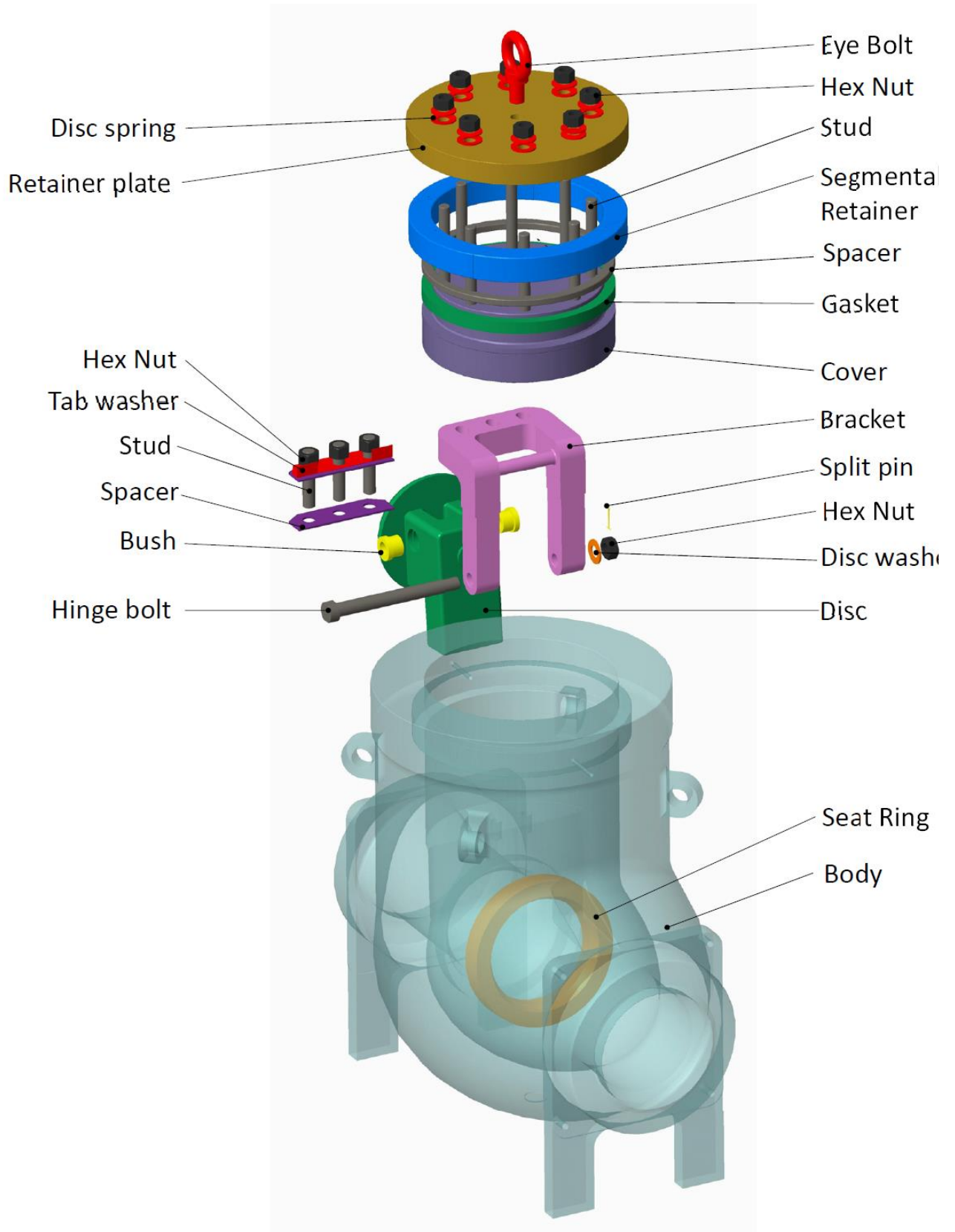



Figure 6 - Pressure Seal Tilting Disc Check Valve - Exploded View


## Delivery

Orientation of the valves in the packing may be either horizontal or vertical depending on the delivered valve dimensions. Please check the packing slip attached to the container before opening the same. The valves and accessories shall be examined for any damages that might have happened during transportation and handling.

Valve identification details can be found on the identification plate and on the body of the valve. Typical identification plate is shown in figures 7 and 8.

		<b>L&amp;T Valves Limited</b>	
ASME B16.34		Made in India	
SIZE	DN 100 (NPS 4)	CLASS	900
	153.2 bar @ 38°C		83.6 bar @ 425°C
BODY	WCB	CAT No	LH9B-5
STEM	CR13	TAG No	TEST 001
DISC	HF	S. No	0001
SEAT	HF	DATE	06/2013

**Figure 7 - Identification Plate for Gate and Globe Valves**

		<b>L&amp;T Valves Limited</b>		ASME B16.34		Made in India	
SIZE	DN 100 (NPS 4)	CLASS	900	CAT No	LS9B-5	DISC	HF
	153.2 bar @ 38°C		83.6 bar @ 425°C	BODY	WCB	SEAT	HF
S. No	001	DATE	06/2013	TAG No	TEST 001		

**Figure 8 - Identification Plate for Check Valves**

Valves supplied for special requirements have a tag plate attached to the valve which indicates the same. Typical tag plates for special requirements are shown in figure 9.

⊕ SUITABLE FOR VACUUM SERVICE ⊕
⊕ SUITABLE FOR HYDROGEN SERVICE ⊕
TAG No. : <input type="text"/>

**Figure 9 - Typical tag plates for special requirements**

Valves are provided with end protectors for avoiding damage to internals. Handwheel and stem protector for gear operated valves are usually dismantled and packed separately.

## Note:

Refer Appendix B for valves with CE & ATEX certification requirements.

## Handling and Storage

### Handling

Valve shall be properly supported and secured before moving, to prevent possible damage to valve, property or harm to personnel.

Do not drag the valve on the ground while transporting. A minimum of one foot height from the ground is to be maintained while moving the valve.

Valve shall not be slung around the valve port for transportation. For large size valves lifting lugs are provided for this purpose.

The crane wire shall not be slung around the actuator/gear unit to avoid any load acting on it. Also, ensure that while handling the valve, no external load acts on the actuator/gear unit.

Valves shall not be handled with the hand wheel keyed/ fixed to the gear unit. The hand wheel shall be dismantled before handling and transporting the valve.

### Storage

Valves shall be stored in covered area which is dust free, least humid and well ventilated. Ensure that the end protectors are in place before the valve is stored, as dry contaminants like dust, sand, grit etc. can scratch metal seating surfaces and the soft parts, leading to leakage during operation.

If the valve end protectors are opened for any check or testing, the same preservation and protection shall be done after the check or testing.

The valve shall always be maintained in an ambience with temperature higher than the dew point temperature at the storage location, so as to avoid collection of water droplets on the valve surface.

Do not keep the valve directly on the floor. Valve shall be placed on wooden pallet such that it is at least at a height of 6 inch from the floor.

Care shall be exercised not to damage the extended portion of the adaptor, gear unit/ actuator while storage.

Do not apply tar, grease or any other material inside the valve, as it could impair the performance of the valve.

Improper storage and/or handling may cause disc/seal damage or deformation of shaft or seat, which will affect sealing and operational performance of the valve.

## Planning & Responsibilities

When installing or maintaining valves,

- Conduct a risk assessment and eliminate or reduce hazards to an acceptable level.
- Work in accordance with health and safety rules of work site.
- Wear all necessary personal protective equipment.
- Never use a valve on a duty which exceeds its prescribed operating parameters. Refer to L&T Valves for further information
- The valve shall not be subjected to frequently occurring disturbances
- End user to ensure there are no external disturbances (e.g. Shocks, vibrations, electromagnetic fields etc.)
- Misuse of valves / valve components shall be avoided.
- Maximum surface temperature of the equipment will be same as the line media temperature. The end user must take account of the line media temperature.
- If the processes or environments that the valves are used in are likely to cause temperatures (high or low) that may cause injury to personnel if touched, then adequate insulation / protection must be fitted.
- Adequate safety measures shall be made for valves similar to pipe lines.
- Due to variety of duties in which these valves can be employed, it is the end user's responsibility to ensure the compatibility of media with the material of construction of the product for each specific application (i.e. corrosion and erosion which may affect integrity of the pressure containing envelope).
- Before valves are installed in areas which may be subject to seismic activity or extreme climatic conditions, consult L&T Valves with data.
- All exposed parts shall be cleaned to prevent dust deposit or insulation is needed similar to pipe line.
- Valves shall be protected by other devices to prevent over-pressurisation. (i.e., caused by temperature, fire etc.).

## Valve Installation

### General

Carefully unpack the valve and check for identification plate or tags etc.

- It is recommended to install Gate and Globe valves with Stem vertical up in longitudinal pipe lines. The valve may be installed in other orientations, but any deviation from vertical is a compromise. For other orientations of stem, refer to L&T Valves.
- The performance of the valve will be better if the flow is smooth. It is suggested to avoid installation of valves where turbulence is expected (Example: Immediate after elbows, bends, pumps, etc.).
- It is recommended to install swing check valves at a distance equal to 10 times or more the pipe diameter from the upstream elbows for better performance.
- Downstream elbows have negligible effect on check valve performance; however in cases of severe downstream flow disturbances, a distance of 3 times pipe diameters is recommended between downstream elbows and check valve.
- It is recommended to install swing check valves in uniform flow lines and shall have sufficient flow to keep the disc at full open condition.
- If the identification plate / arrow plate / tag is lost or destroyed during the shipment or while in storage or if it is not legible, contact your distributor or L&T Valves
- Look for any special warning tags or plate attached to or accompanying the valve and if any, take appropriate action.
- Some of the valves may be uni-directional, it shall be ensured that the valves are installed in the direction as marked in the body (Example: Swing check valves, Gate valves with cavity relief hole in disc, extended bonnet gate valves with cavity relief hole, etc.).
- It is recommended to remove all foreign particles from the pipe line by flushing it with a suitable fluid. Corrosion inhibitors shall be added to the flushing medium to prevent any corrosion due to trapped fluids.
- Remove the end protectors and protective sheath within the flow bore of the valve, wherever provided.
- Gasket contact faces of the valve end flanges and pipe flanges shall be inspected thoroughly for scratches / defects. Scratches, if any, shall be corrected by grinding the surfaces or by rubbing with emery sheet.
- After cleaning, operate the valve for at least two complete cycles before installing.
- Ensure that the valve is in fully closed position during installation.
- The pipes/flanges shall be properly aligned and provisions made to minimize stresses from external load/thermal expansion. Always review pipe manufacturer's recommendation.
- In case of pipes with long overhangs, adequate support/jacks shall be provided at the flange ends of the pipe so as to avoid bending of pipes due to weight of the valve.
- The fasteners on the valves might have loosened or relaxed during transportation or long storage. It is highly recommended that all fasteners (gasket preloading bolts, body-yoke bolts,

gland bolts, gear unit/actuator bolts, guide plate bolts, etc.) shall be retightened to the required torque provided in appendices.

The improper alignment of the pipe and the valve during installation can lead to unbalanced tightening of the flanges which may cause excessive stress on the flanges and bolts and lead to leakage

During installation of BW end valve to pipeline, i.e. during welding of the valve to pipeline, stem and gland packing area (especially the gap between gland flange and stem) shall be protected at all times to prevent entry of foreign particles between the stem and gland arrangement. If foreign particles are trapped between the stem and gland / gland flange, the same can cause extensive damage to stem and its guiding components during valve operation. In any case, prior to valve operation, the stem and gland packing area shall be thoroughly cleaned of all foreign particles.

- Insulation of the valve shall be restricted to the valve body. Yoke and upper portion of the valve shall not be insulated, since temperature build up in this area can cause damage to the upper works.
- Gate and globe valves shall not be operated under steam blowing conditions. Operating the valve under steam blowing conditions can cause damage to the valve internal parts.

## Flanged Ends

- Refer [Appendix A1](#) for applicable standards
- Clean valve flanges and companion flanges and remove protective grease from the valve flanges. Clean the valve interiors adjacent to piping prior to mounting the valve pipe joint.
- Align the bolt holes of the valve end flange and pipe flange.
- Fasteners shall be lubricated for ease of installation.
- Insert the gasket (not supplied with valve) and tighten the fasteners (not supplied with valve). Flange fasteners shall be tightened evenly, using suitable device, in cross rotation to prevent damage to the flange.
- For sequence of tightening fasteners, refer [Appendix A2](#)
- For larger flanged valves, which are provided with foot support supporting base/pedestal shall be placed beneath the valve after the alignment and bolting of the pipe.

If valve is not cleaned or if cleaning is done after valve installation cavities may form a natural trap in the piping system. Any impurity not dissolved or washed out by the flushing fluid/line fluid may settle in such cavities and adversely affect valve performance.



## Butt-welding Ends

- All the valves are provided with butt-welding end preparation are as per standard ASME B16.25 or as per customer requirements. Please refer to the general assembly drawings for the exact butt-welding ends dimensions.
- The welding of valves onto the pipeline shall be performed by qualified welders using qualified procedures.
- Valves shall be kept in the closed position during welding.
- Care shall be taken to avoid weld spatter from falling onto the seating surfaces to prevent damage and maintain sealing effect between the metallic contacts.
- Local post weld heat treatment (PWHT) on the weld and heat affected zone (HAZ) shall be carried out if required by the procedure.
- It is recommended that the pipeline be flushed again, after welding, to avoid damage to disc and seat(s). The valve shall be kept fully open during flushing.
- After flushing is completed, operate the valve three times and ensure that it is smooth. It is recommended to carry out pressure testing of the joints.

## Operation

### General

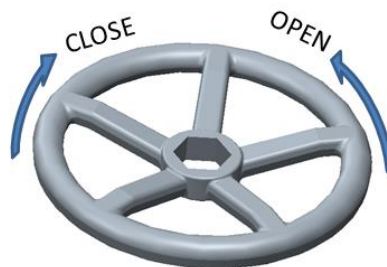
- Operational life of the valves can be maximized if the valves are used within the rated range, in accordance with design parameters.
- For understanding the internal construction, refer to the general assembly drawing of the valve.

### Operation Mechanism

Gate and Globe valve opening/closing is achieved using Handwheel/Gear unit/Electrical/Hydraulic/Pneumatic Actuator.

### Gear Unit

Gear units are provided on valves for easier operation. All valves close by rotating the handwheel clockwise and open by rotating counter-clockwise. The position of the valve can be noted using the position indicator provided on the stem protector or valve yoke. The number of turns will depend on the gear unit used



**Figure 10 - Open - Close Direction**

Forcing the hand wheel, Chain wheel or nut against the stops will not provide tighter shutoff of the valve and may damage the gear unit

### Electric Actuator

It gives multi-turn output and is either directly mounted on the valve or on the gear unit or directly. The actuator drives the gear unit shaft which in turn rotates the stem nut and because of this gate / globe valve stem travels linearly. Electrically actuated valves are provided with declutching mechanism for manual operation of the valve. For electric actuators, L&T Valves recommends to strictly adhere to the instructions as per actuator's manual. Actuator settings are done at factory and normally resetting at site will not be required.

In Flex Wedge Gate and Globe valves, electrically actuated valves shall be set as below

Open : Limit  
Close : Torque

In Parallel Slide Gate valves, electrically actuated valves shall be set as below

Open : Limit

Close : Limit

### Pneumatic / Hydraulic Actuator

Pneumatic/hydraulic actuators are fitted directly on the valve, without separate gear unit. It is recommended to strictly adhere to the instructions as per actuator manual.

In case, valves are supplied as bare stem, as per customer requirement, ensure that connecting devices for actuators do not exert any axial or radial loads on the valve stem, as it may lead to bending of the stem and excessive loading on the disc. This in turn can cause the torque to increase and may lead to problem in valve operation

## Do's and Don'ts

### Do's

Before taking valve for erection, make sure that is cleaned properly from inside and outside and there are no foreign particles or metallic chips sticking on to sealing element.

While installing the operator, make sure that the valve is in fully closed position.

Make sure to remove the entire rust preventive on the machined surface in the flow area before a valve is put in the pipe line.

Carefully read the identification plate details and install the valve in the right place and for the correct duty conditions for which it is designed and manufactured. Gate with pressure relief arrangement, will have preferred sealing direction marked by an arrow on the valve body beneath the identification plate.

Make sure to supply rated voltage and frequency to the electrical actuator.

Wear all necessary protective equipment before installing the valve.

Checks tag number plate of valves before installation.

### Don'ts

DO NOT lift the valve by the handwheel, gear box, actuator or bypass arrangement.

DO NOT use the lifting points located on the Gear unit / actuator, if any, to lift the valve. These lifting points are for the Gear unit / actuator only.

DO NOT over-tighten packing gland nuts. Over-tightening will increase the torque required to operate the valve.

DO NOT operate electrically operated valves from fully open or fully closed position for initial starting. Make sure to bring them to mid-travel position by hand operation and check phase for reversal, if any, correct the phase reversal immediately. Note that none of the safety devices like limit switch, torque switch etc., will be effective in case of wrong phase connecting to the actuator.

DO NOT install a valve in the pipe line without the operating mechanism.

DO NOT keep the gate valves in partial open condition to regulate flow.

DO NOT keep valve in open condition before installation.

### Do's

Check operation (Open/Close) of valves before installation.

Remove paper cover provided on stem before operating the valve.

Check and ensure that gland bolts are not loose before pressurizing the valve.

Never remove or maintain a valve or joint unless the line fully depressurized and drained.

Always operate the valve to open position to ensure that no trapped pressure exists within the cavity.

Visually check and clean seat area if required (seat ring/disc) before installation.

### Don'ts

DO NOT use force multiplying devices like levers or pulleys. In case a valve demands excessive operating torque, make sure there is no artificial obstruction in the pipe line or in the operating mechanism.

DO NOT use impacting devices to tighten up the bolting on the body / yoke. Use suitable mechanical devices for tightening.

DO NOT disturb factory settings of actuator.  
DO NOT disturb the stem stopper setting in parallel slide gate valves.

DO NOT remove operating mechanism from the valve when the disc is partially open & not under flow conditions.

DO NOT keep the valves with end cover removed and store the valve in open yard and sand environment.

DO NOT loosen / over tight fasteners in gland & fasteners used for bonnet preloading.

DO NOT apply excessive torque in parallel slide gate valves to arrest leakage. Parallel slide gate valves are position seated and over torqueing does not help to achieve better leak tightness.

## Maintenance Introduction

For enhanced life of the valve and better operability, it is recommended to do a periodic inspection and maintenance of the valves as per the procedure explained below:

The frequency of observation depends on its application. L&T Valves recommends that valve shall be inspected every 50 cycles or three months (whichever earlier) for smooth operation and leak free performance. This is recommended even for stored valves also. It is advisable to maintain a record of the performance of the valve.

## Safety Procedure

Always depressurize the pipeline when taking up any maintenance activity on the valve/ actuator. Always disconnect the electrical supply to the electrical actuator before carrying out any maintenance activity on the valve/actuator.

Study carefully and understand the instructions outlined in the installation, operation & maintenance manual of the valve & actuator before taking up any maintenance.

## Routine Maintenance

The following activities can be carried out during the routine maintenance of the valves.

Item to Inspect	Gate	Globe / Stop Check	Check
Check for Gland leaks	✓	✓	-
Check for Pressure Seal Gasket leaks	✓	✓	✓
Check Stem threads for Wear	✓	✓	-
Ensure Stem and seal areas are free from debris	✓	✓	-
Check all lubrication points	✓	✓	-
Check condition of Gear Unit / Actuator (if used)	✓	✓	-
If conditions permit, operate valve	✓	✓	-
Inspect valve for obvious damage	✓	✓	✓
Inspect all external connections	✓	✓	✓

## Gland Leak

Check the tightness of the gland nuts and tighten evenly if required. If the leak persists, the packing shall be renewed. The pipeline shall be shut off so that there is no pressure inside the valve before the gland nuts are loosened. It shall also be noted that the valve should be able to operate freely at all times. If the valve cannot operate due to excessive packing force, the packing has become worn and must be replaced during a system shutdown.

