

Installation, Operation and Maintenance Manual of Triple Offset Butterfly Valves



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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 (Manapakkam), 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 Plug Valves
- Control Valves
- Customised Solutions

Designs for the valves are created by an experienced team of valve experts who have a deep understanding of user-industry processes. An 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 institutionalised 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

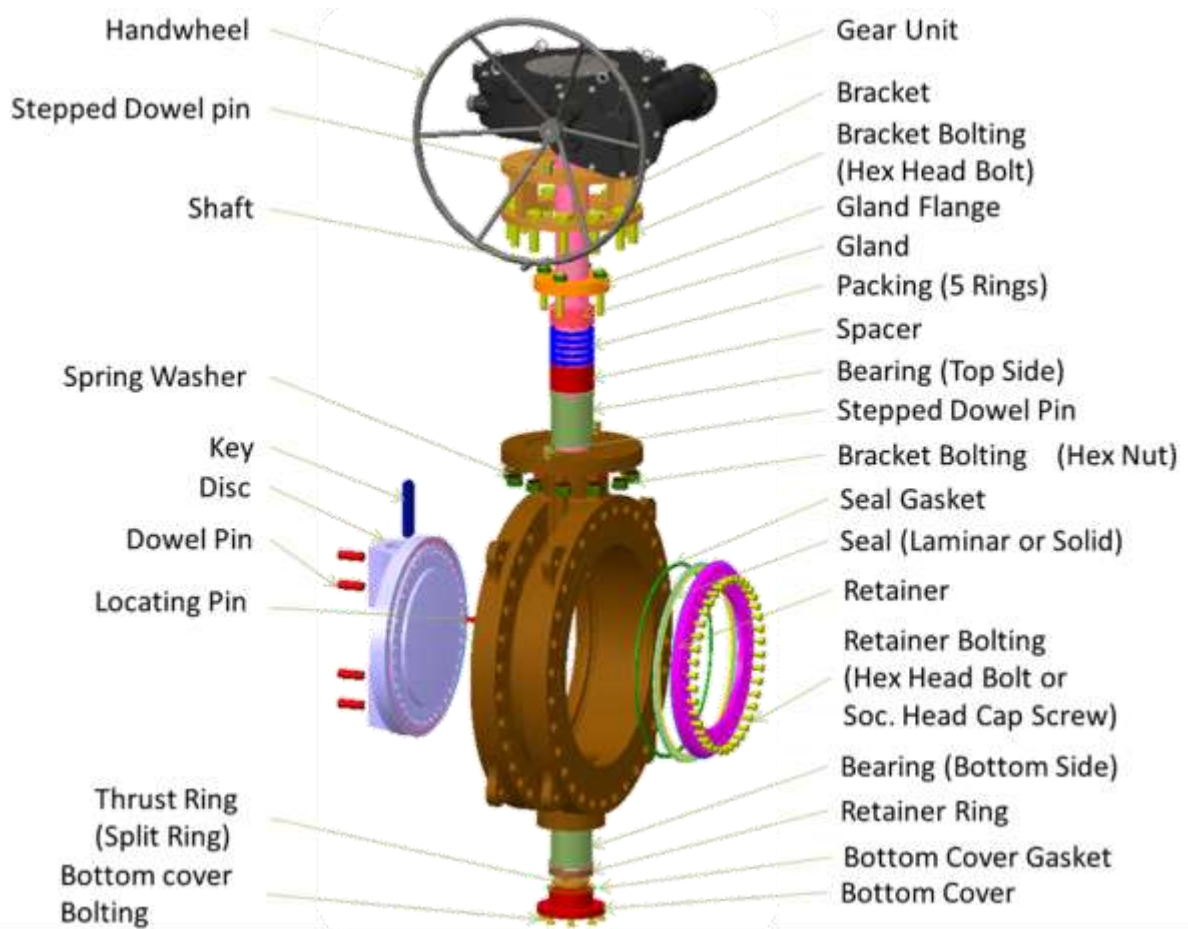
Triple Offset Butterfly Valves

Triple offset seat geometry gives frictionless seal with uniform compressive sealing. TOBV valves are bi-directional valves that allow flow in either preferred & non-preferred flow direction having flow characteristic of regulating & shut off, which have the capability of replacing GATE & GLOBE valves. They are ideally used in process industries like petro-products, chemical industry, paper & pulp industry & Food processing units.

