

Installation, Operation and Maintenance Manual of Fabricated Steel 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 Valves
- Control Valves
- Customised 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 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.

Fabricated Steel Butterfly Valves

The butterfly valves are bi-directional valves that allow flow in either direction. They are ideally suited for pump house applications where both sides of the discharge valves are expected to be pressurized.

Butterfly valves are offered in fabricated/cast construction. Valves are with single piece body construction either with flanged (Flat face/Raised face)/ butt weld ends. In addition, for sea water application valve bodies are supplied with Ebonite/EPDM lining and discs are Fusion bonded Epoxy coated/Ebonite/EPDM lined.

Range

Size	Pressure Rating
150 mm to 3000 mm	PN 6
150 mm to 2000 mm	PN 10
150 mm to 1400 mm	PN 16
200 mm to 900 mm	PN 20
250 mm to 400 mm	PN 25

Exploded View

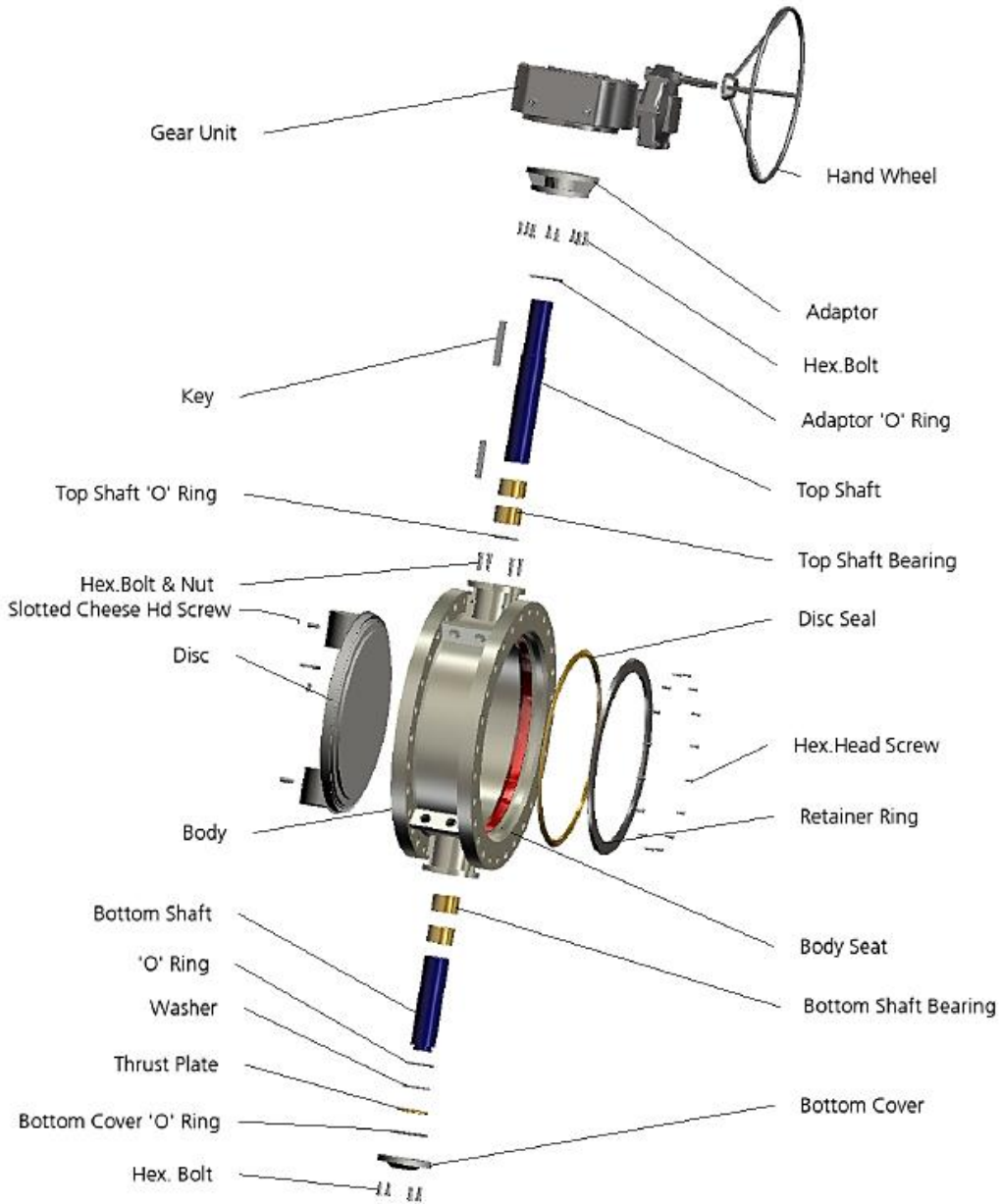


Fig 1

Shipment

Valves are shipped with the disc in a crack-open position, such that the elastomeric seal is not under compression and at the same time the disc does not protrude outside valve flange. Orientation of the valve in the packing 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. 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 (cast design). A typical identification plate is shown in Fig 2.