**Caution:** Do no overstress the bolting.

**Caution:** Do not attempt to replace gland packing when the line is under pressure.

## Pressure Seal Gasket leak

The possibility of leak in this type of pressure seal bonnet is remote. It is recommended to retighten the pressure seal gasket once the valve is taken to operating pressure and temperature. Once torqued at operating pressure and temperature, sustained sealing can be achieved. However, bolt load may be lost due to pressure and temperature fluctuations. Hence the gasket bolt load shall be checked once in every 6 months as part of routine maintenance and re-torqued if required. The bonnet bolting is provided with live loading using a pair of disc springs to retain the bolt loads.

For metal gasket, use the torque values provided in Table 1, irrespective of valve pressures and temperatures.

For graphite gasket use the torque values provided in Table 1, if the valve is not pressurized. If the valve is under operating conditions (pressure and temperature), use of 50% of the torque values provided in Table 1 is sufficient.

If persistent leak is found, the gasket must be renewed (refer Gasket Replacement Procedure section).

## Gear Unit

Gear operated valves are fitted with enclosed water tight bevel gear units. Generally the gear units are filled with grease (ZENITH EPSB-1 or equivalent). They do not require any additional maintenance. However in case extreme difficulty of operation, remove the top cover and refill the grease.

In case of actuator operated valves, the actuator shall also be operated to check smooth operation.

## Lubrication

Grease the stem and stem nut threads in gate and globe valves periodically to reduce wear, operating torque, and to deter corrosion. Care shall be taken to ensure that only the threaded portion of the stem is lubricated. Following are the lubrication compounds recommended.

Components	Recommended Compound
Threaded area of stem/ stem nut (yoke sleeve) and seating area of yoke sleeve	Copper gel or equivalent
Threaded area of studs and retaining face of bolts, screws and nuts	Molykote 1000 or equivalent

## Dismantling and Assembly Procedure

### Front Sectional Views of Pressure Seal Valves

Typical front sectional views of various types of pressure seal valves are shown in figures 11 through 17. It shall be noted that there are 3 different types of pressure seal bonnets in gate and globes valves.

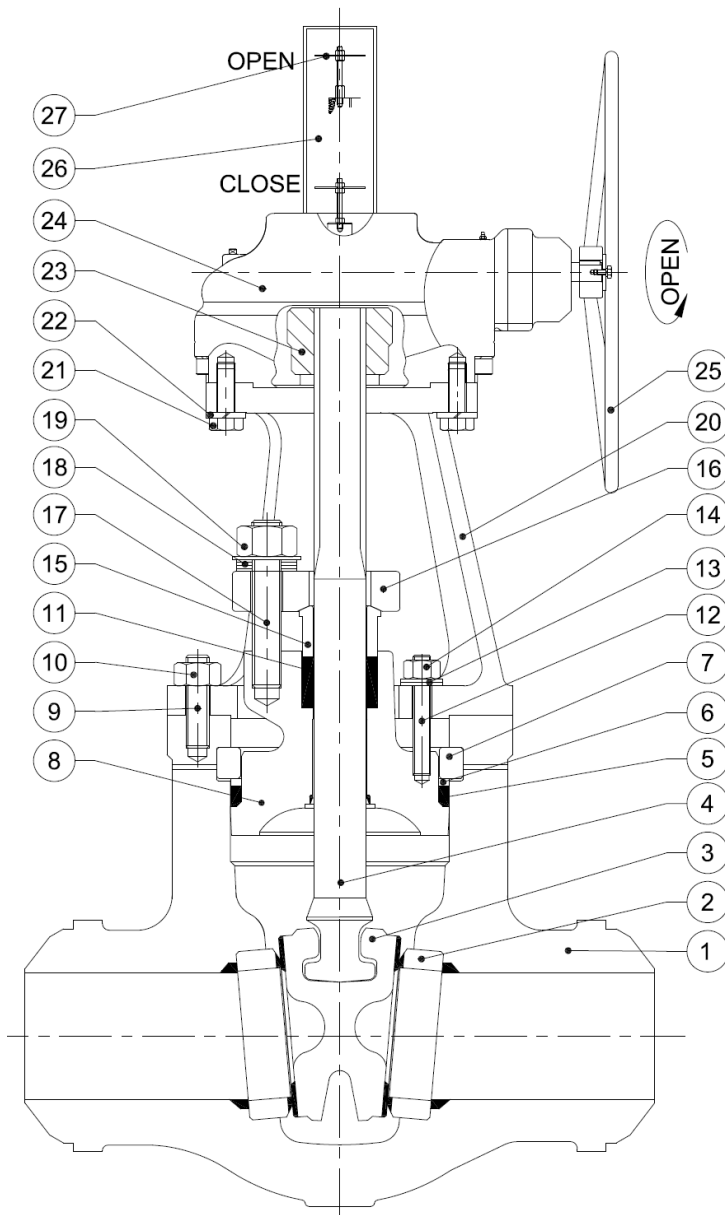
- 1) Standard bonnet with 2 gland bolting
- 2) Standard bonnet with 4 gland bolting
- 3) Compact bonnet with 4 gland bolting

It shall be noted that the gate and globe valves can be either direct hand wheel operated or gear unit operated.

- Figure 11 shows front sectional view of flexible wedge gate valve with standard bonnet with 2 gland bolting and gear unit operated.
- Figure 12 shows front sectional view of parallel slide gate valve with standard bonnet with 4 gland bolting and gear unit operated.
- Figure 13 shows front sectional view of Y-Pattern globe valve with standard bonnet with 2 gland bolting and direct hand wheel operated.
- Figure 14 shows front sectional view of T-Pattern globe valve with compact bonnet with 4 gland bolting and gear unit operated.
- Figure 15 shows front sectional view of swing check valve with internal hinge construction.
- Figure 16 shows front sectional view of tilting disc check valve.
- Figure 17 shows front section view and top view of swing check valve with hydraulic dashpot.

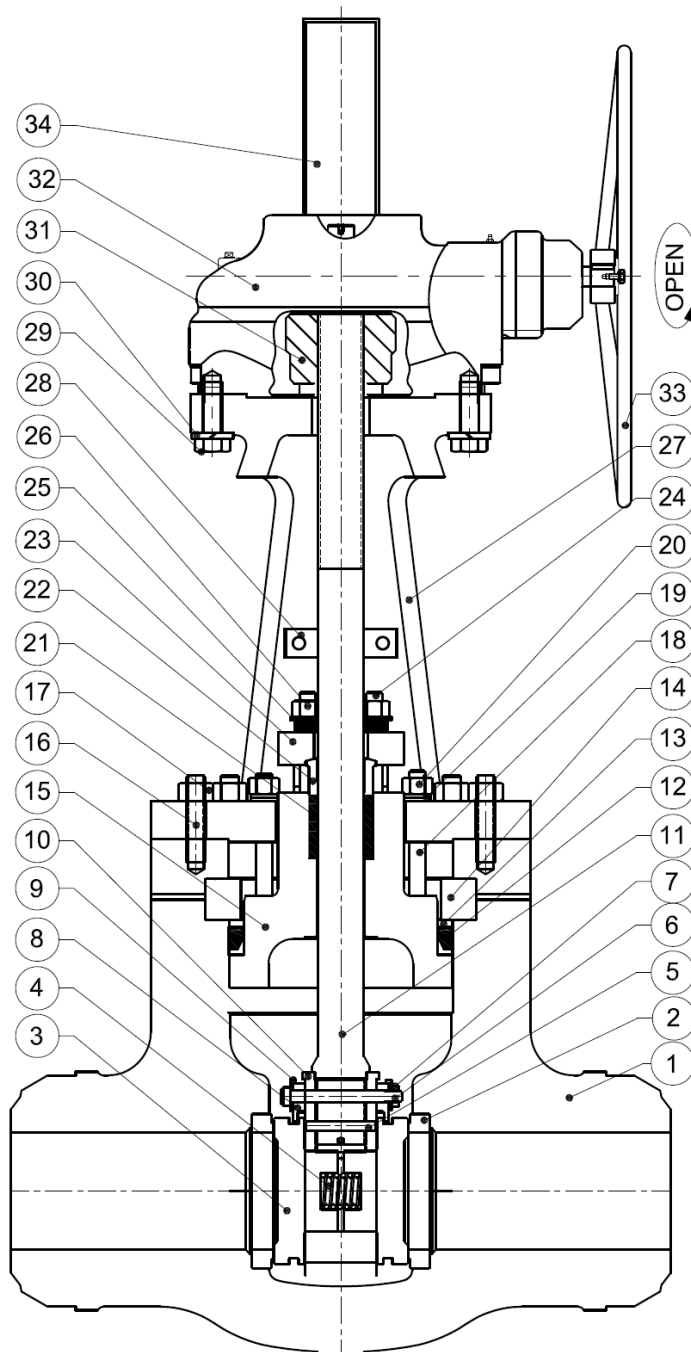
It shall be noted that figures shown are typical and other combinations also exist, i.e. flexible wedge gate valve and globe valve with compact bonnets, parallel slide gate valve with standard bonnet with 2 gland bolting, gate valve with compact bonnets, gate valve with direct hand wheel operated, etc. Refer GAD for specific valve construction details. Kindly note that the live loading arrangement shown in the gland bolting is not provided by default in all the valves.





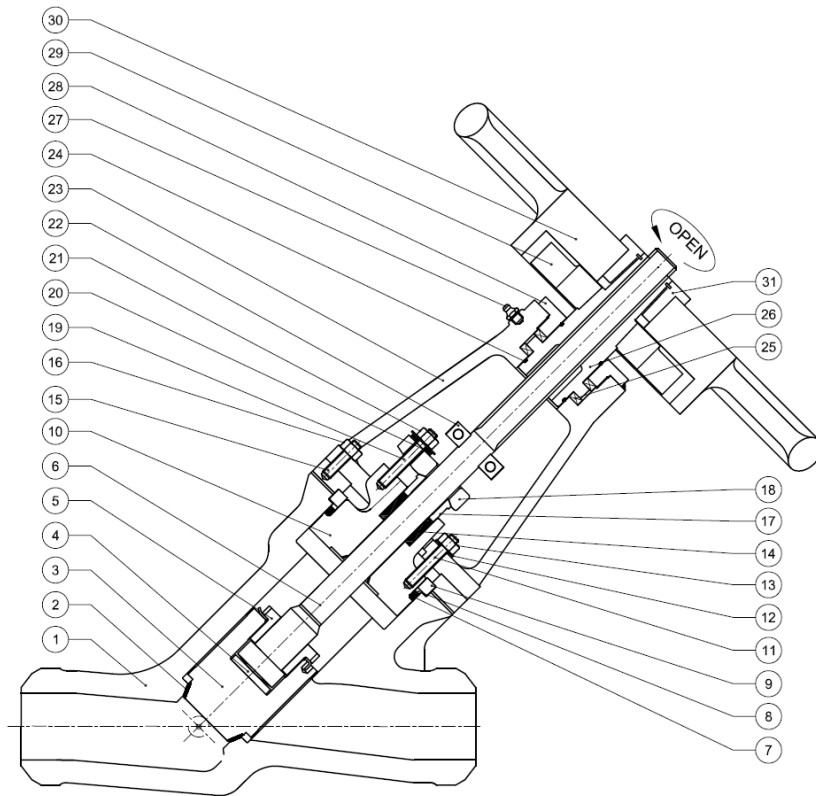
ITEM No	DESCRIPTION
1	BODY
2	SEAT RING
3	WEDGE (DISC)
4	STEM
5	GASKET
6	SPACER
7	SEGMENTAL RETAINER
8	BONNET
9	STUD (BODY-YOKE)
10	NUT (BODY-YOKE)
11	PACKING
12	STUD (BONNET-YOKE)
13	DISC SPRING
14	NUT (BONNET-YOKE)
15	GLAND
16	GLAND FLANGE
17	GLAND STUD
18	DISC SPRING
19	GLAND NUT
20	YOKE
21	HEX SCREW
22	SPRING WASHER
23	STEM NUT (DRIVE BUSH)
24	GEAR UNIT
25	HANDWHEEL
26	STEM PROTECTOR
27	POSITION INDICATOR
	IDENTIFICATION PLATE

**Figure 11 - Pressure Seal Flexible Wedge Gate Valve**  
 (standard pressure seal bonnet with 2 gland bolting, gear unit operated)



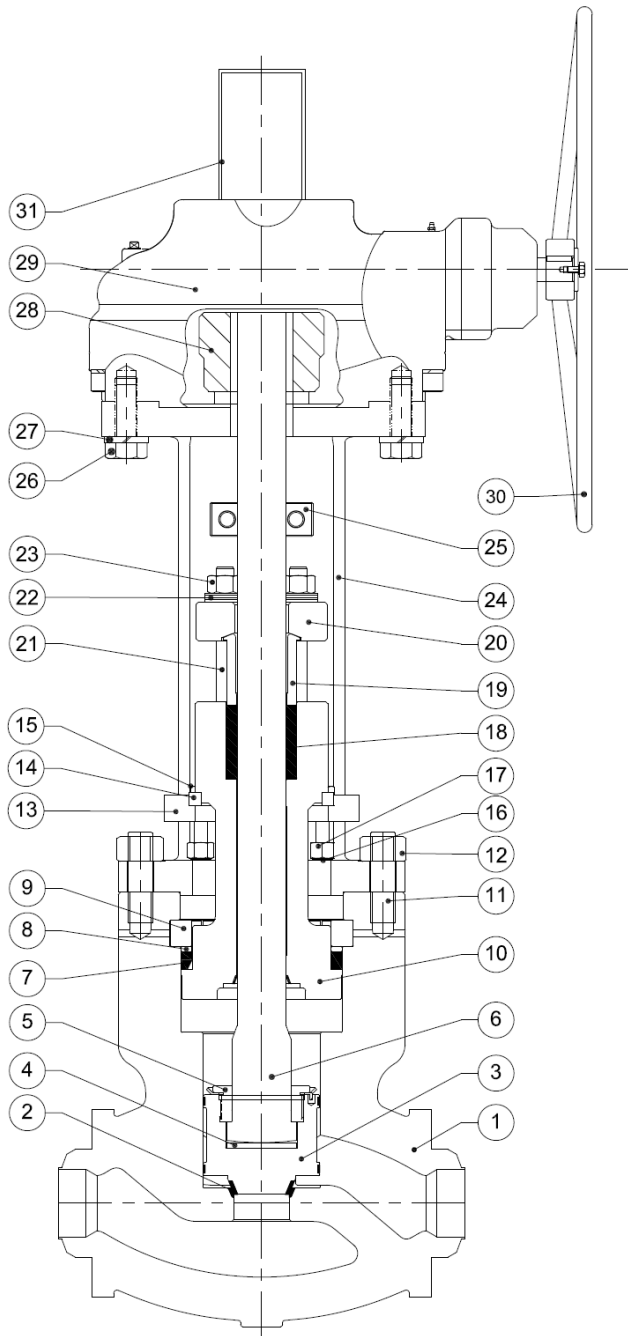
ITEM No	DESCRIPTION
1	BODY
2	SEAT RING
3	DISC
4	SPRING
5	PIN
6	HEX BOLT
7	HEX NUT
8	LIMIT PIECE
9	TAB WASHER
10	DISC CARRIER
11	STEM
12	GASKET
13	SPACER
14	SEGMENTAL RETAINER
15	BONNET
16	STUD (BODY-YOKE)
17	NUT (BODY-YOKE)
18	STUD (BONNET-YOKE)
19	DISC SPRING
20	NUT (BONNET-YOKE)
21	PACKING
22	GLAND
23	GLAND FLANGE
24	GLAND STUD
25	DISC SPRING
26	GLAND NUT
27	YOKE
28	GUIDE PLATE
29	HEX SCREW
30	SPRING WASHER
31	STEM NUT (DRIVE BUSH)
32	GEAR UNIT
33	HANDWHEEL
34	STEM PROTECTOR
	IDENTIFICATION PLATE

**Figure 12 - Pressure Seal Parallel Slide Gate Valve**  
(standard pressure seal bonnet with 4 gland bolting, gear unit operated)



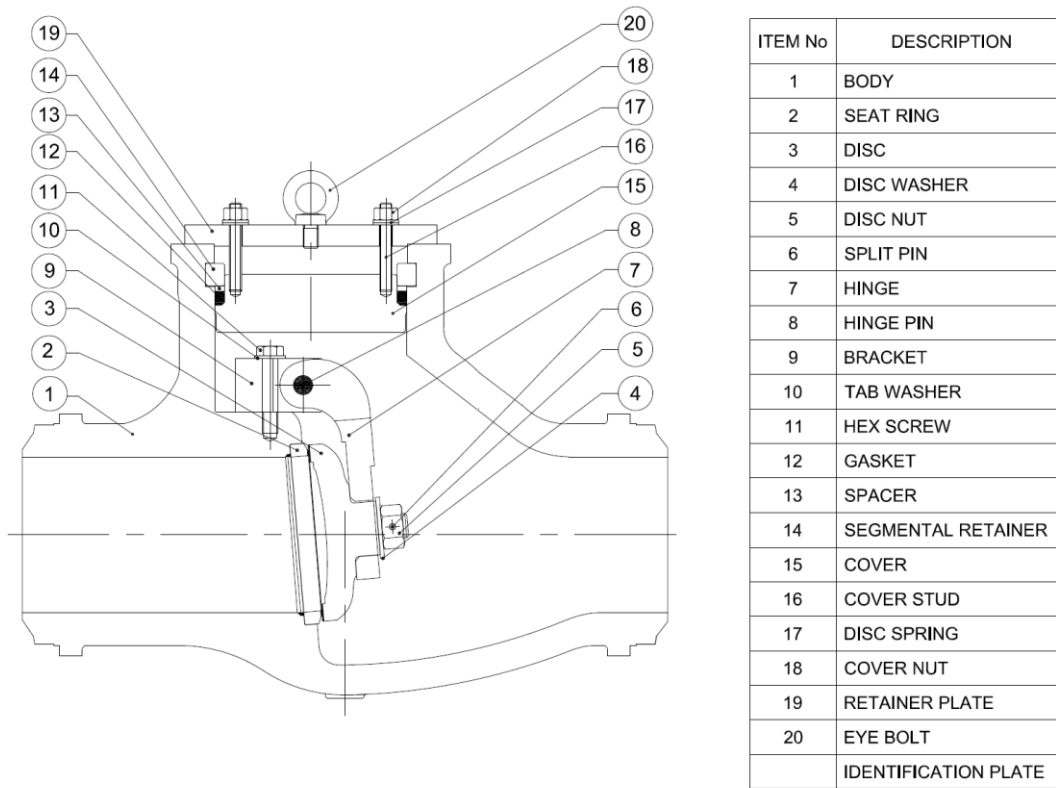
ITEM No	DESCRIPTION
1	BODY
2	SEAT RING (INSITU)
3	DISC
4	DISC WASHER
5	DISC NUT
6	STEM
7	GASKET
8	SPACER
9	SEGMENTAL RETAINER
10	BONNET
11	STUD (BONNET-YOKE)
12	DISC SPRING
13	NUT (BONNET-YOKE)
14	PACKING
15	STUD (BODY-YOKE)
16	NUT (BODY-YOKE)
17	GLAND
18	GLAND FLANGE
19	GLAND STUD
20	DISC SPRING
21	GLAND NUT
22	GUIDE PLATE
23	YOKE
24	O-RING
25	BEARING
26	STEM NUT (YOKE SLEEVE)
27	GREASE FITTING
28	RETAINER NUT
29	ADAPTOR
30	HANDWHEEL
31	HANDWHEEL NUT
	IDENTIFICATION PLATE

**Figure 13 - Y-Pattern Pressure Seal Globe Valve**  
 (standard pressure seal bonnet with 2 gland bolting, hand wheel operated)