TOBV's valves are offered in Cast form. Valves are with single piece body construction either with flanged short & long pattern (Flat face/Raised face/RTJ)/short & long pattern butt weld ends/Wafer Lugged/Wafer type. Special coating such as Epoxy/Belzona/Corro coats will be provided in the body.

Range Chart

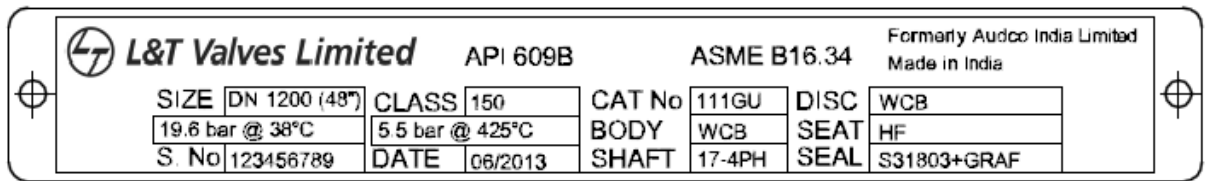
| Size | Pressure Rating |
|-------------|-----------------|
| NPS 3 to 64 | Class 150 |
| NPS 3 to 54 | Class 300 |
| NPS 3 to 48 | Class 600 |



Delivery

Valves are shipped with the disc closed condition. Orientation of the valve may be either horizontal or vertical depending on the shipped valve dimensions. Please check the packing slip attached to the container before opening the same.

Valve identification details can be found on the name plate and on the body of the valve. A typical identification plate is shown in Fig 2.




| | | | | | | | |
|---|-----------------|----------|-----------------|---|--------|------|-------------|
|  L&T Valves Limited | | API 609B | ASME B16.34 | Formerly Audco India Limited Made in India | | | |
| SIZE | DN 1200 (48") | CLASS | 150 | CAT No | 111GU | DISC | WCB |
| | 19.6 bar @ 38°C | | 5.5 bar @ 425°C | BODY | WCB | SEAT | HF |
| S. No | 123456789 | DATE | 06/2013 | SHAFT | 17-4PH | SEAL | S31803+GRAF |

Fig 2

Valves are supplied with end protectors for avoiding damage to internals. Hand wheels for gear operated valves are usually dismantled and packed separately.

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. Lifting lugs are provided for this purpose on the valves.

The crane wire should 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

Clean the yard and 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 leakages during operation.

Valves shall be stored in covered area which is dust free, least humid and well ventilated.

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 inches from the floor.

Care should 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 safe systems of work site.
- Observe all site health and safety rules.
- 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 are strictly prohibited.
- 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 should be protected by other devices to prevent over-pressurisation. (i.e., caused by temperature, fire etc.).

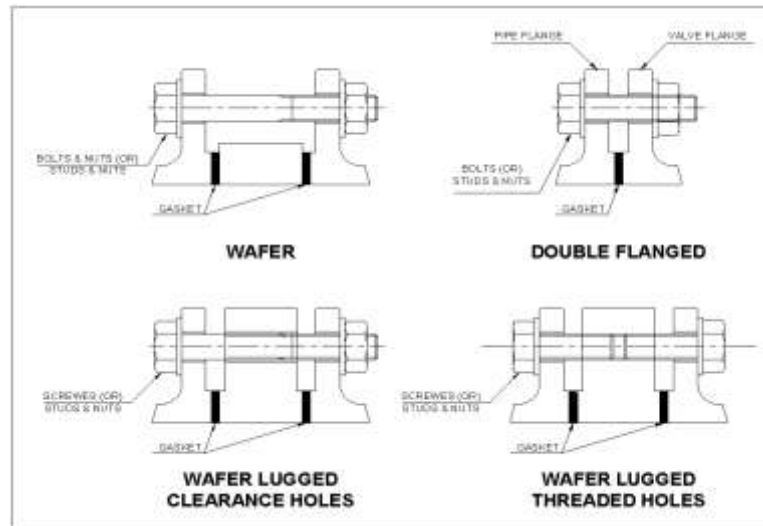
Valve Installation

General

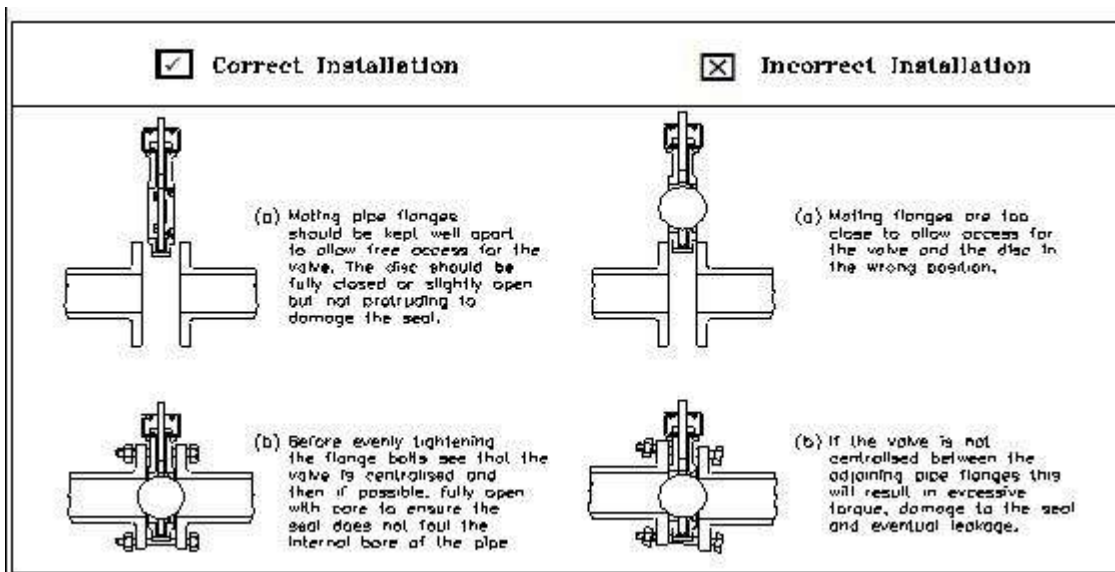
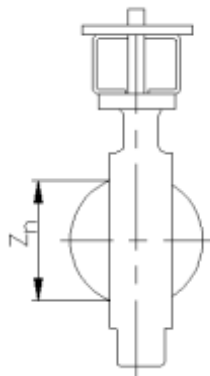
Carefully unpack the valve and check for tags or identification plates, etc.

- 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.
- 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 valve, wherever provided.
- Gasket contact faces of the valve 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.
- The pipes must 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.
- For best performance it is recommended that these valves are installed with the shaft horizontal with the hand wheel facing up. Otherwise preferred to install shaft at an angle so that sediments cannot deposit on lower bearing area which affects the valve open, close operation.
- This valve has bi-directional sealing capabilities and therefore can be installed in either direction. However, a preferred flow direction is indicated in the valve by means of an arrow mark and it is strongly recommended that the valve is installed such that the flow is in the direction of the arrow.

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 bolts and lead to leakage



- For wafer & wafer lug valves Check ZN dimension provided in the GAD & compare it with the pipe schedule used in the site.