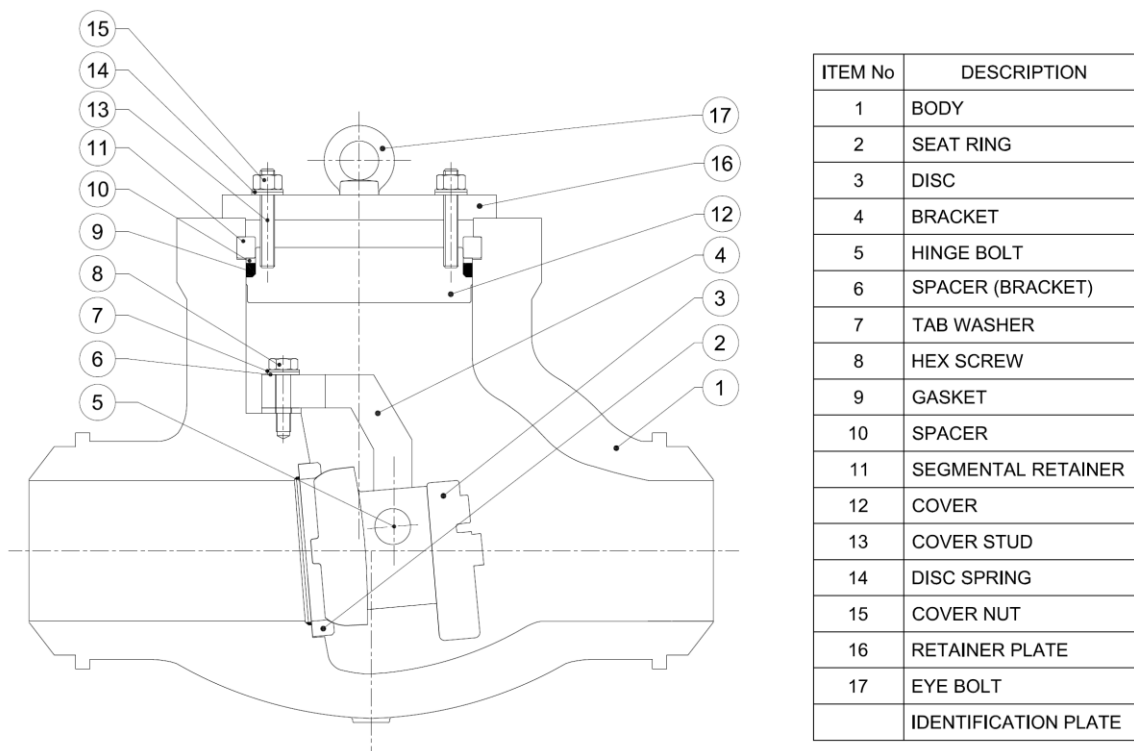


ITEM No	DESCRIPTION
1	BODY
2	SEAT (INSITU)
3	DISC
4	DISC WASHER
5	DISC NUT
6	STEM
7	GASKET
8	SPACER
9	SEGMENTAL RETAINER
10	BONNET
11	STUD (BODY-YOKE)
12	NUT (BODY-YOKE)
13	BONNET RETAINER
14	SPLIT RING
15	HEX SCREW (BONNET-YOKE)
16	DISC SPRING
17	NUT (BONNET-YOKE)
18	PACKING
19	GLAND
20	GLAND FLANGE
21	GLAND STUD
22	DISC SPRING
23	GLAND NUT
24	YOKE
25	GUIDE PLATE
26	HEX SCREW
27	SPRING WASHER
28	STEM NUT (DRIVE BUSH)
29	GEAR UNIT
30	HANDWHEEL
31	STEM PROTECTOR
	IDENTIFICATION PLATE

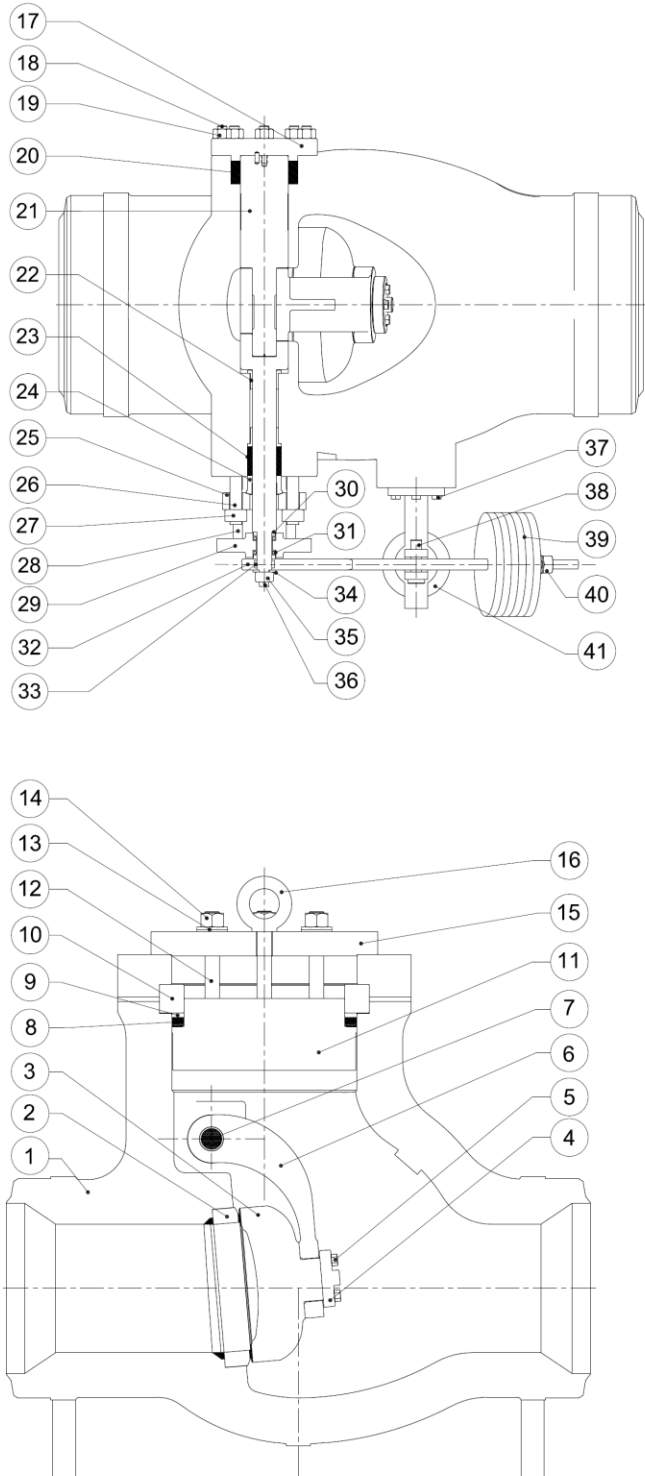
**Figure 14 - T-Pattern Pressure Seal Globe Valve**  
(compact pressure seal bonnet with 4 gland bolting)



**Figure 15 - Pressure Seal Swing Check Valve  
(with internal hinge)**



**Figure 16 - Pressure Seal Tilting Disc Check Valve**



ITEM NO	DESCRIPTION
1	BODY
2	SEAT RING
3	DISC
4	DISC PLATE
5	HEX SCREW
6	HINGE
7	HINGE PIN
8	GASKET
9	SPACER
10	SEGMENTAL RETAINER
11	COVER
12	COVER STUD
13	DISC SPRING
14	COVER NUT
15	RETAINER PLATE
16	EYE BOLT
17	END PLATE
18	STUD (END PLATE)
19	NUT (END PLATE)
20	PACKING
21	SUPPORT SHAFT
22	HINGE BUSH
23	PACKING
24	GLAND
25	GLAND FLANGE
26	GLAND STUD
27	GLAND NUT
28	PILLAR
29	YOKE PLATE
30	THRUST WASHER
31	THRUST BEARING
32	LEVER ARM
33	KEY
34	WASHER
35	HEX NUT
36	SPLIT PIN
37	HEX SCREW
38	CLEVIS PIN
39	COUNTER WEIGHT
40	HEX NUT
41	HYDRAULIC DASHPOT
	IDENTIFICATION PLATE

**Figure 17 - Pressure Seal Swing Check Valve  
(with hydraulic dashpot)**

- All valves are designed to permit inspection without removing the body from the pipeline. The section of the pipe must be shut off and pressure is fully reduced before dismantling the valve for inspection.
- Gate and globe valves can be inspected by removing the bonnet assembly. Check valves can be inspected by removing the cover assembly.
- In the case of check valves there is no stem and hence only the cover is to be removed. The disc is hinged inside the body. For ease of illustration only the word bonnet is used in the dismantling and reassembly procedure. This may be changed to read as cover with respect to check valves.

### Disassembly of Hand wheel

- Remove grub screw from the handwheel nut. Unscrew and remove the Handwheel nut and Retainer nut.
- Remove the hand wheel.
- Unless the yoke sleeve assembly requires servicing or parts replacement, yoke sleeve assembly need not be disassembled from the yoke.
- To remove yoke sleeve assembly, remove the tab welded to yoke for retaining yoke sleeve nut.
- After removal of yoke sleeve nut, thrust bearing, yoke sleeve and O-rings can be disassembled.

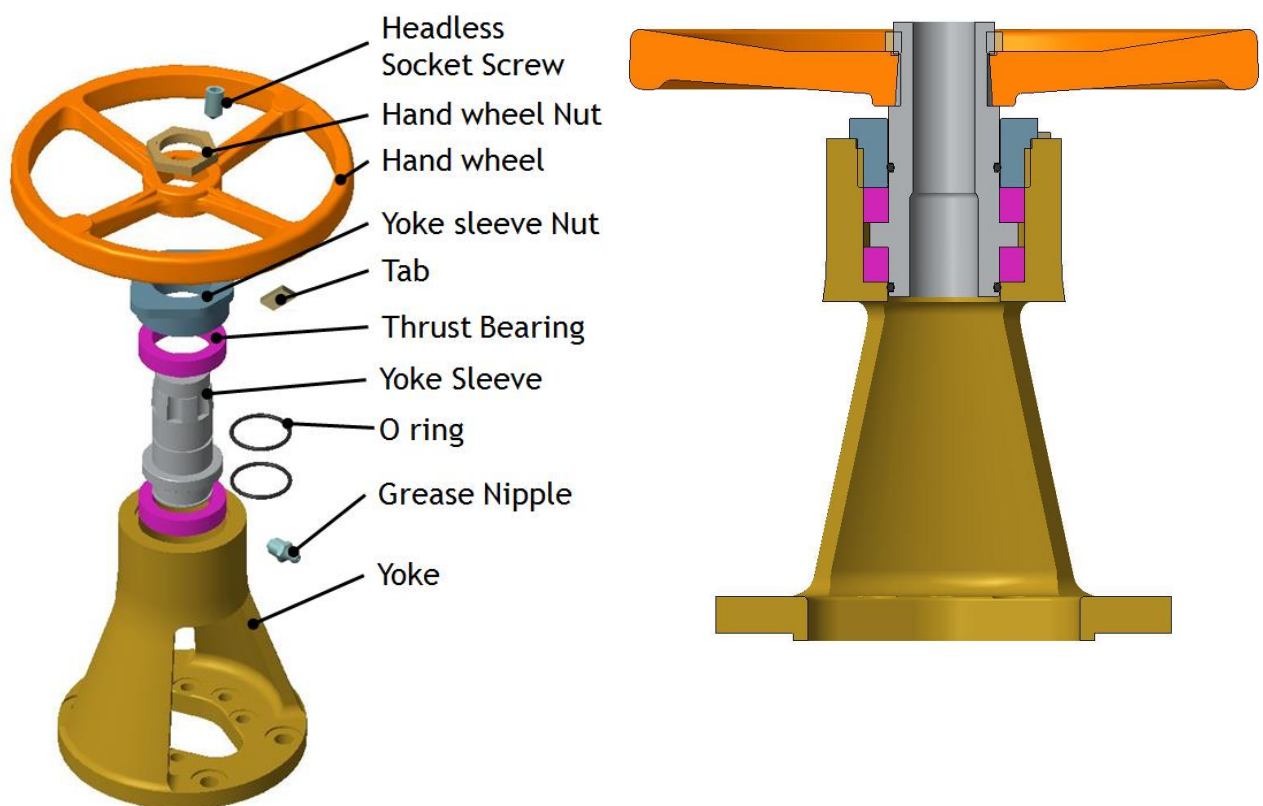
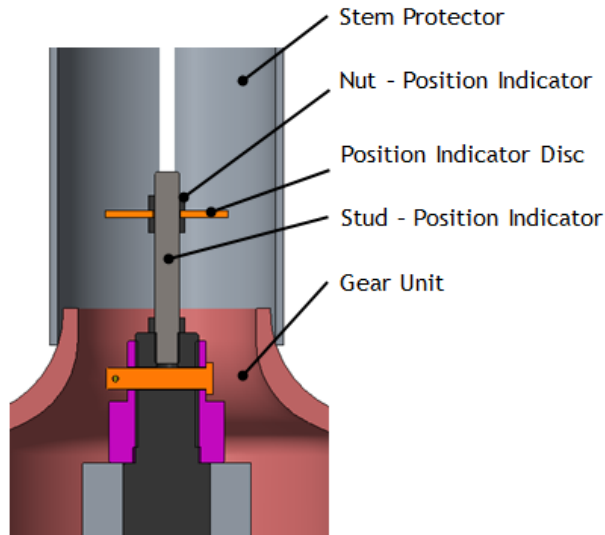


Figure 18 - Disassembly of Direct Handwheel Operated Yoke

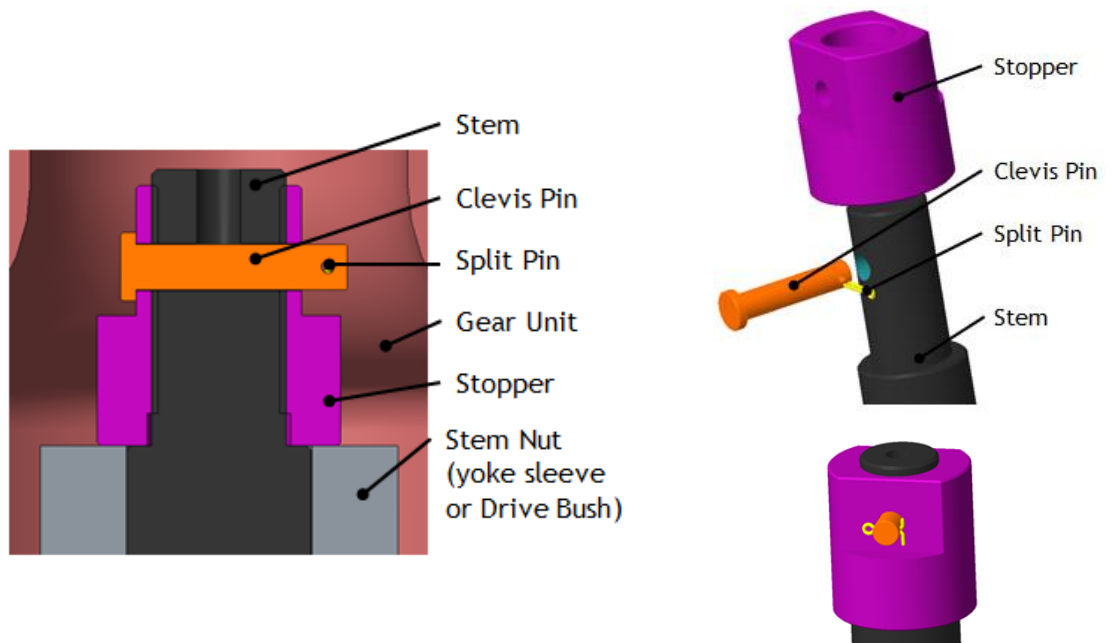
## Disassembly of Gear Unit

- Remove the position indicator stud, nuts, and disc, if any from the stem top.



**Figure 19 - Position Indication Arrangement on Stem**

- Except for parallel slide gate valves, close the valve manually by turning the gear unit handwheel. In the case of an actuator operated gear unit, close the valve using the actuator.
- In case of parallel slide gate valves, keep the valve in open position and remove the stopper, clevis pin and split pin. After removal of stopper, close the valve manually by turning the gear unit handwheel. In the case of an actuator operated gear unit, close the valve using the actuator.



**Figure 20 - Stopper Arrangement in Parallel Slide Gate Valves**



- Prepare a hoist to support the gear unit weight, so that when disengagement begins, the valve stem does not get jammed or damaged.
- Remove the Cover Tube.
- Unscrew and remove the hexagonal screws and spring washers from the yoke underside.
- Slowly turn the handwheel in the valve closing direction. In the case of an actuator operated gear unit, slowly turn the actuator handwheel manually in the closing direction.
- Continue turning the handwheel. This will cause the valve stem to unthread itself from the gear unit and it will rise from the yoke plate.
- Remove the gear unit when it is completely disengaged from the stem.

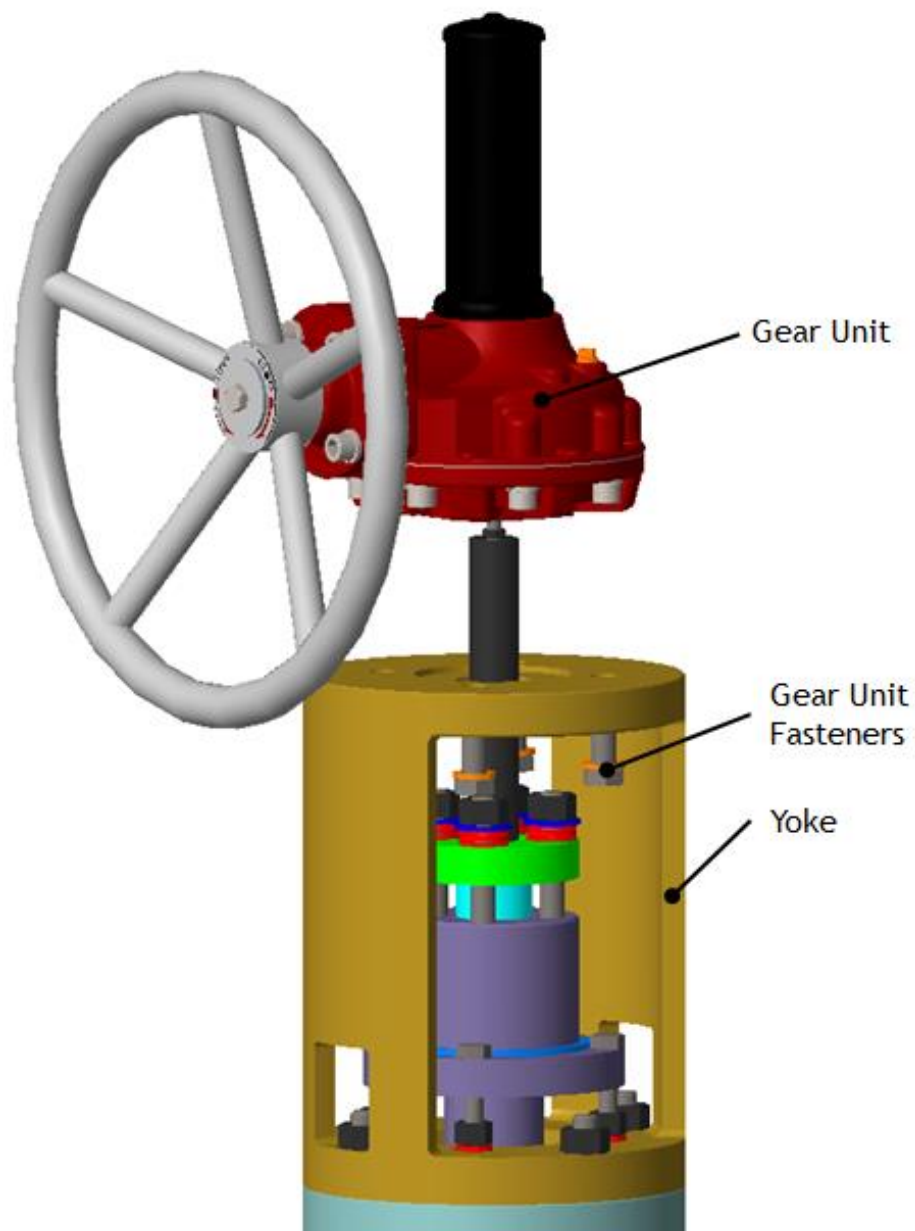


Figure 21 - Disassembly of Gear Unit from Yoke

## Disassembly of Electrical Actuator

- Turn off the electric power source and open the compartment cover of the electric actuator.
- Disconnect the outside wiring. Tag the wires during disassembly so as to ensure correct wiring during re-assembly.
- Change the actuator operation mode from motor to manual by declutching the actuator. Manually close the valve using the actuator handwheel. For parallel slide gate valves, remove the stopper arrangement before closing the valve.
- Prepare a hoist to support the actuator, so that when disengagement begins, the valve stem is not damaged by supporting the entire weight of the actuator.
- Remove the protector cap from the top of the actuator.
- For directly mounted actuators unscrew and remove the hexagonal screws and spring washers from the yoke plate underside.
- For actuators mounted to the adaptor flange of a gear unit, unscrew and remove the adaptor stud and nuts, and spring washers.
- Slowly turn the handwheel in the valve closing direction.
- Continue turning the handwheel. This will cause the valve stem to unthread itself from the actuator and the actuator will rise from the mounting flange.
- Remove the actuator when it is completely disengaged from the stem.
- Actuator setting done in factory for open/close position of Gate/Globe valves are given below.
- Actuator Setting method with respect for valve types are given below.