Flanged Ends

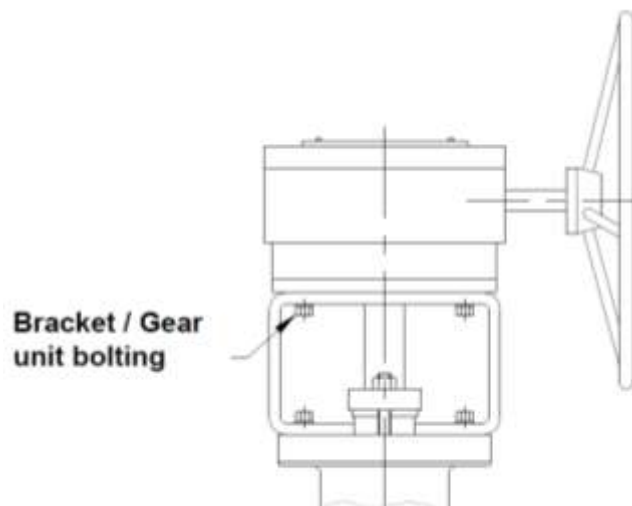
- Refer Appendix A1 for applicable standards
- For handling refer relevant section on Handling and Storage
- Please refer to the arrow plate attached to the valve body for preferred direction of flow
- Ensure that the valve is in fully closed position during installation
- Clean valve flanges and companion flanges and remove protective grease from the valve flanges. Clean the valve interiors adjacent piping priors to mounting of the valve pipe joint.
- Align the bolt holes of the valve end flange and pipe flange.
- Insert the gasket (not supplied with valve) and tighten the bolts. Flange bolts shall be tightened evenly. Using suitable device, in cross rotation to prevent damage to the flange.
- Bolts should be lubricated for ease of installation
- For sequence of tightening bolts, refer Appendix A2

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.

Reorientation of Gear unit

- If reorientation of gear unit is required, follow the points below.
- Unscrew the Bracket/Gear unit boltings.
- Remove the Gear unit.
- Check the no of key ways in the Drive Bush, if 4 key ways are available in the Drive Bush, then rotate the Gear unit to the required orientation in the steps of 90°, if two keyways are available, Remove the Gear unit, dismantle the drive bush from the top of the Gear unit & rotate it to the required orientation and assemble back to the Gear unit. Then mount the Gear unit to the valve.
- Tighten the bolts on Bracket/Gear unit.
- Operate the valve 2 or 3 times to check whether it was mounted correctly.
- For actuator reorientation, please check with factory for guideline.

Re-orientation of Gear unit to be carried out only when there is no pressure in pipe line



Valve Operation

General

- Operational life of the valve can be maximized if the valve is 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

Quarter turn motion of the valve is achieved using Gear unit/Hydraulic/Pneumatic/ Electric Actuator.

Gear Unit

Gear units are provided on valves for easier operation. Usually clockwise operation is for closing and anti-clockwise for opening of the valve. The position of the valve can be noted using the position indicator provided on top of the gear unit. The number of turns will depend on the gear unit used. The gear units are self-locking type, i.e., the line fluid will not make the disc to rotate. The gear units have mechanical stopper screws for setting the exact open and close position which are factory set. Refer trouble shooting section for correcting the mechanical stoppers (if required).

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, only gear unit stopper adjustment will affect the valve shut off.

Electric Actuator

It gives multi-turn output and is fitted on the gear unit or the quarter turn electrical actuators are directly mounted on the valve. The multi turn actuator drives the gear unit which in turn rotates the shaft. 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.

Electrically actuated butterfly valves are powered with gear unit, which convert multiple motor input turns into $\frac{1}{4}$ turn valve operation. The travel of the valve disc is limited by limit switches in the actuator housing and physical stop in the gear unit housing. Valve shutoff is affected by limit switch and physical stop settings.

Improperly set limit switches and/or physical stops may damage the motor and/or gear unit.

Pneumatic / Hydraulic /Electro-Hydraulic

Pneumatic/hydraulic/Electro-Hydraulic actuators are fitted directly on the valve, without separate gear unit, as these actuators have built-in quarter turn mechanisms / special lever arrangement. It is recommended to strictly adhere to the instructions as per actuator manufacturer's manual.

In case, valves are supplied as bare stem, as per customer requirement, ensure that connecting devices for actuators does not exert any axial or radial loads on the valve shaft, as it may lead to bending of the shaft 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 operating mechanism make sure that the TOBV valves 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. Butterfly valves 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.