Valve Type	Open Position	Close Position
Flexi Wedge Gate	Limit	Torque
Globe Valve	Limit	Torque
Parallel Slide Gate	Limit	Limit

## Disassembly of Yoke in Gate and Globe Valves

- After removing the operator, check for any stem guides present between the yoke and the stem. They are to be disassembled before removing the yoke.
- Stem guides are not available in flexible wedge gate valves. They are present in all globe valves and in some parallel slide gate valves.

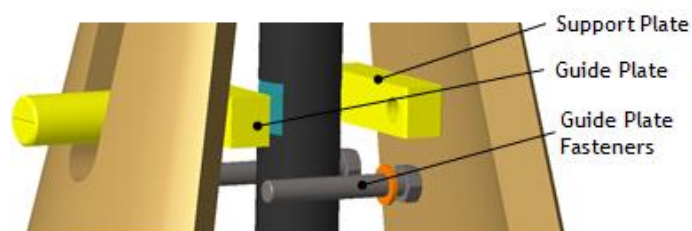


Figure 22 - Exploded View of Guide Assembly

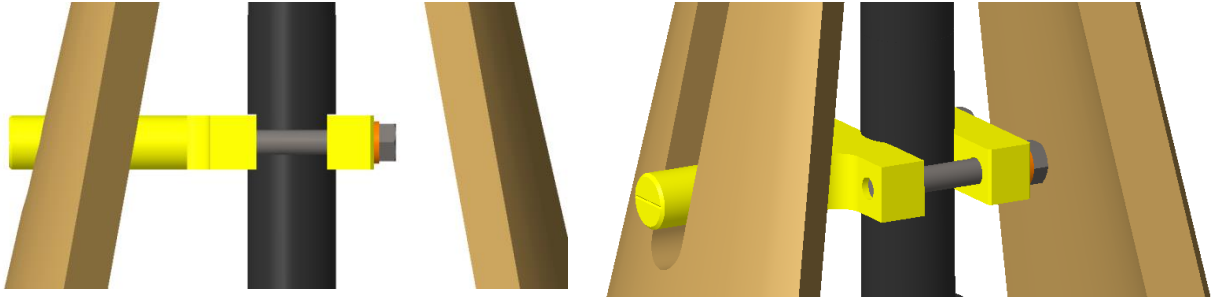


Figure 23 Guide Assembly

- Loosen and remove body-yoke bolting.
- For standard bonnets, loosen and remove bonnet-yoke bolting. It shall be noted that bonnet-yoke bolting has a live loading arrangement with disc springs. Remove the yoke from the body.
- For compact bonnets, loosen and remove the bonnet screw, nut and disc springs between bonnet retainer and yoke. Remove the split ring between bonnet and bonnet retainer. Raise and remove the yoke from the body along with bonnet retainer.

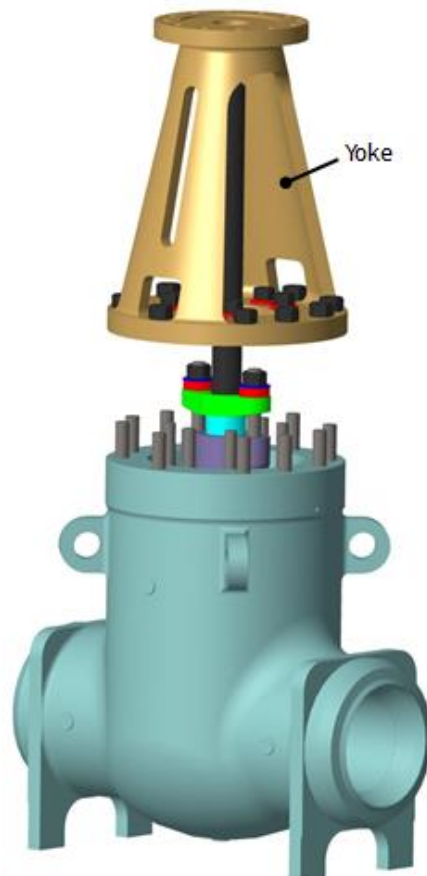


Figure 24 - Disassembly of Yoke in Standard Bonnet Valves

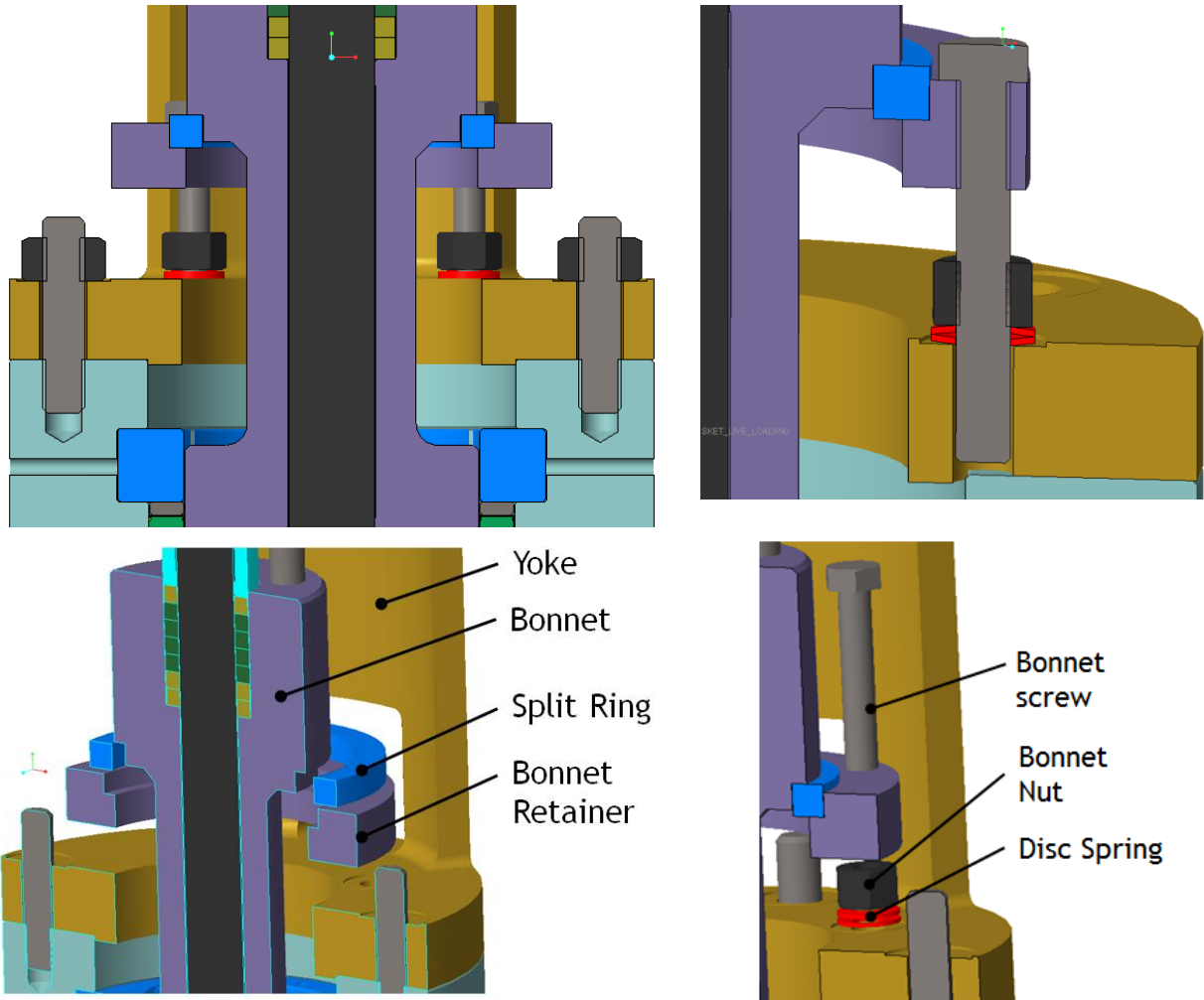


Figure 25 - Disassembly of Yoke in Compact Bonnet Valves

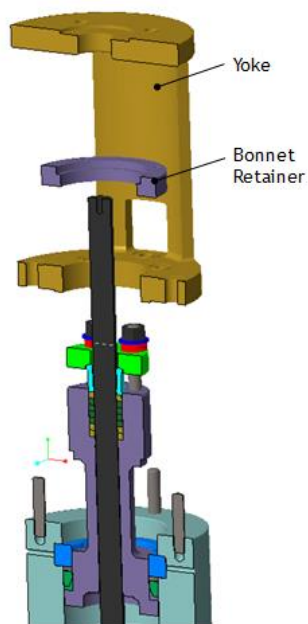


Figure 26 - Disassembly of Yoke in Compact Bonnet Valves

## Disassembly of Retainer Plate in Check Valves

- Loosen and remove retainer plate - cover bolting. It shall be noted that retainer plate - cover bolting has a live loading arrangement with disc springs. Remove the retainer plate from the body.

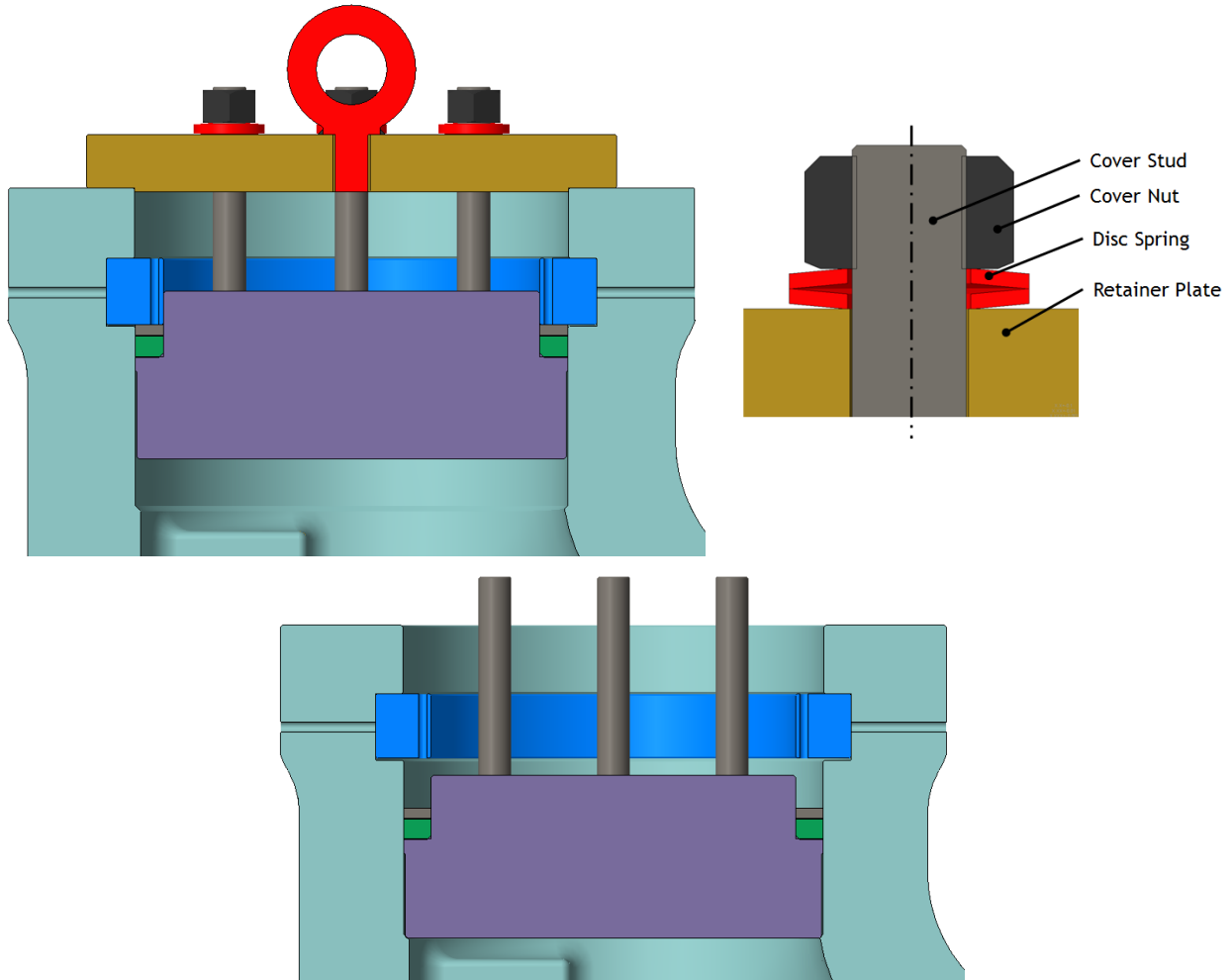
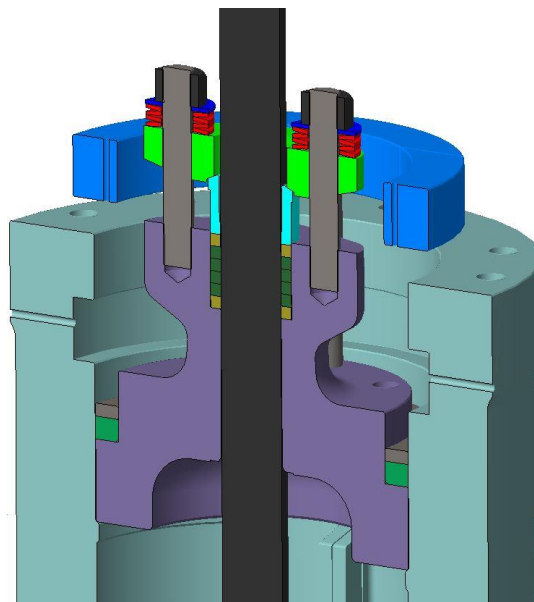
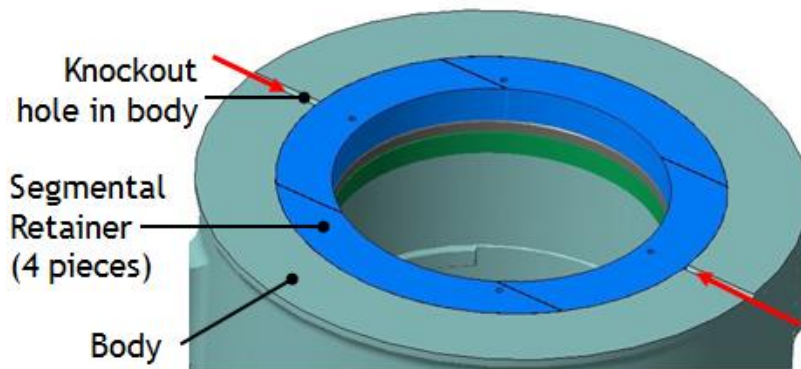
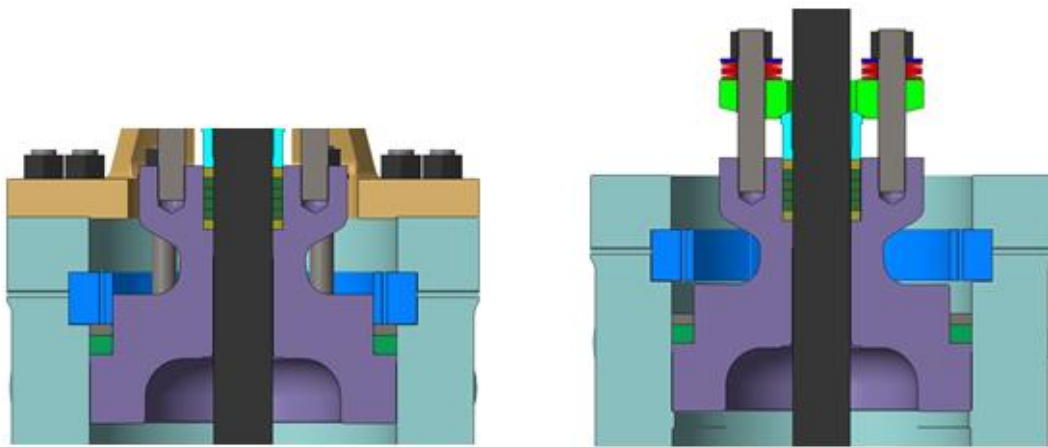


Figure 27 - Disassembly of Retainer Plate in Check Valves

## Disassembly of Pressure Seal Arrangement and Bonnet Subassembly

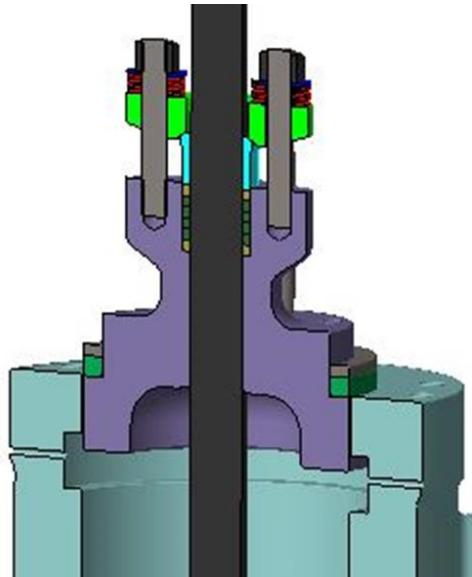
- To disassemble bonnet subassembly, segmental retainer needs to be removed. Segmental retainer is secured between the body groove and bonnet.
- Push the bonnet down, so that the segmental rings can slide over the top of the bonnet.



**Figure 28 - Disassembly of Pressure Seal Arrangement**

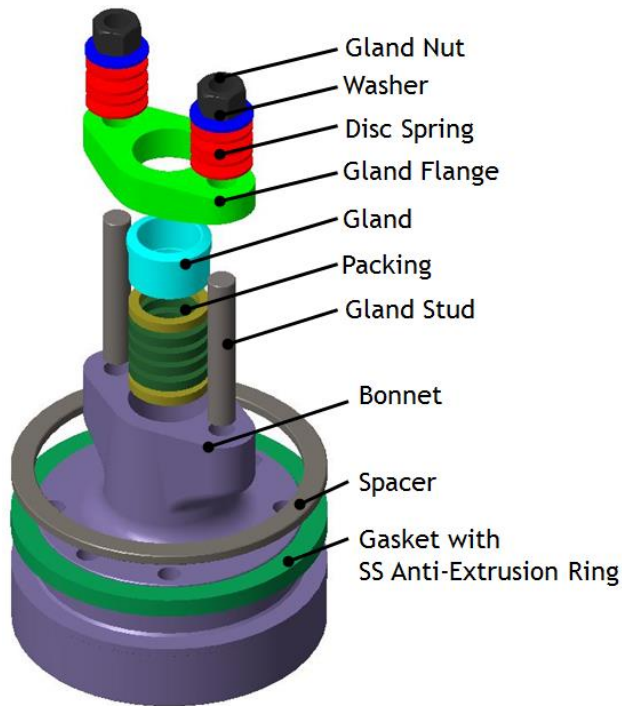
- To push the bonnet out of the body groove, 2 knockout holes are provided on the body. Drive a pin through the knock out hole and push the segmental retainer out. By rotating each segment of the retainer, all the 4 retainer segments can be taken out. To handle segmental retainer from the top, holes are provided in each segment.

- After segmental retainer is removed, bonnet subassembly can be pulled up from the body and stem along with the gland arrangement, gasket, and spacer. If required, gland bolting shall be loosened for easy movement of bonnet subassembly on the stem.