Refer the general assembly drawing for recommended valve installation. Valves should be installed in the line after visually checking the condition of disc seal, In case there is any damage to the disc seal, the valve will not be leak tight, in such a case, replace the seal, before installing the valve in the line.

TOBV valve needs care and maintenance in its use. Always make routine checks once in three months for the working condition of operating mechanism

Always use recommended spares as per our guidance.

Lined Pipes and Heavy walled pipes should have a minimum inside diameter well clear of Dimension "Zn" (Refer Figure) in Disc full open position

Don'ts

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

DO NOT attempt forcible assembly of actuator on to the valve shaft, In case of any difficulty in proper matching of the key-ways, refer to the detailed instructional manual

DO NOT hammer actuator surface to drive it in

DO NOT use adaptor, actuator body and gear box casting as lifting points

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 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 remove operating mechanism from the valve when the disc is partially open/Close.

Do not remove gland & gland packing while fluid pressure is in the line.

These valves are not to be used for End of line service.

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

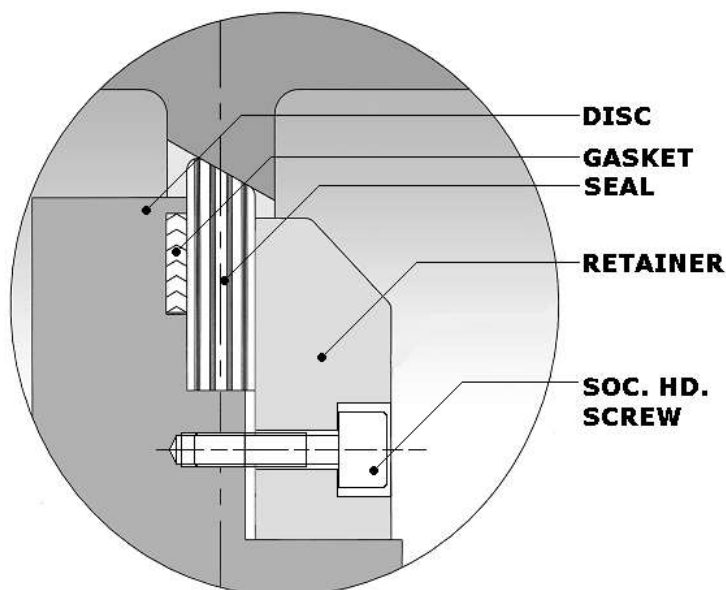
Always depressurize the pipeline when taking up any maintenance activity on the valve/ actuator.

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.

In-line Maintenance

- 1.1 These butterfly valves require only minimum in-line maintenance for satisfactory performance.
- 1.2 Check Gland nuts for tightness at regular intervals. If loose, tighten them evenly.
- 1.3 Refer Table II for Gland nut tightening Torque.



Routine Maintenance

1. Gland Leak

Check the tightness of the gland nuts and tighten evenly if required. If the leak persists, the packing may be renewed.

2. Packing Replacement

Caution: DO NOT replace the gland packing when the line is under pressure. Do not over-tighten packing and gland nuts. Over-tightening will increase the torque required to operate the valve.

Remove the gear unit/actuator and connecting keys. Its position relative to the valve must be noted for reassembly of gear unit/actuator.

Remove gland nut, gland flange and gland.

Remove packing and carefully clean packing cavity and shaft.

Insert new packing rings. Most of the packing rings are already cut so that they can be inserted around the stem. In case of solid moulded packing like Graphite rings, use a sharp knife and cut the ring at 30° angle. Then slightly twist the ring and insert it around the stem. Do not open up the ring as it could break.

Reassemble gland, gland flange and gland nut.