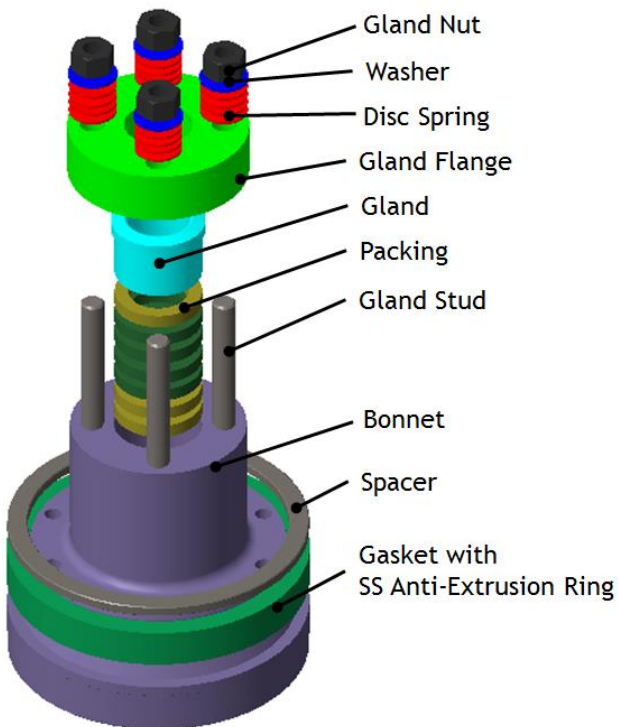


**Figure 29 - Disassembly of Bonnet**

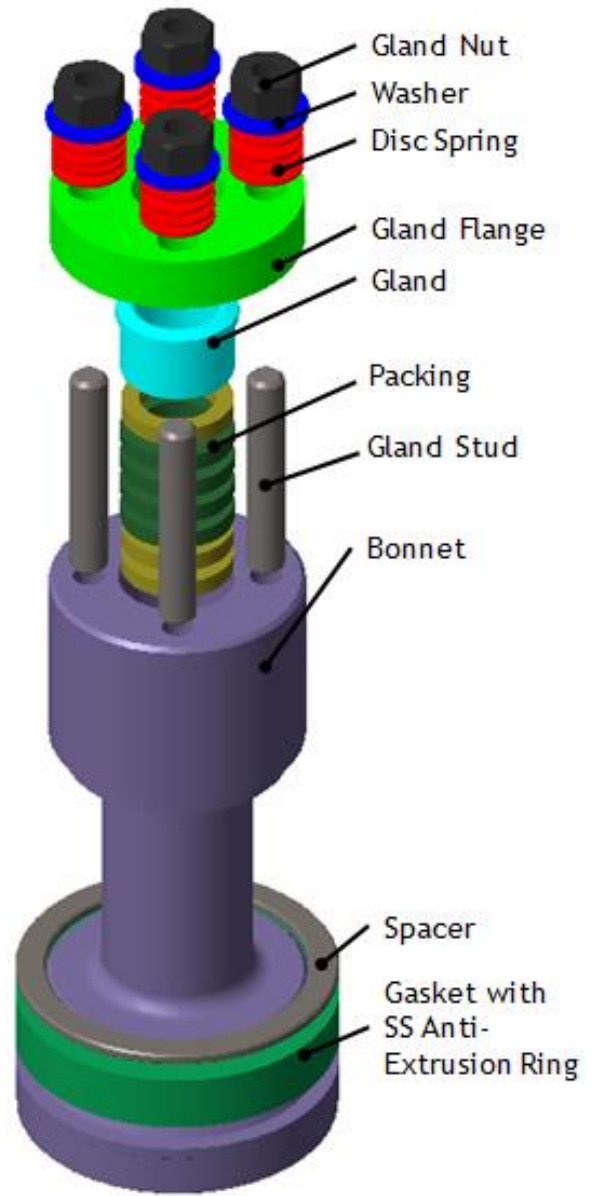
- Once the valve is opened, it is not recommended to reuse gasket and packing, which are soft components. They need to be replaced with fresh spares.
- Exploded views of 3 different types of bonnet subassemblies are shown in figure 30.



Type 1 - Standard Bonnet with 2 Gland Bolting



Type 2 - Standard Bonnet with 4 Gland Bolting



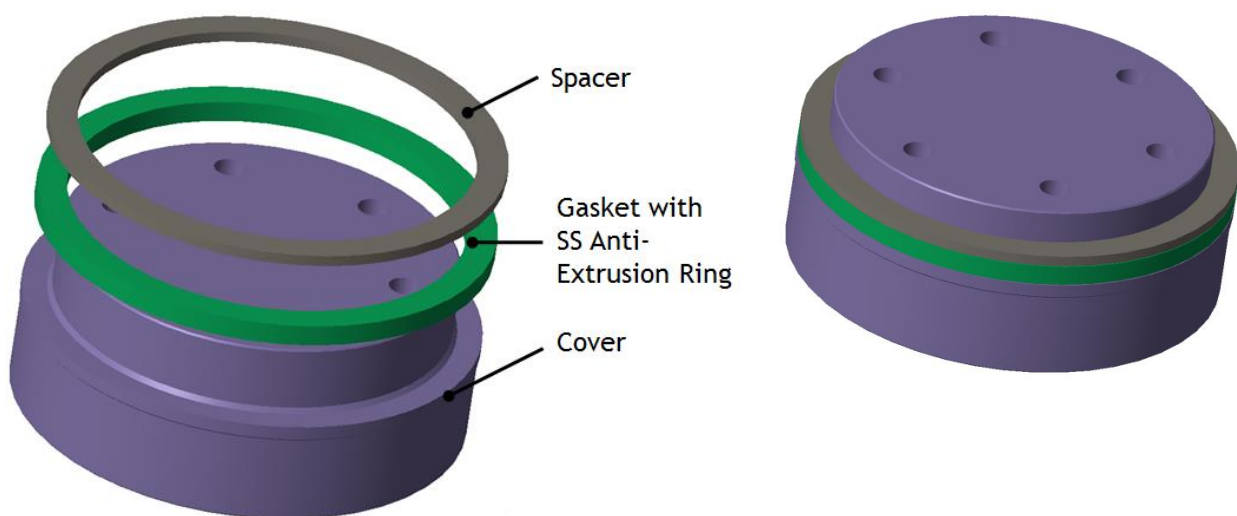
Type 3 - Compact Bonnet with 4 Gland Bolting

Figure 30 - Exploded Views of Different Types of Bonnet Subassemblies  
(Live loading disc Springs are not provided by default)



## Disassembly of Pressure Seal Arrangement and Cover subassembly in Check Valves

- Push the cover subassembly down, so that the segmental ring can slide over the top of the cover. Remove the segmental retainer as it is done for gate and globe valves.
- After segmental retainer is removed, cover subassembly can be pulled up from the body along with the gasket and spacer.
- Once the valve is opened, it is not recommended to reuse the gasket. They need to be replaced with fresh spares.



**Figure 31 - Cover Subassembly**

If the disassembly is performed only for the purpose of replacing gasket, it is not necessary to remove the stem disc assembly (or hinge disc assembly in case of check valves) from the body. Valve can be replaced with fresh gasket and assembled back without removing the stem disc assembly.

## Disassembly of Stem Disc Assembly in Flexible Wedge Gate Valves

- Lift the stem disc assembly from the body. The stem to disc connection is a loose T-Slot connection and the disc can be easily dismantled from the stem.

## Disassembly of Stem Disc Assembly in Parallel Slide Gate Valves

- Lift the entire stem disc assembly from the body. Check the disc seating surfaces and do not dismantle the assembly further unless any damage is noticed.
- The stem disc assembly of parallel slide gate valve is shown in figure 32. The two disc surfaces are held against the seating surfaces with the use of a spring (or set of 3 springs in case of some large size valves).
- To disassemble the stem disc assembly, remove the disc carrier bolt (with nut and tab washer) and the pin, connecting the stem and disc carrier. It shall be noted that some smaller sizes do

not have pin. Stem to disc carrier is a threaded connection. After removal of bolt and pin, the limit pieces, stem, disc carrier and discs can be disassembled.

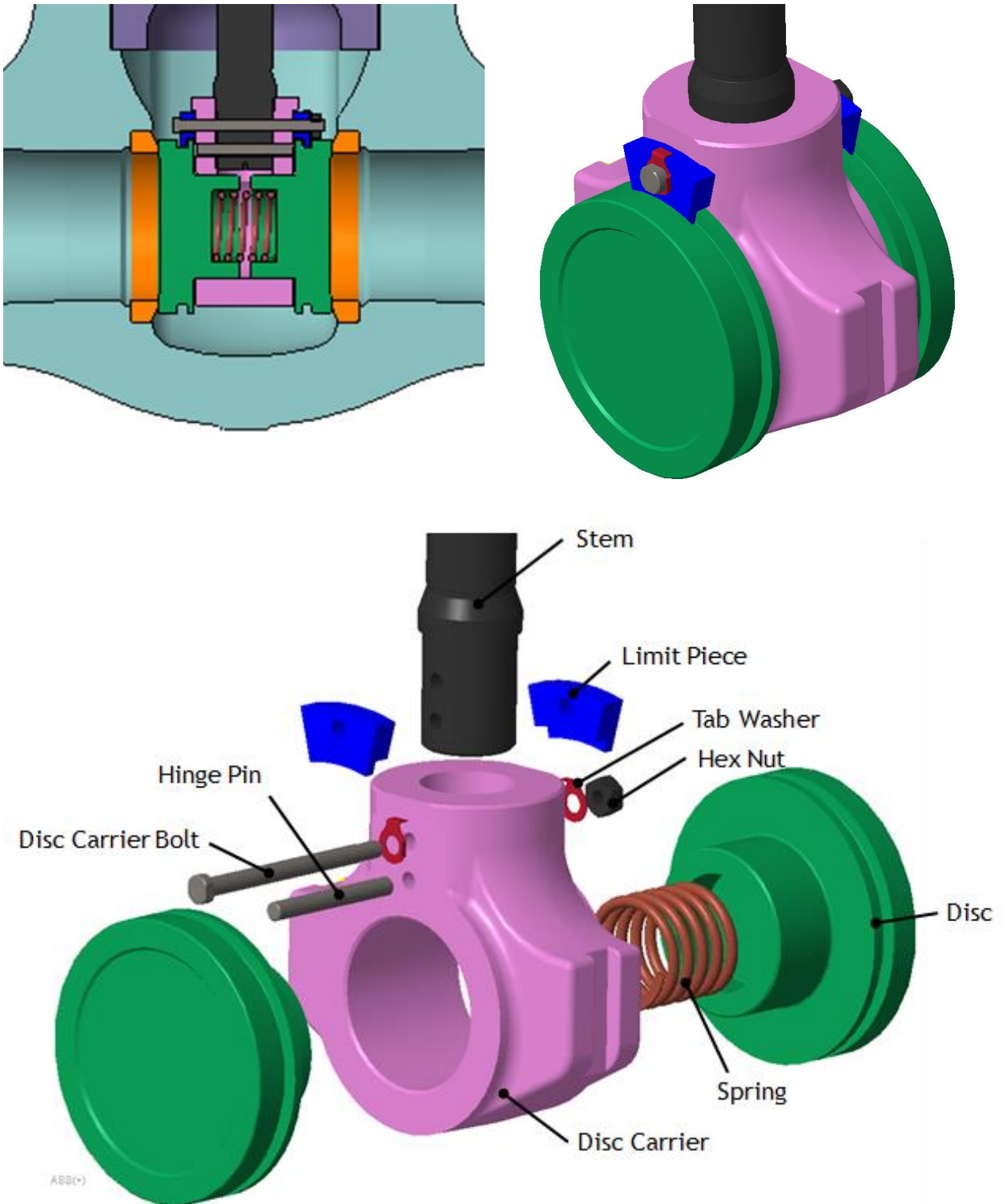


Figure 32 - Disassembly of Parallel Slide Discs

## Disassembly of Stem Disc Assembly in Globe Valves

- Lift the entire stem disc assembly from the body.
- The stem disc assembly of globe valve is show in figure 33. The disc is secured to the stem with the help of disc nut and lock washer. A disc washer is placed between the bottom of the stem and disc. The disc nut is threaded to the disc. Disc nut loosening is prevented by lock washer.
- To disassemble the stem disc assembly, remove the lock washer by unfolding and remove the disc nut from the disc.

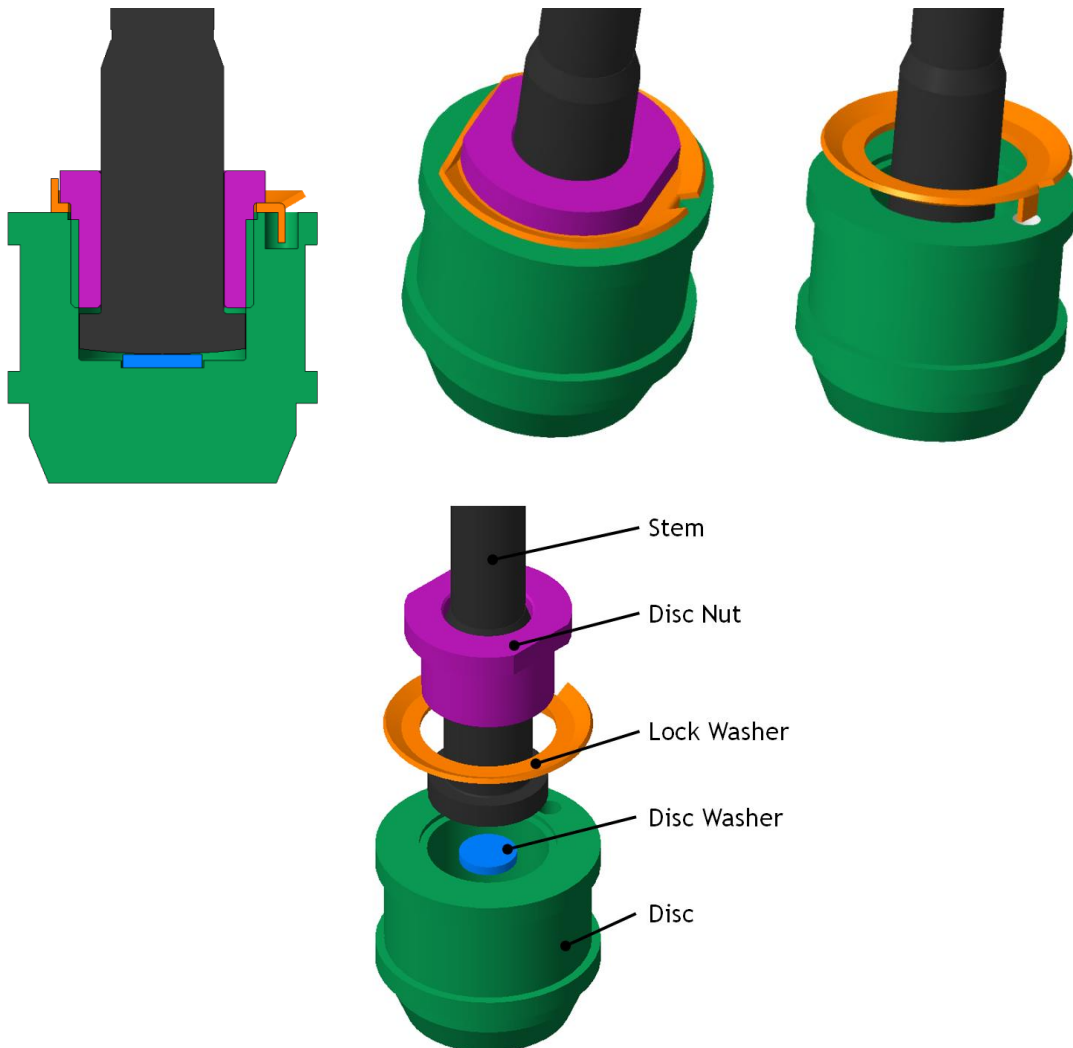


Figure 33 - Disassembly of Globe Discs

## Disassembly of Stem Disc Assembly in Stop-check Valves

- Stop-Check Valves are a modification of globe valves. By a simple modification between stem-disc connection, a combined function of isolation (Stop valve) and non-return (check valve) can be achieved. In closed position, stop-check valve isolates the flow and in open position, it acts like a check valve. Stop-Check Valves can be of either Y-Pattern or T-Pattern.
- To disassembly, remove the stem from the valve body. Remove the disc and disc washer from the valve body.

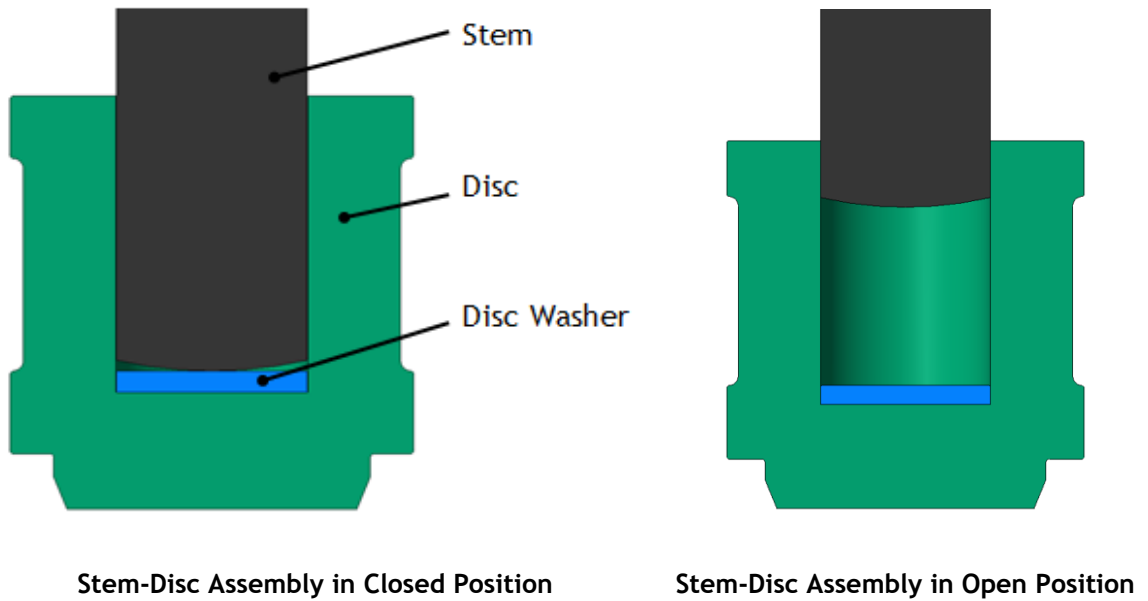


Figure 34 - Stem-Disc Assembly of Stop-Check Valve

### Disassembly of Hinge Disc Assembly in Swing Check Valves

- In swing check valves with internal hinge, hinge disc assembly is secured to the body with the help of bracket, hinge pin and screws.
- Remove the tab washer and screws connecting the bracket and body. Lift the bracket hinge disc subassembly from the body. Bracket can be separated from the hinge disc subassembly by removing the hinge pin