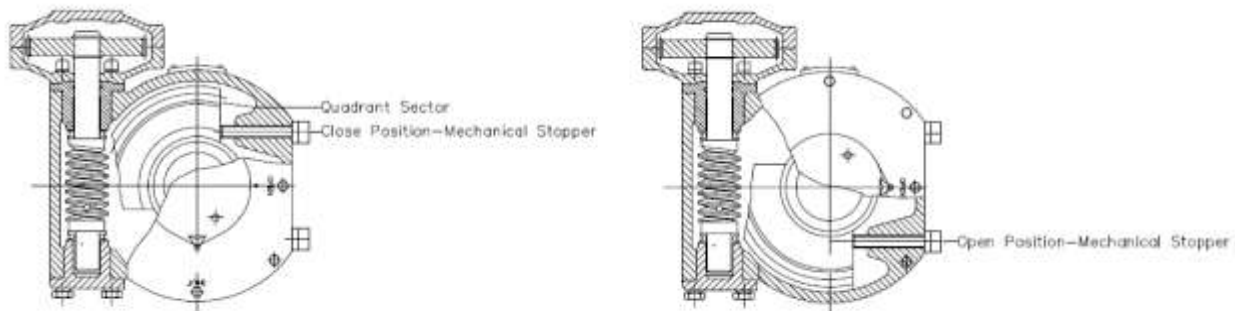
Reassemble connecting keys, gear unit/actuator and close the valve.

Caution: The gear unit/actuator will be a free moving fit. Do not force it on the stem.

Tighten the gland nuts and cycle the valve. Pressurize the line. If leakage is detected, tighten the gland nuts slowly and evenly until leakage stops.

3. Gear Units

Gear Operated valves are fitted with enclosed water tight worm gear units. The gears are designed to function without maintenance for many years. All gear units are lubricated with heavy bearing grease when assembled and may be refilled as required.



4. Actuators

For maintenance of electrical /pneumatic/hydraulic actuator refer the instruction manual of the electric actuator

Note: After maintenance of the TOBV, and before commissioning the same, please observe all the installation guidelines as mentioned in Valve Installation section.

Periodic Maintenance

Dismantling

The pipeline shall be drained of the line fluid and the valve removed from the line before dismantling.

Care should be taken during the removal of wafer and wafer lugged valves fitted with fail-open actuators. Such valves shall be closed using the manual over-ride gear unit before removing from the pipeline. If no manual over-ride is available, the fail open actuator shall be dismantled before the valve is removed from the pipe line. Subsequently, the valve shall be closed with a wrench and then removed.

The Operator may be changed without removing the valve from the pipeline, however, the line pressure should be relieved.

Maintenance of the operator shall be done as per manufacturer instruction.

Operator shall be changed when the valve shall be in the fully closed condition.

If the operator has a fail-safe position that cannot be overridden then unscrewing the bolting on the valve bracket should dismantle the actuator.

Dismantling and Assembly Procedure

Dismantling Procedure

- Depressurize the line and open the valve to drain the line
- Valves shall be slung properly and supported before loosening companion flange bolts.
- Place the valve in platform or base and transport to the repair shop. Refer GA drawings / Exploded view for component identification
- Open the valve completely and loosen the bolts of gear unit. If Motor operated valve, remove the actuator prior to loosening of gear unit
- Remove & Rotate the gear unit 90° anti clockwise.
- Rotate the disc to 180 degrees position, such that the retainer side is opposite to body seat side.
- Loose the gland bolting's.
- Remove the Retainer screw, Retainer and Seal from the disc.
- Pull out the dowel pin from the disc hub side using puller.
- Remove the gear unit from valve.
- Remove Bracket, Gland, Gland flange, spacer & packing.
- Loose the bottom cover screws to remove bottom cover from the body.
- Hold the disc firmly by using tapped holes provided in the disc hub.
- Pull out the shaft from bottom side.
- Remove the disc from the body.
- Remove the bearings & bearing seal from the body.

Carry out the required replacement of the parts and reassemble the valve with new parts

Assembly Procedure

Follow our standard assembly procedure LTV-DEP-526. Below given is general instruction for assembly.