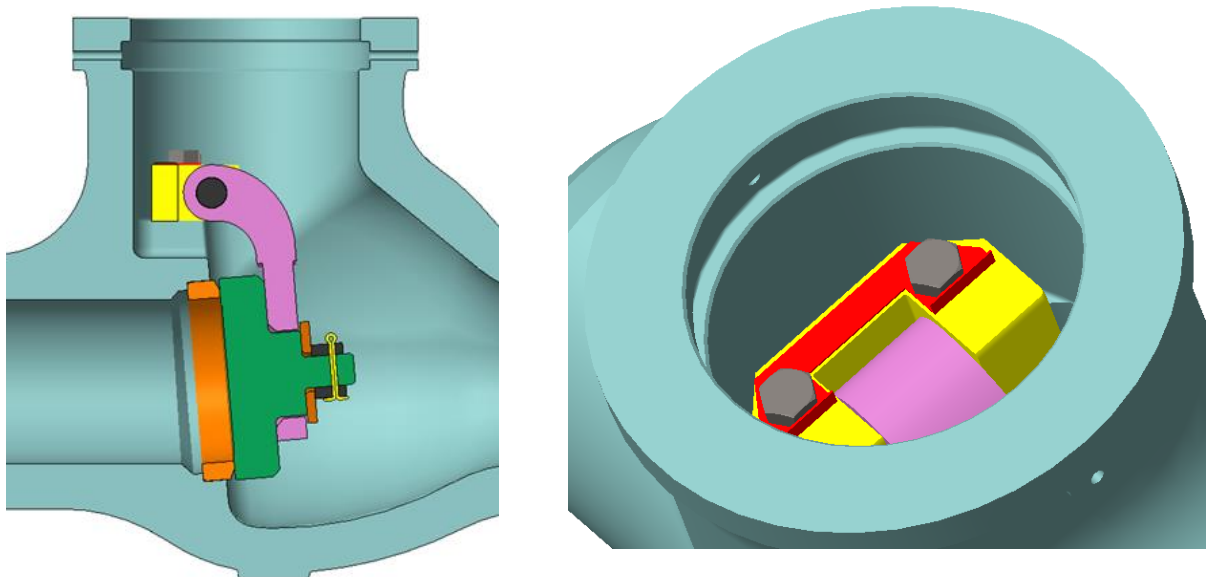
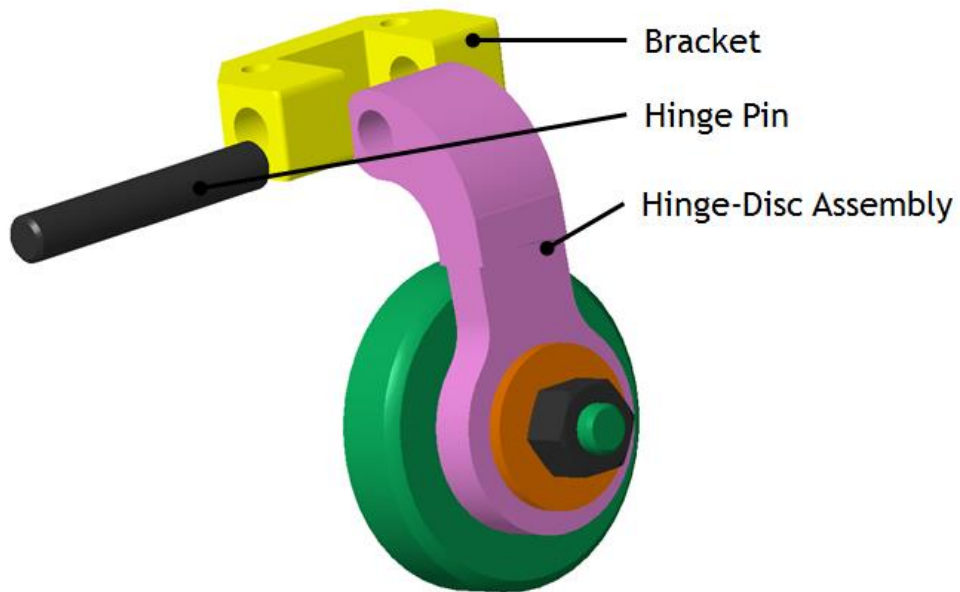
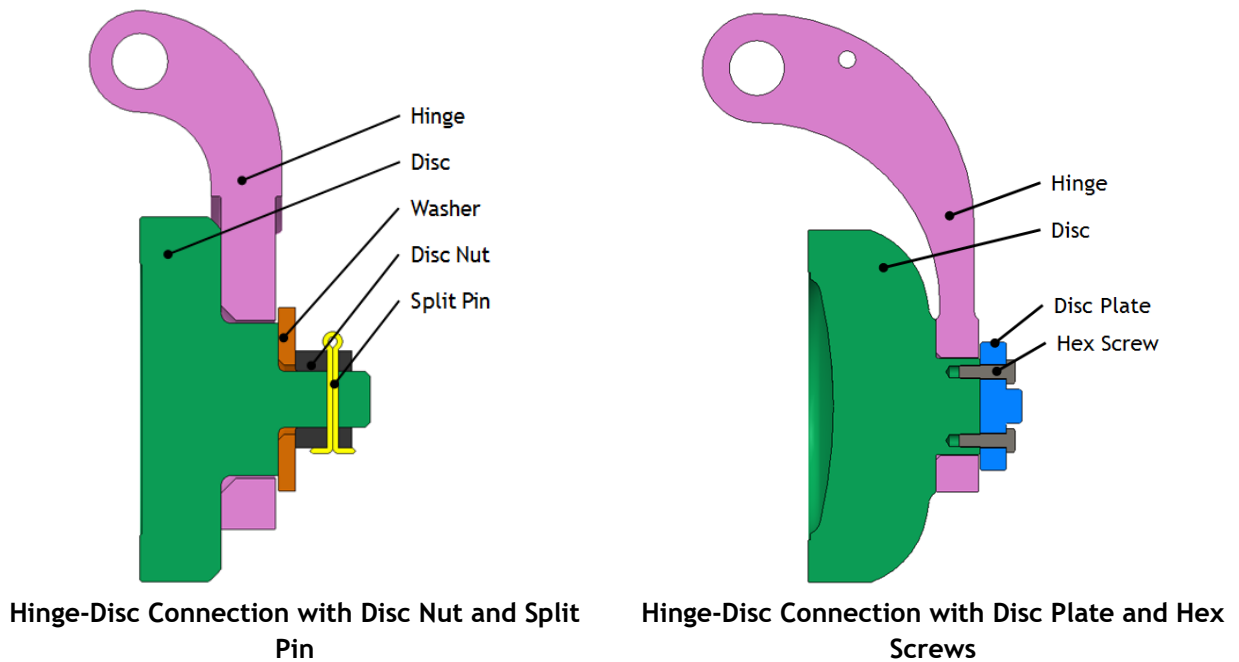


Figure 35 - Disc Assembly of Swing Check Valve



**Figure 36 - Disassembly of Swing Check Valves Disc**

- Hinge to disc assembly can be of any one of the following types
  - a) Type 1 - Hinge disc connection with disc nut and split pin
  - b) Type 2 - Hinge disc connection with disc plate and hex screws.
- In case of hinge disc connection with disc nut and split pin, remove the split pin, hex nut and washer. Disc can be disassembled from the hinge.
- In case of hinge disc connection with disc plate and hex screws, ground the tack weld between hex screw and disc plate. Remove the hex screw and disc plate. Disc can be disassembled from the hinge.



**Figure 37 - Hinge-Disc Subassembly**

## Disassembly of Hinge Disc Assembly in Tilting Disc Check Valves

- In case of tilting disc check valves, disc assembly is secured to the body with the help of bracket and screws.
- Remove tab washer and screws connecting the bracket and body. Lift the bracket disc subassembly from the body. Bracket is connected to the disc with the help of hinge bolt, nut and split pin. Remove the split pin, unscrew the nut and remove the hinge bolt. Bracket can be separated from the disc. It shall be noted that the disc has two bushes fitted into it with interference fit for bearing hinge bolt. They are not required to be removed unless damaged.

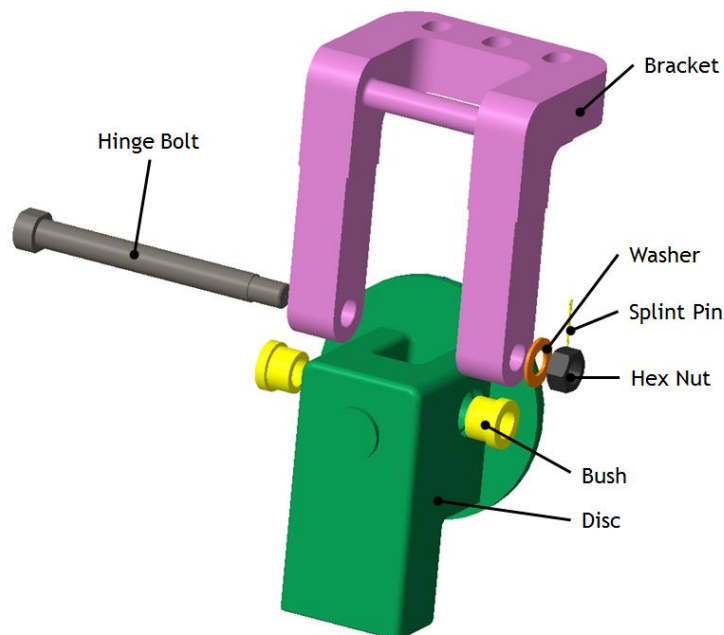
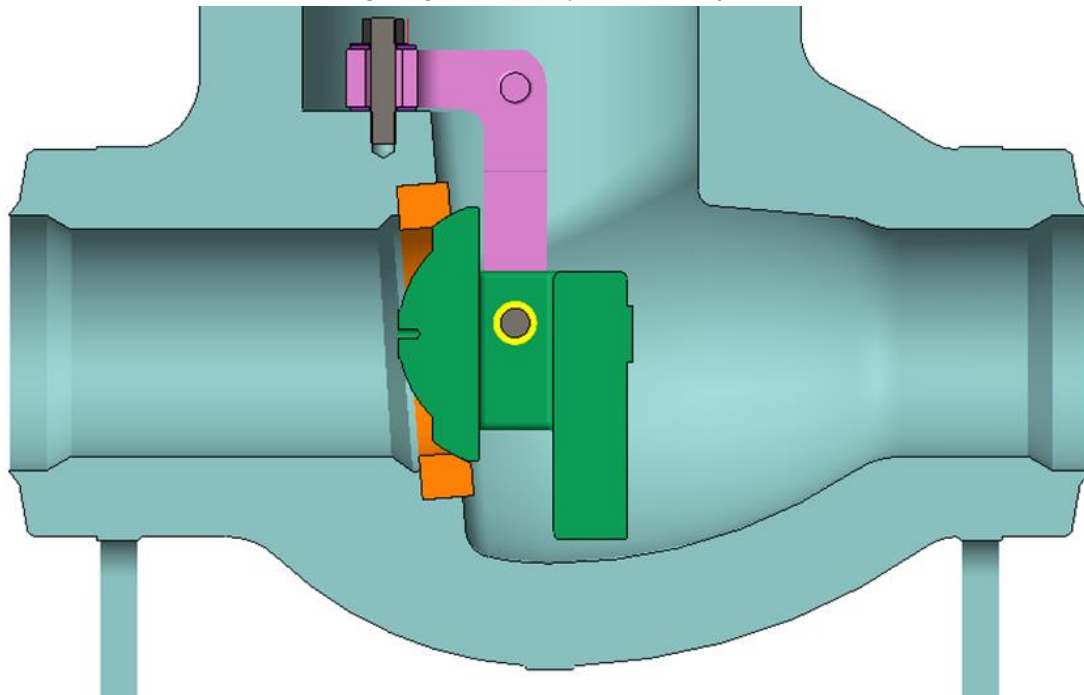
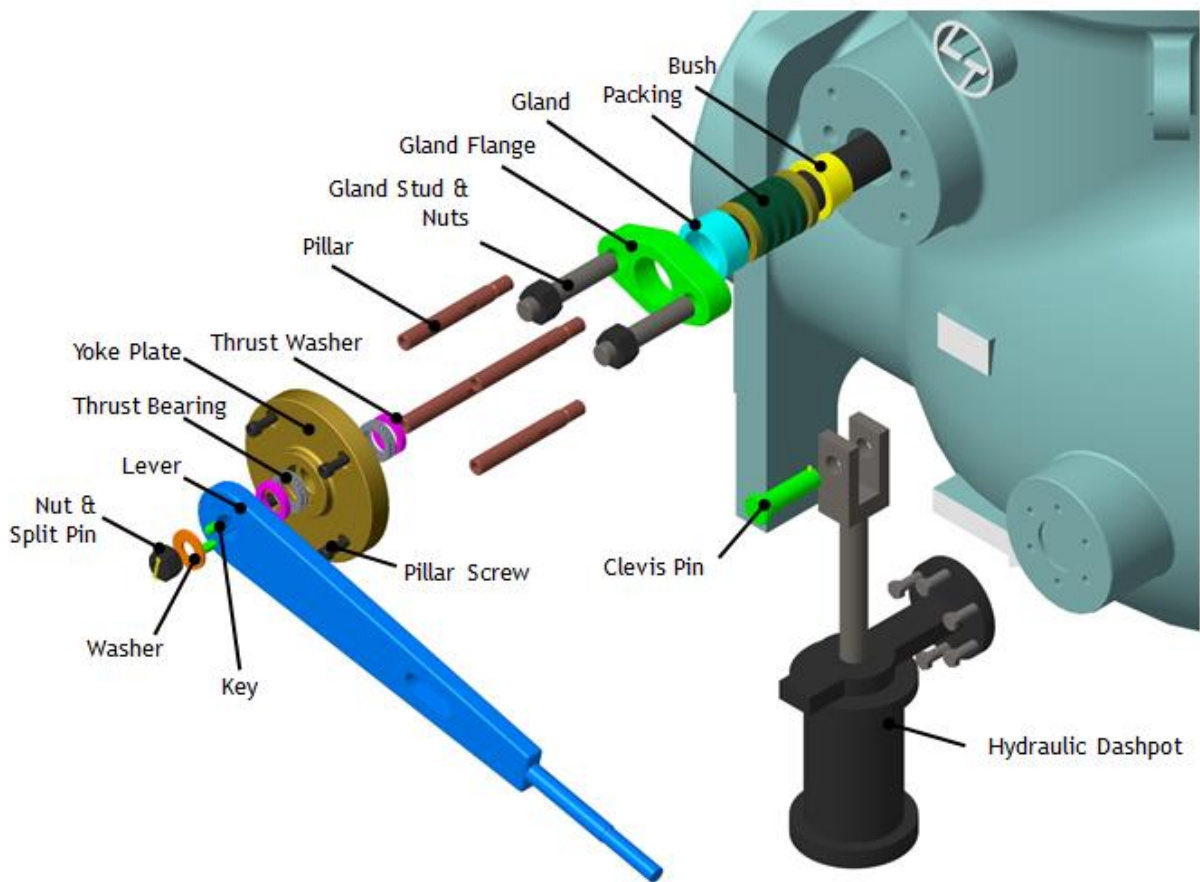


Figure 38 - Disassembly of Tilting Disc

## Disassembly of Hinge Disc Assembly and Hydraulic Dashpot in Swing Check Valves

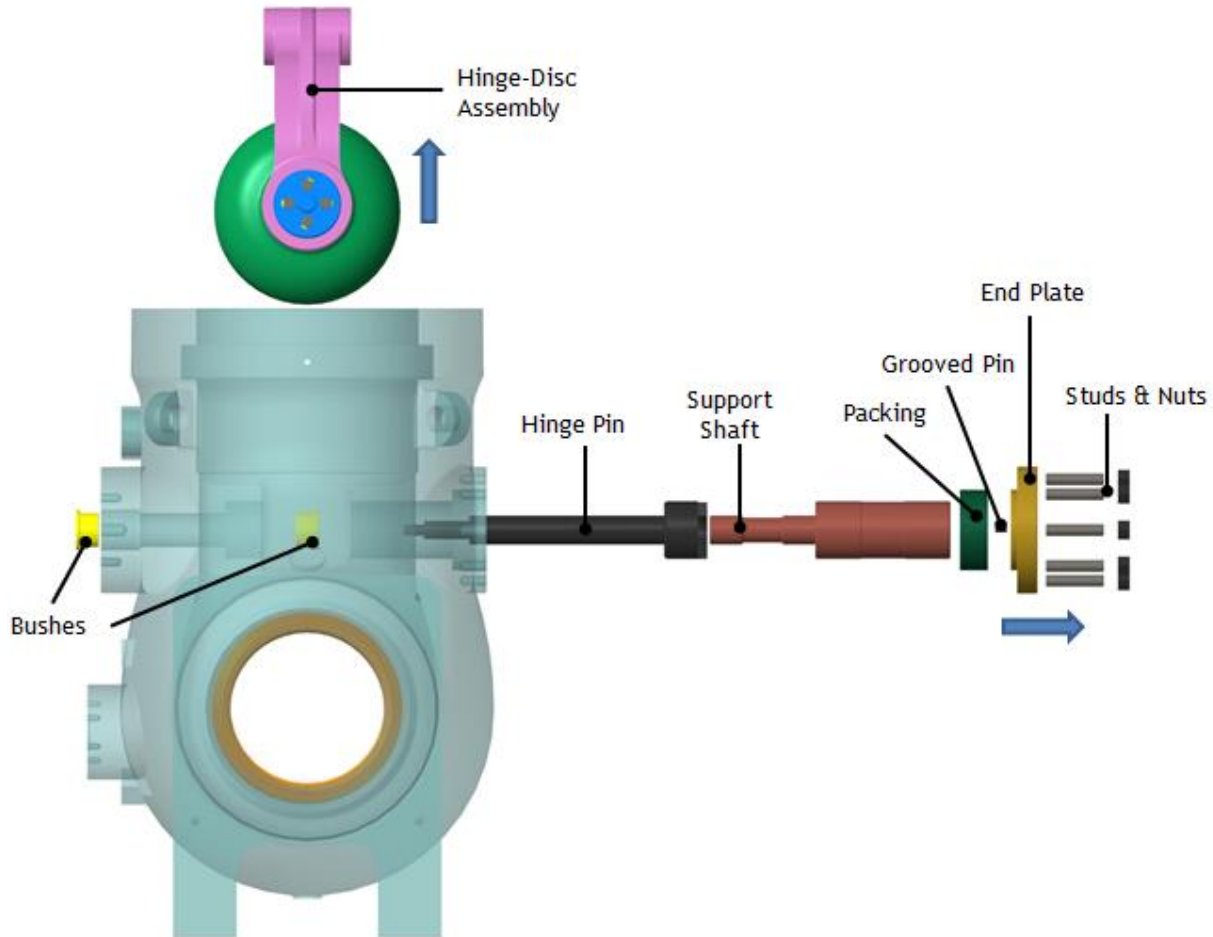
- The exploded view of dashpot arrangement is shown in figure 39.
- Remove counter weights (if any) from the lever.
- Remove clevis pin to disconnect lever and dashpot. Remove split pin, nut and washer that fasten the lever to hinge pin. Remove the lever and the keys connecting lever to hinge pin.
- Unscrew and remove the socket head cap screws connecting the yoke plate and lever. Remove yoke plate, thrust washer and thrust bearing. Unscrew pillars from the body.
- Loosen the gland studs & nuts and remove gland and gland flange. It shall be noted that the hinge pin needs to be removed from the other side of the body.



**Figure 39 - Disassembly of Hydraulic Dashpot**

- Loosen the studs & nuts on the other side of the body and remove the end plate, packing and grooved pin. Grooved pin connects the support shaft and end plate to prevent free rotation of the support shaft.
- Hinge disc assembly is held by support shaft. Hence, hold the hinge disc assembly from the top while removing the support shaft from the side.
- After removing the support shaft, hinge pin can be removed from the side opposite to dashpot mounting. It shall be noted that two bushes are held inside for bearing the hinge pin. They can be removed from the sides.

- After removing the support shaft, hinge disc assembly can be taken from the top. Hinge disc assembly shall be further disassembled as explained for swing check valves with internal hinge.