- Check for cleanliness of all components i.e. body, disc, Shaft, bearing etc.
- Insert the bearings & bearing seal.
- Apply Molykote 321R on the bearing seal.
- Place the body in horizontal position.
- Place the disc on the body.
- Insert the shaft with thrust plate from bottom side
- Place the key in the shaft and fix the key to disc hub.
- Insert the spacer, packing, gland in the stuffing box area and fix the gland flange by bolting. (Refer packing replacement section)
- Assemble the bracket and gear unit.
- Insert the dowel pin in the disc hub side to connect with shaft.
- Rotate the disc 180 degrees (such that the disc seal groove shall be opposite to the seat end) and insert the disc seal gasket in the groove, place the seal & bolt the retainer to the disc.
- Tighten the gear unit with the top flange of bracket.
- For necessary tightening torque values refer Table 1 & 2.

Troubleshooting

| Problem | Reason | Action |
|---|--------------------------------|---|
| Leaks across Disc | Valve not fully closed | Check the indicator position in the gear unit & Rotate the handwheel until the 'close' position is reached. |
| | Valve seating damaged | Adjust the close position mechanical stopper by quarter turn & then close the valve. |
| | Seal gasket worn out | Dismantle and replace seal |
| Leaks through Gland | Packing loosened | Tighten Gland nuts |
| | Packing worn out | Replace packing |
| Not closing fully | Accumulation of debris on seat | Flush the pipeline with the valve in fully open condition |
| Leakage through Bottom cover | Gasket worn out | Dismantle and replace gasket |
| Leakage thru End flange | Gasket worn out | Dismantle and replace gasket |
| Noise/Vibration while opening & closing | Over tightened gland bolting | Loose and tighten the gland bolting with appropriate torque values for tightening |

IMPORTANT:

All these procedures require emptying the upstream and downstream piping and removal of valve from the pipe line. If the piping system provides access to retainer ring side of the valve (e.g. by dismantling / expansion joint/man hole access), removal of valve from piping is not necessary.

Appendix

A1 - References

Face to Face Dimensions

| | |
|----------|---|
| API 609 | Butterfly Valves: Double flanged. Lug and Wafer type |
| ISO 5752 | Metal valves for use in flanged pipe systems - Face to Face and Centre to Face dimensions |

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 | Butt Welding Ends |

Testing Standard

| | |
|---------|-------------------------------|
| API 598 | Valve Inspections and Testing |
|---------|-------------------------------|

A2 - Tightening Sequence & Torque

The tightening sequence for all possible number of bolting is beyond the scope of this manual. However, the logic to be followed is explained below

- Tighten the first four nuts in the sequence shown Fig.4. This helps in correct location of the mating parts.
- Tighten the other bolts in the sequence shown Fig.5 the same way.
- The sequence goes clockwise around the bolt
- Ensure that the recommended torque (refer Table1&2) is maintained in all bolting.

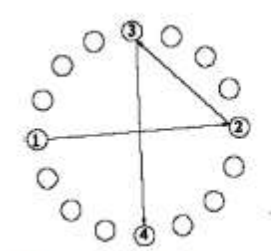


Fig. 4 Initial Tightening

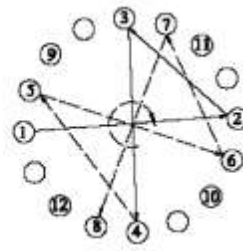


Fig. 5 Sequence of Tightening

Table 1 Tightening Torque values for Carbon steel bolting

| Thread size | Torque (+/-10%) (Nm) |
|-------------|----------------------|
| M8 | 16 |
| M10 | 32 |
| M12 | 57 |
| M16 | 140 |
| M20 | 274 |
| M24 | 473 |
| M27 | 693 |
| M30 | 940 |
| M33 | 1280 |
| M36 | 1644 |

Table 2 Tightening Torque values for Stainless steel bolting

| Thread size | Torque (+/-10%) (Nm) |
|-------------|-------------------------|
| M8 | 8 |
| M10 | 15 |
| M12 | 26 |
| M16 | 65 |
| M20 | 127 |
| M24 | 219 |