**Figure 40 - Disassembly of Hinge Pin and Discs**

## Assembly Procedure

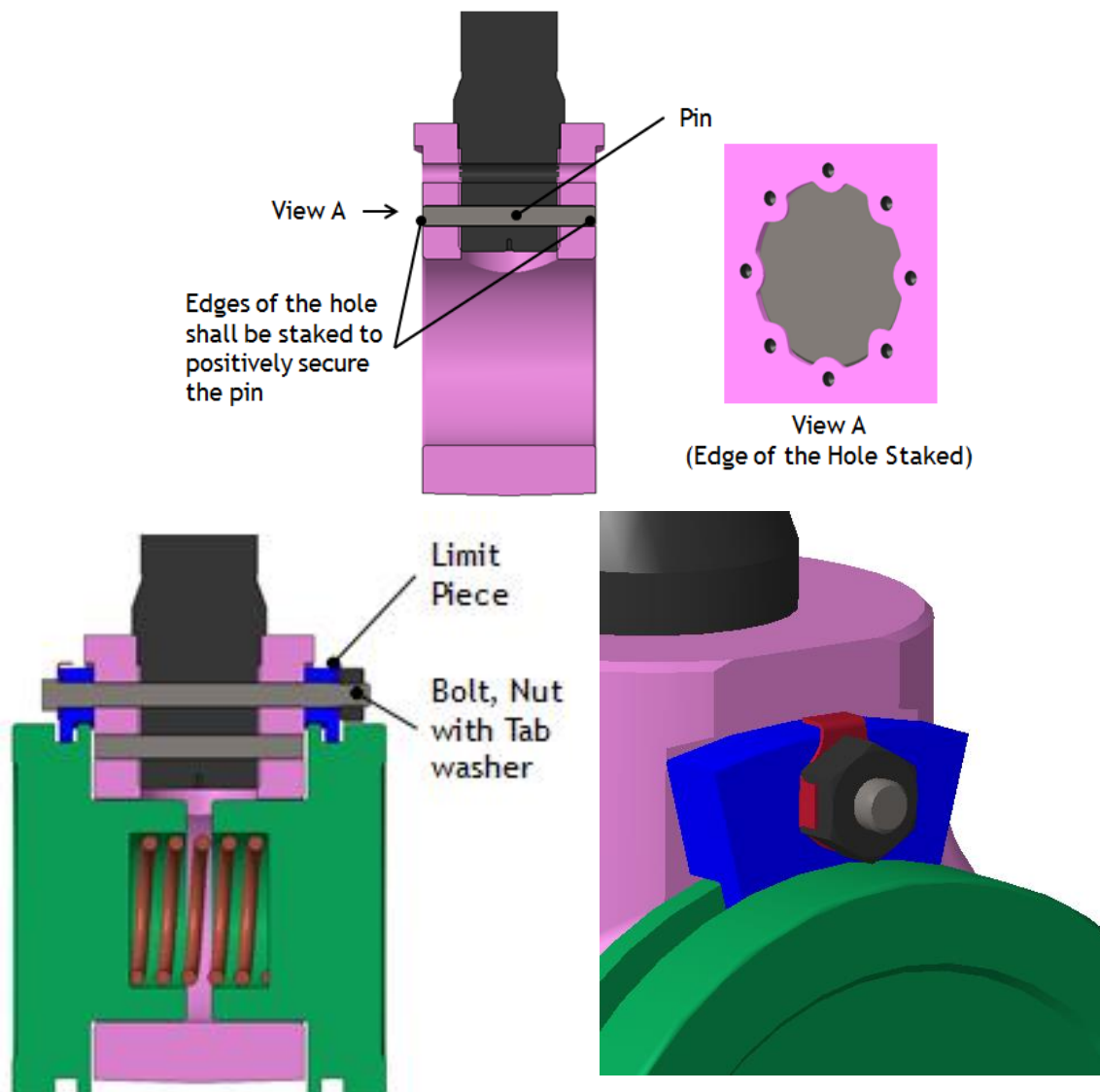
### General

- Stud and nut threads shall be lubricated.
- Clean disc and seat sealing surfaces thoroughly.
- Conduct blue bearing test to ensure there is uniform contact in flexible wedge gate and globe valves.

### Stem Disc Assembly

- In case of flexible wedge gate valves, attach disc to the stem and ensure that the disc freely enters into the stem T-head. Lower stem disc assembly into the body and push the stem gently to the closed position.
- In case of parallel slide gate valves, assemble stem and disc carrier with the pin. After insertion of the hole, the edges of the hole shall be staked to positively secure the pin. Assemble spring and two discs on the disc carrier. Assemble limit pieces on the disc slot and bolt them to the disc carrier with the help of disc carrier bolt, nut and tab washer. Tab washer shall be bent over limit piece edge and nut (and bolt) faces. Clamp the two parallel slide discs together to insert the stem disc assembly into the body neck.





**Figure 41 - Assembly of Parallel Slide Discs**

- In case of globe valves, assemble stem, disc washer and disc. Assemble lock washer with lug through the stem onto the disc such that lug in the lock washer is inserted into hole provided in disc. Insert the disc nut through stem and fasten to the disc. Bend the lock washer periphery onto the disc nut to prevent disc nut loosening. This is an important operation to prevent the loosening of stem disc subassembly (Refer figure 33)
- In case of stop check valves, place the disc washer between the stem and disc.
- In case of swing check valves, assemble disc and hinge with the help of washer, disc nut and split pin (or disc plate and hex screws with tack welding on screw for positive retention). Assemble hinge disc subassembly, bracket and hinge pin. Insert the entire disc assembly through the body neck and fix the bracket to the body with the help of hex screws and tab washer. Bend the tab washer over the edges of bracket and hex screw for positive retention.
- In case of tilting disc check valves, assemble disc and bracket with the help of hinge bolt, washer, nut, and split pin. Insert the entire disc assembly through the body neck and fix the bracket to the body with the help of 2 spacers (one each on top and bottom of the bracket),

tab washer and hex screws. Bend the tab washer over the edges of bracket and hex screw for positive retention.

- In case swing check valves with hydraulic dashpot, insert the hinge pin from the support shaft side. Insert the disc assembly through the body neck and insert the support shaft from the side. Support shaft shall hold the disc assembly through the hinge. Close the support shaft side with packing, end plate, grooved pin and fasteners. Assemble gland arrangement and pillar on the other side of the body. Assemble thrust washers, thrust bearings, and yoke plate on the pillar and hinge pin and the lever and dashpot. Connect the lever and dashpot with clevis pin. Check for oil level in the hydraulic dashpot. Recommended oil for refilling is HYDROL 15 or equivalent.

### Assembly of Bonnet (or Cover) and Pressure Seal Arrangement

- Assemble gasket with anti-extrusion ring and spacer on the bonnet (or cover) and lower the bonnet assembly on the stem and into body carefully and allow it to rest on the body. It shall be ensured that the gasket along with anti-extrusion rings and spacer shall be pushed gently below the retainer groove on the body.
- Assemble segmental retainer in the groove of the body. Align the segments in the body groove such that the segments can be knocked off from the knockout hole provided on the body. Pull the bonnet (or cover) up and assemble the pre-loading studs on the bonnet.
- Assemble the body-yoke studs on the body.

### Assembly of Yoke

- Place the yoke on the body and assemble the body-yoke bolting and bonnet-yoke bolting. A pair of disc springs shall be assembled in the bonnet-yoke bolting. For compact bonnets assemble bonnet retainer and split ring on the bonnet and fix hex screw, nut and springs for pre-loading. (Refer figures 25 and 26).
- In case of direct hand wheel operated valves, assemble the yoke sleeve nut and weld the tab as shown below in figure 42. Place the handwheel over the yoke sleeve. Wherever applicable place the lock washer over handwheel and tighten the handwheel nut with yoke sleeve top thread. Wherever applicable tighten the headless socket screw on the hand wheel nut to avoid loosening.



**Figure 42 - Tab Welding of Yoke Sleeve Nut**

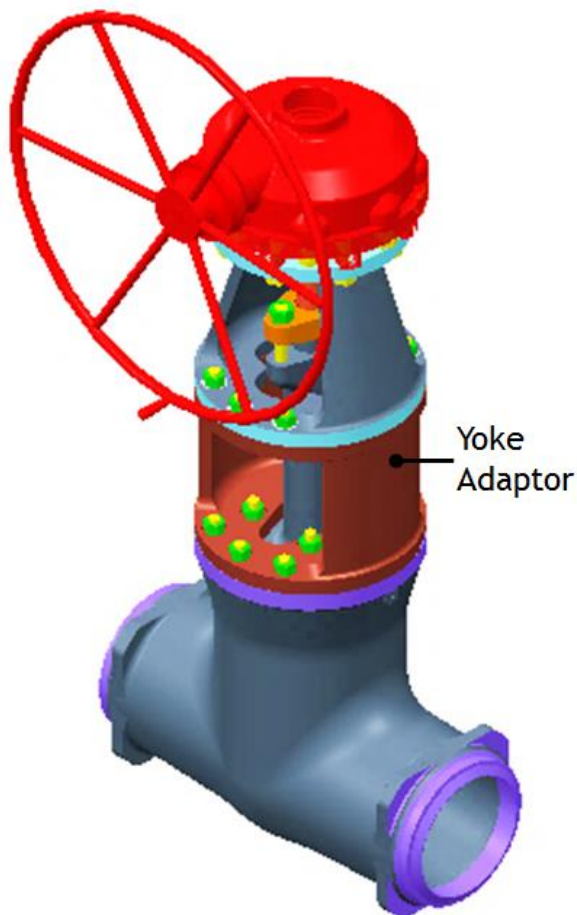
- In case of gear unit or actuator operated valves, assemble the gear unit or actuator on the yoke and fasten it with the help of hex screw and helical spring lock washer. For parallel slide

gate valves, stopper, clevis pin and split pin, shall be assembled on the stem after assembly of gear unit or actuator drive bush on the stem. Stopper is precisely machined to position the disc on the seat faces. Hence stopper cannot be interchanged between valves. In case of stopper replacement, the height and position of the old stopper shall be measured and the dimensions shall be replicated in the replacement stopper.

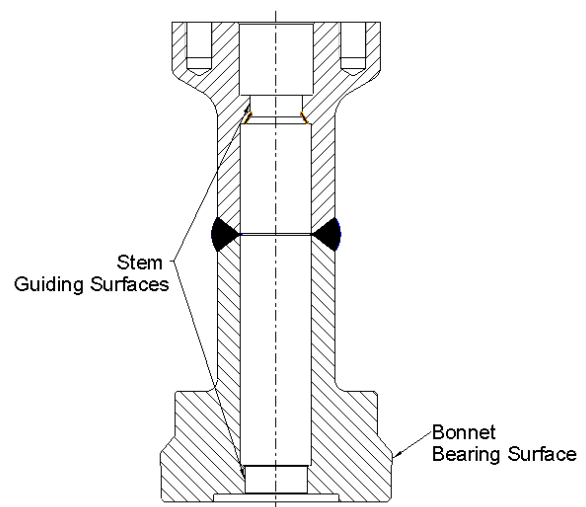
- Operate the valve at least once from full open to full closed condition and ensure smooth operation.

### Dismantling and Assembly of Extended Bonnet Valves

- Valves with extended bonnet for high temperature applications have following modifications from the standard design
  - a) Bonnet is in two pieces butt-welded.
  - b) In extended bonnet valves, yoke is either in single piece (as in general gate and globe valves) or there is a yoke adaptor between yoke and the body.



**Assembly**



**Front Section View of Extended Bonnet**

**Figure 43 - Extended Bonnet Pressure Seal Valves**

- Extended bonnet valve shall be assembled / disassembled in similar manner as that of a normal gate or globe valve except with the addition / modification of the below steps.

- a) For valves with yoke adaptor, bonnet- yoke bolting shall be between the bonnet and yoke adaptor.
- b) For valves with yoke adaptor, yoke adaptor shall be assembled on the body. Yoke shall be assembled on the yoke adaptor.

## Tightening Torque

- Except the gland bolting and pressure seal gasket bolting (bonnet-yoke bolting), all other bolting (such as body-yoke bolting, gear unit bolting, etc) shall be tightened to the torque values specified in table 1.
- Gland bolting shall be tightened as per the torque values specified in table 2.
- Before pressurizing the valve, pressure seal gasket bolting shall be tightened to the torque values specified in table 1. But pressure seal gasket bolting is required to be torqued once again, when the valve is taken to operating conditions. Once the valve is pressurized, for valves with metal gasket, the bolting shall be tightened to the torque values specified in table 1. For valves with graphite gasket, use of 50% of the torque values specified in table 1 is sufficient, when the valve is under operating conditions.

## Packing & Gasket Maintenance

### Packing Maintenance

Inspection of gland leak shall be a part of routine maintenance. If gland leak is noticed, the bolts holding the gland flange shall be re-tightened gradually until leakage stops. If satisfactory sealing could not be achieved by this process, it may be desirable to increase or to replace the packing.

**Caution:** Extreme care shall be taken when working on or around pressurized equipment

**Caution:** Excessive tightening of bolting may lead to over-compression of the packing against the stem, thereby producing excessive wear, loss of packing material and high valve operating torque.

If gland travel reaches its maximum and leakage doesn't cease, the stem must be inspected for anomalies. Any deterioration in the surface finish of stem, particularly the region which is in contact with the packing such as dents, scratches, pitting or corrosion could be a potential cause for the leakage problems. Regular operation will minimize the chances of corrosion between the stem and packing. Misalignment of the stem could also be a reason for scratches which might cause gland leak. If any of the above conditions exist, the stem must be reworked or replaced. If none of the above anomalies could be observed in the stem, replacement of the packing may be necessary.

Replacement packing shall be ensured to be suitable for the operating conditions. The stuffing box shall be ensured to be dry and free from any sort of contamination. The following procedure must be followed for the replacement of packing on site.

## Packing Replacement Procedure

- It is always recommended to depressurize the line in which the valve is installed prior to replacing the packing. If this is not possible, the valve shall be opened to back seat so that the pressure could be arrested from entering the stuffing box.
- Loosen and remove nuts holding the gland flange in place. The gland flange and the gland will be free to move up the stem and the stem packing is exposed.
- Remove the old packing. Care shall be taken to ensure that tools used to remove packing do not scratch either the stem shaft or the inside of the stuffing box. Clean shaft and box thoroughly.
- Replace original packing with the new ones as per the following instructions. In most cases, the packing will be a combination of die-moulded graphite / split braided filament rings.
- To open the split braided filament ring, twist the open ends in opposite directions to resemble an 'S'. In case of solid die-moulded packing, use a sharp knife and cut the rings at 30° angle. Slightly twist the ring and insert it around the stem. Do not open up the rings too much as it could get damaged.

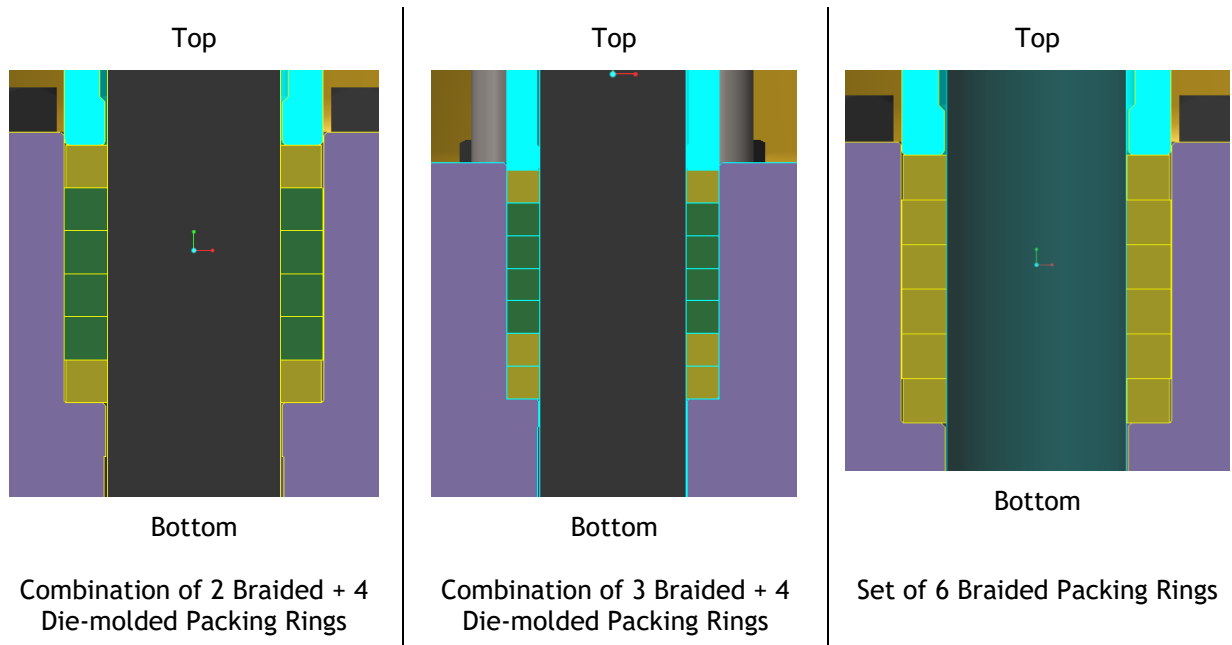


**Figure 44 - Split Braided Packing Ring**

- Install each packing ring separately, tapping each ring after complete insertion to avoid air gaps / voids. The gland shall be used to set right the packing in the bottom of the stuffing box.
- The joints of split packing rings should be staggered 90 degrees to 120 degrees from the joints of adjacent rings.
- If lantern ring was provided, make sure it is replaced in its original position.
- Replace the gland and gland flange as was in the original condition and tighten the gland nuts to the torques mentioned in **Table 1** of Appendix A.
- Operate the valve a few times to ensure all parts are working smoothly.
- Inspect valve for leakage a week after installation.

## Types of Packing

- Generally, packings are either a combination of braided & die-molded rings or a full set of braided rings. Refer GAD for the details of packing used.
- Valves up to and including class 2500 generally have 6 packing rings (2 braided + 4 die-molded). Valve above 2500 generally have 7 packing rings (3 braided + 4 die-molded)



**Figure 45 - Packing Configurations**

## Gasket Maintenance

Inspection of pressure seal arrangement shall be part of routine maintenance. Inspect the valve body neck area for any leak through pressure seal gasket. If minor leaks are observed during initial stages of pressurization or during hydro test of pipeline, the pressure seal gasket bolting (bonnet-yoke) shall be tightened. Minor leaks through knockout hole during initial stages of pressurization are rare but can happen due to disturbances during handling, storage and transportation and relaxation of graphite material. If minor leaks are observed through knockout hole, pressure seal gasket bolting shall be re-tightened. Retightening the pressure seal gasket bolting once after installation, will eliminate any further leak across pressure seal gasket at all pressures.

Almost all pressure seal valves are supplied with graphite gasket. Where process conditions do not permit use of graphite gasket, valves are supplied with metal gasket (for e.g. valves in hot air (oxidizing atmosphere) service with operating temperature more than 450°C).

In the case of leakage, pressure seal gasket bolting shall be tightened to the torque values specified in Table 1. Whenever possible, backseat the valve before tightening the bolting. If leakage doesn't cease, pressure seal gasket is probably damaged and the valve must be opened for examination and replacement of gasket. The leakage is because of the imperfect seal between either gasket and bonnet or gasket and body. Replacement gasket shall be ensured to be suitable for operating conditions. Following procedure must be followed for the replacement of gasket at site.

## Gasket Replacement Procedure

- Valve shall be de-pressurized. Yoke and bonnet assembly shall be dismantled. Care shall be taken to pull the bonnet along with gasket from the body neck.
- Remove the old gasket from the bonnet and replace with new gasket. Graphite gaskets have stainless steel anti-extrusion rings on top and bottom of the gasket and they shall be assembled along with the gasket. Metal gaskets do not have separate anti-extrusion rings.

- Before assembling with new gasket, clean the body and bonnet gasket area and visually inspect them for any surface defects or imperfections. After ensuring that the gasket seating area is free of surface defects, assemble the bonnet with new gasket and re-assemble rest of the valve components.
- Apply torque to the pressure seal gasket bolting as per the torque values given in Table 1. Whenever possible, backseat the valve before tightening the bolting. Pressure seal gasket bolting is provided with a pair of disc springs for live loading. While applying torque to the bolting, proper tightening sequence shall be followed. The sequence of bolt tightening is vital to avoid uneven compression of the gasket. It is also recommended to tighten the bolting in stages of 30, 60 and 100 percent of the final torque to ensure the bolts are not over stressed and the gasket is compressed uniformly.
- For valves with gasket replaced, pressure seal gasket bolting is required to be tightened again, once the valve is taken to operating pressure and temperature. For metal gaskets, use torque values provided in Table 1. For graphite gaskets, if the valve is under operating pressure and temperature, use of 50% of the torque values provided in Table 1 is sufficient.
- Gasket bolt load shall be checked once in every 6 months as part of routine maintenance and re-torqued, if required.

## Notes on Fluid Thermal Expansion

There is possibility of gate valves sealing simultaneously in both directions under pressure differential from the centre cavity. When the centre cavity is filled with liquid and subjected to an increase in temperature, the pressure build-up in the cavity will be excessive leading to pressure boundary failure.

To prevent centre cavity over-pressurization, the cavity pressure is required to be relieved. The cavity pressure is generally relieved to the upstream side of the valve. This can be done either by putting a hole in the disc or by connecting the centre cavity to upstream side with an equalizing line (with or without valve).

Requirement of cavity relief arrangement is to be specified by the user. The requirement is based on process conditions and operating philosophy, the details of which are known better to piping and process engineers. ASME B16.34 Clause 2.3.3 places the responsibility on the user to specify the requirement of cavity relief arrangement.

## Bypass and Equalizing Arrangement

Bypass arrangement allows a small amount of fluid to pass across the main valve without opening the main valve. Generally globe valves are used as bypass valves. MSS SP-45 specifies two series (Series A and B) of bypass arrangement for two different purposes.

Series A is specified for preheating the piping system (normally with steam) before opening main valve and for balancing pressures where lines are of limited volume.

Series B is specified for lines conveying gases or liquids, where bypassing may facilitate the operation of the main valve by balancing the pressure on both side of the disc or discs.






Recommended bypass sizes of series A is commonly specified and used, since preheating requirement is common. Series B is generally not required, since the operator is always sized for full differential pressure by the manufacturers.

Bypass arrangements are not offered by default. Requirement of bypass arrangements shall be identified and specified by piping and process engineers.

When the requirement of bypass and cavity relief is specified, these arrangements can be combined in different ways. Following are some of the commonly used bypass arrangements, equalizing arrangements, and combined bypass and equalizing arrangement.

The bi-directionality of the gate valve is not affected by the preferred flow direction of the globe valve. Bypass globe valves generally have preferred flow direction for flow from under the disc. But globe valves when used as bypass valves can be treated as bi-directional.



	<p><b>Type 1: Bypass Arrangement</b></p> <p>The upstream and downstream sides of the valve are connected by a bypass pipe fitted with a globe valve. The gate valve is bi-directional.</p>
	<p><b>Type 2: Equalizing Arrangement</b></p> <p>The centre cavity and upstream side of the valve are connected by an equalizing pipe fitted with a globe valve. The gate valve is uni-directional.</p>
	<p><b>Type 3: Bypass and Equalizing Arrangement</b></p> <p>In addition to the bypass arrangement, the centre cavity and the upstream side are connected by equalizing pipe. The gate valve is uni-directional.</p>
	<p><b>Type 4: Bypass and Equalizing Arrangement</b></p> <p>The arrangement consists of a connection between centre cavity and a bypass pipe, with one valve each on the upstream and downstream side of the bypass pipe. Based on the flow direction, one valve acts as bypass valve and the other as pressure equalizing valve. The gate valve is bi-directional. This kind of arrangement is commonly used in manual operated valves with bypass and equalizing arrangement. This arrangement is not suitable for motor operated bypass valves, due to complexity in providing support to the motor operator.</p>
	<p><b>Type 5: Bypass and Equalizing Arrangement</b></p> <p>The arrangement consists of a connection between centre cavity and upstream side of the valve with an equalizing valve. The upstream and downstream sides of the valve are connected by a bypass pipe fitted with a globe valve. The gate valve is uni-directional. This kind of arrangement is commonly used with manual equalizing valve and motor operated bypass valve.</p>

**Figure 46 - Various Types of Bypass and Equalizing Arrangement**

## Troubleshooting

Problem	Reason	Action
Valve Leaking	Valve not closed fully	Re-tighten the handwheel
	Valve seating damage	Dismantle and lap the seating
	Bypass valve not closed fully	Close the bypass valve fully
	Internal components are damaged or have worn out.	Disassemble the valve and inspect internal components.
	Bypass valve seat may be damaged	Check the seating of the bypass valve
Leakage through Gland	Packing loosened	Tighten the gland nuts.
	Packing worn out	Replace the packing
	Gland is binding against the stem or packing chamber wall	Ensure gland is centered and evenly tightened
	Inadequate amount of packing rings	Install additional packing rings.
	Packing is hard and dry	Replace with new packing.
	Packing was not properly cut and staggered	Replace with new packing.
	Stem is damaged	Repair or replace as required.
Leakage through valve body neck	Pressure Seal Gasket is damaged or not properly compressed	Check whether the gasket is properly placed between anti-extrusion rings.
	Anti-Extrusion Rings are damaged.	Replace anti-extrusion rings.
	Studs loosened	Use the values in Table 2 to tighten the studs.

Problem	Reason	Action
Problems while operating the valve	Debris inside the valve	Clean the pipeline
	Stem binding during travel	Remove dirt and lubricate stem.
	Packing is exerting excessive force on the stem	Optimize the torque on gland nuts.
	Stem is damaged	Examine stem through full open and close action. Repair or replace as required.
Leakage through end flange facings	Internal components may be damaged	Disassemble the valve. Inspect and repair as needed.
	Inadequate tightening of flanged joint	Re tighten the Flanged joint
Noise /Vibrations while opening or closing of the valve	Gasket damage	Replace the gasket
	Inadequately supported / fixed valve and its assembly	Support / fix upstream / downstream piping.
Leakage through knockout hole during valve pressurization and pipeline hydrotest	Disturbance of pressure seal gasket bolting during handling, storage and transportation	Re tighten the pressure seal gasket bolting.
	Relaxation of graphite material and loss of gasket bolt loads	Re tighten the pressure seal gasket bolting

## Appendix A

### A1 - References

#### Face to Face Dimensions

ASME B16.10      Face-to-Face and End-to-End Dimensions of Valves

#### End Connections

ASME B16.5      Pipe Flanges and Flange Fittings (NPS ½ through NPS 24)

ASME B16.47      Large Diameter Steel Flanges (NPS 26 through NPS 60)

ASME B16.25      Buttwelding Ends

#### Testing Standard

API 598          Valve Inspections and Testing

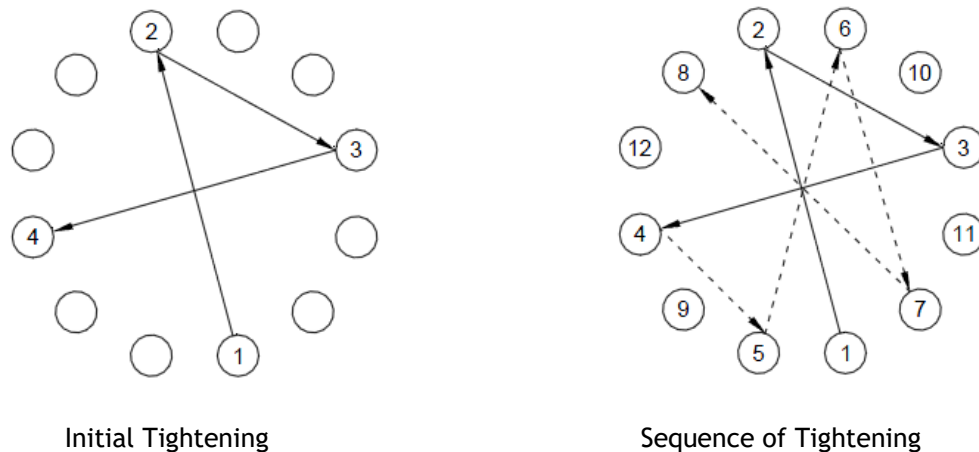
MSS SP-61      Pressure Testing of Valves

EN12266 PART-1    Industrial Valves - Testing Of Valve

### A2 - Tightening Sequence & Torque

The tightening sequence for all possible number of bolting, the logic to be followed is explained below:

- Tighten the first four nuts in the sequence shown Fig. A2.1. This helps in correct location of the mating parts.
- Tighten the other bolts in the sequence shown Fig.A2.1.
- The sequence goes clockwise around the bolt.
- Ensure that the recommended torque (refer Table 1) is maintained in all bolting.



**Figure A2.1 - Tightening Sequence**

**Table 1 Tightening Torque**

THREAD SIZE, inch-TPI	TORQUE					
	B7/B7M/B16/L7/L7M/ L43/660 Cl.A/UNS N07718/UNS 09925		B8 Cl.2/B8C Cl.2/ B8M Cl.2/B8T Cl.2/ XM-19		UNS N06625 Gr 1	
	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft
1/4-20 UNC	7	5	7	5	5	4
5/16-18 UNC	15	11	15	11	10	7
3/8-16 UNC	25	18	25	18	15	11
7/16-14 UNC	40	30	40	30	25	18
1/2-13 UNC	60	44	60	44	40	30
9/16-12 UNC	90	66	90	66	60	44
5/8-11 UNC	120	89	120	89	80	59
3/4-10 UNC	215	159	215	159	145	107
7/8- 9 UNC	345	254	315	232	230	170
1-8 UNC	520	384	475	350	345	254
1.1/8-8 UN	765	564	625	461	510	376
1.1/4-8 UN	1075	793	880	649	715	527
1.3/8-8 UN	1460	1077	975	719	975	719
1.1/2-8 UN	1925	1420	1285	948	1285	948
1.5/8-8 UN	2480	1829	1655	1221	1655	1221
1.3/4-8 UN	3140	2316	2090	1542	2090	1542
1.7/8-8 UN	3900	2876	2600	1918	2600	1918
2-8 UN	4775	3522	3180	2345	3180	2345
2.1/4-8 UN	6900	5089	4600	3393	4600	3393
2.1/2-8 UN	9575	7062	6380	4706	6380	4706
2.3/4-8 UN	12865	9489	8575	6325	8575	6325
3-8 UN	16835	12417	11225	8279	11225	8279
3.1/4-8 UN	21545	15891	14365	10595	14365	10595
3.1/2-8 UN	27065	19962	18045	13309	18050	13309

lbf.ft = Nm / 1.35582



**Table 2A Gland Tightening Torque for Flexible Wedge Gate Valves**

VALVE SIZE (NPS)	TORQUE									
	CLASS									
	600		900		1500		2500		3100	
	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft
2	10	7	27	20	27	20	28	21	--	--
3	17	13	59	44	64	47	70	52	45	33
4	24	18	64	47	69	51	75	55	60	44
6	44	32	120	89	125	92	205	151	125	92
8	47	35	155	114	230	170	345	254	160	118
10	62	46	205	151	380	280	390	288	180	133
12	88	65	355	262	380	280	530	391	220	162
14	115	85	335	247	515	380	680	502	--	--
16	120	89	420	310	550	406	1055	778	320	236
18	130	96	550	406	1115	822	1395	1029	495	365
20	135	100	550	406	1045	771	1565	1154	585	431
22	--	--	--	--	--	--	1635	1206	--	--
24	165	122	815	601	2280	1682	1935	1427	--	--
30	330	243	1190	878	2675	1973	--	--	--	--
32	--	--	2280	1682	--	--	--	--	--	--
36	360	266	--	--	--	--	--	--	--	--

lbf.ft = Nm / 1.35582

**Table 2B Gland Tightening Torque for Parallel Slide Gate Valves**

VALVE SIZE (NPS)	TORQUE									
	CLASS									
	600		900		1500		2500		3100	
	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft
3	--	--	59	44	59	44	70	52	45	33
4	--	--	64	47	65	48	70	52	60	44
6	--	--	120	89	120	89	150	111	125	92
8	--	--	165	122	165	122	270	199	160	118
10	--	--	335	247	335	247	345	254	180	133
12	--	--	260	192	335	247	365	269	220	162
14	--	--	260	192	355	262	530	391	300	221
16	--	--	355	262	420	310	1060	782	320	236
18	--	--	465	343	550	406	1090	804	495	365

VALVE SIZE (NPS)	TORQUE									
	CLASS									
	600		900		1500		2500		3100	
	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft
20	--	--	550	406	--	--	1490	1099	585	431
22	170	125	--	--	--	--	1565	1154	610	450
24	--	--	855	631	1190	878	1635	1206	--	--
26	--	--	--	--	--	--	--	--	740	546
28	--	--	1140	841	--	--	--	--	--	--

lbf.ft = Nm / 1.35582

**Table 2C Gland Tightening Torque for T-Pattern Pressure Seal Globe Valves (Style-A Design)**

VALVE SIZE (NPS)	TORQUE									
	CLASS									
	600		900		1500		2500		3100	
	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft
2	15	11	60	44	60	44	115	85	--	--
3	25	18	60	44	110	81	85	63	70	52
4	40	30	65	48	55	41	150	111	125	92
6	45	33	140	103	250	184	345	254	180	133
8	115	85	230	170	295	218	--	--	265	195
10	--	--	--	--	--	--	1005	741	--	--
12	380	280	--	--	--	--	1300	959	--	--
14	--	--	--	--	--	--	--	--	--	--
16	--	--	--	--	--	--	2430	1792	--	--
18	--	--	--	--	--	--	--	--	--	--

lbf.ft = Nm / 1.35582

**Table 2D Gland Tightening Torque for Y-Pattern Pressure Seal Globe Valves (Style-A Design)**

VALVE SIZE (NPS)	TORQUE							
	CLASS							
	600		900		1500		2500	
	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft
2	--	--	60	44	60	44	65	48
3	--	--	65	48	65	48	85	63
4	30	22	65	48	55	41	150	111
6	--	--	140	103	110	81	345	254

VALVE SIZE (NPS)	TORQUE							
	CLASS							
	600		900		1500		2500	
	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft
8	--	--	295	218	295	218	625	461
10	--	--	--	--	515	380	1005	741
12	--	--	--	--	940	693	1300	959
14	--	--	--	--	1585	1169	1635	1206
16	--	--	--	--	--	--	--	--
18	--	--	1045	771	--	--	3220	2375

lbf.ft = Nm / 1.35582

**Table 2E Gland Tightening Torque for Y-Pattern and T-Pattern Globe Valves (Style-B Design)**

VALVE SIZE (NPS)	TORQUE					
	CLASS					
	900		1500		2500	
	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft
2	--	--	60	44	115	85
3	--	--	110	81	150	111
4	--	--	110	81	285	210
6	--	--	380	280	625	461
8	410	302	815	601	--	--
10	--	--	1045	771	--	--
12	--	--	--	--	--	--
14	--	--	2675	1973	--	--

lbf.ft = Nm / 1.35582

**Table 2F Gland Tightening Torque for Angle Valves**

VALVE SIZE	TORQUE							
	CLASS							
	600		1500		2500		3100	
	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft	Nm	lbf.ft
3	--	--	110	81	85	63	70	52
8	115	85	--	--	--	--	--	--

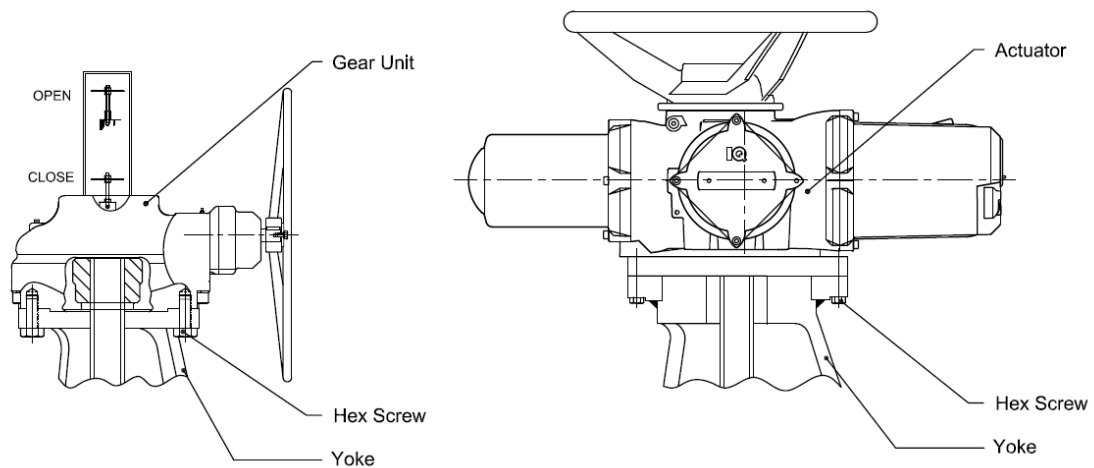
lbf.ft = Nm / 1.35582



### A3 - Actuator / Gear Unit Reorientation Procedure:

Gear unit or Actuator orientation change procedure is given below,

- Depressurize the line and keep the valve in half open position.
- Remove actuator/gear unit bottom screws.
- Rotate the actuator/gear unit and change orientation to required position, match holes in the yoke plate to that of the gear unit.
- Insert the bottom screws & tighten to required torque.
- Operate the valve 2 to 3 times before pressurizing line.
- In order to dismount actuator/gear unit from valve, follow procedures given under dismantling & assembly procedure.



**Figure A3.1 - Gear Unit and Actuator Re-orientation**

## Appendix B

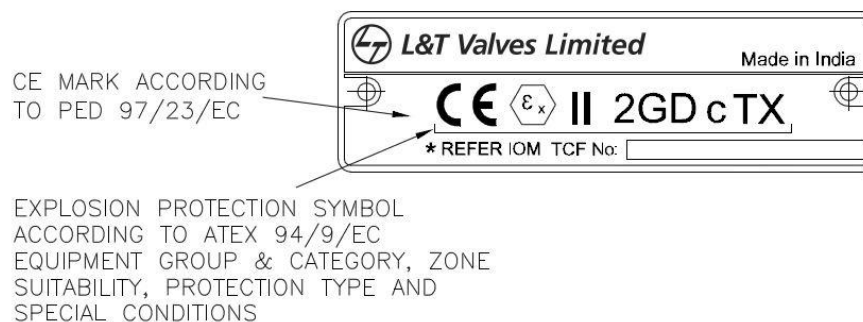
For valves with CE & ATEX certification requirements

- Each valve has a stainless steel name plate fixed to the body. The name plate is marked with details of “figure number”, along with various other details such as the materials of construction, pressure-temperature rating as shown below.

L&T Valves Limited		Formerly Audco India Limited	
ASME B16.34		Made in India	
SIZE	DN 100 (4")	CLASS	900
	153.2 BAR @ -20°C		85.0 BAR @ 427°C
BODY	WCB	CAT No	381.1/2 UF
STEM	CR13		
DISC	HF	S. No	0001
SEAT	HF	DATE	06/2013
			0575

According to PED 97/23/EC

**Figure B.1 - 'CE' Marking Name Plate**



Definition of name plate marking above :

- 'II' = Equipment group
- '2' = Equipment category
- 'G' = Gas zone suitability (Zones 1 & 2)
- 'D' = Dust zone suitability (Zones 21 & 22)
- 'c' = Type of protection (i.e.) constructional safety (EN 13463-5)
- 'X' = Special conditions (EN 13463-1).
- Special Condition: X

Surface temperature: As per EN 13463-1:2001(E) paragraph 14.2.g, the temperature class or maximum surface temperature cannot be marked on the product as it is dependent on the operating conditions. However the maximum allowable operating temperature for the product is marked on the identification plate.

- Material tractability markings are hard marked on the valve body

CAUTIONARY  
NOTES



When installing or maintaining valves

- Observation shall be made for safety codes and working practices relevant to gas zones 1 & 2 and dust zones 21 & 22 (as defined in EN 1127-1:1998).
- The equipment shall not be subjected to frequently occurring disturbances.
- End user to ensure there is no external disturbances (e.g. Shocks, vibrations, electromagnetic fields etc.).
- Misuse of valves / valve components are strictly prohibited.
- If the processes or environments that the products are used in are likely to cause temperatures (high or low) that may cause injury to personnel if touched, then adequate insulation / protection must be fitted.
- Adequate safety measures shall be made for valves similar to pipe lines.
- Before equipment is installed in areas which may be subject to seismic activity or extreme climatic conditions consult L&T Valves with data.
- Maximum surface temperature of the equipment will be same as the line media temperature. The end user must take account of the line media temperature.
- All exposed parts shall be cleaned to prevent dust deposit or insulation is needed similar to pipe line.
- This equipment should be protected by other devices to prevent over-pressurization. (i.e. caused by external fire etc.).
- End user to ensure that the accessories (actuator, limit switches, solenoid valve, etc.) if fitted with valve are of ATEX qualified as per the directive.
- Valves are not suitable for terminal connections. In such cases, valves shall be fitted with blind flanges.



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As we continuously endeavor to improve our products, the data given herein is subject to change. Please refer [www.lntvalves.com](http://www.lntvalves.com) for the latest IOM.