 L&T Valves Limited			
			Made in India
SIZE	DN 800	MAX PR	10 bar
BODY	IS:2062 GR B	MAX TEMP	90°C
SHAFT	SS 410	CAT No	-
DISC	IS:2062 GR B	TAG No	
SEAT	SS 304	S. No	
SEAL	NITRILE	DATE	

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 the 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.

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 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 identification plates or, tags etc.

- 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.)
- 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
- 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.
- Ensure that the valve is in fully closed position during installation
- The pipes/flanges 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 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 (Body-Bonnet/cover joint, yoke, gland, retainer, gear unit/actuator) shall be retightened to the required torque provided in appendix.

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 which may lead to leakage.

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 piping prior 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.
- Fasteners should be lubricated for ease of installation
- For sequence of tightening bolts, 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.

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 catalogues and general assembly drawing of the valve.
- Butterfly valves do not rely on shaft actuating force to provide tight shut-off. They require correct positioning of the closure element to seal properly.

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. Clockwise operation is for closing and anti-clockwise for opening of the valve (Refer fig.3). The position of the valve can be noted using the position indicator provided on 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).

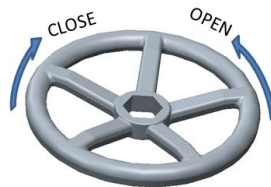


Fig 3

Forcing the hand wheel/chain wheel against the stops will not provide tighter shutoff of the valve and may damage the gear unit, only gear unit adjustment will affect the valve shut off.

Electric Actuator

It gives multi-turn output and is fitted on the gear unit. The 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. Actuator settings are to be done at factory and normally resetting at site will not be required.

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 effected by limit switch and physical stop settings.

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

Electrically actuated valve shall be set as below

Open : Position

Close : Position

Pneumatic / Hydraulic Actuator

Pneumatic/hydraulic actuators are fitted directly on the valve, without 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 butterfly 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 rubber seal, before installing the valve in the line.

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

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. Note under flow conditions, butterfly valves with eccentric disc are not self-locking, which may cause dangerous accidents.

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.

- Check the disc seal for any damage
- Check for any leak through the shaft seals
- Check bearings for any damage
- Check Operators for smooth and complete operation

1. Disc Seal

Depressurize the pipe line. Disconnect the electrical supply. Keeping the valve in closed position; remove it from pipe line, observing the necessary precautions for dismantling the valve from the pipe line. Keeping the valve disc in open position, check the disc seal for any damage

If the seal has been damaged replace it with new seal (refer relevant section on [Dismantling & Assembly Procedure](#))

2. Shaft Seals ('O' Ring)

There is no possibility of leakage through the shaft seal in the design, as the pressure is held by means of 'O' rings. However, in the extreme case of leakage due to damage of the 'O' rings, replace it (refer relevant section on [Dismantling & Assembly Procedure](#))

3. Shaft Bearings

This is a major repair operation of the valve and requires special equipment. Initially the valve should be taken out of pipeline by dismantling the side flange joints. Keep the valve so that the side flanges rest on smooth & clean flat surface.

Crane facility should be made available to hold / lift the valve. Dismantle the valve operator assembly, bottom cover and sealing assemblies on both top and bottom shaft sides. For removal of bearing, refer relevant section on [Dismantling & Assembly Procedure](#)

4. Gear Unit & Actuators

Generally the gear units are filled with grease (Shell Alvania EP2/equivalent 3). They do not require any additional maintenance. However in case extreme difficulty of operation, remove the top cover and refill the grease. Assemble the top cover; ensure that the mechanical stoppers inside the gear unit are not disturbed.

Setting of Mechanical Stoppers:

Close the valve manually till movement of disc is stopped by mechanical stopper in the gear unit. Check whether the disc seal engages uniformly with body seat ring. If not, loosen the close position mechanical stopper of the gear unit, move the disc till the contact line of the seal and body seat ring is parallel to face of the body seat ring. Set the close position mechanical stopper bolt, so that it touches the worm sector. Lock the mechanical stopper bolt in this position with the help of lock nut provided.

Open the valve manually till disc movement is stopped by open position mechanical stopper of the gear unit. Measure the angular movement of the position indicator, which should be 90 degrees. If not, move the disc so that the indicator shows 90 degrees angular movement from "shut" position. Set the open position mechanical stopper, so that it touches the worm sector. Lock the mechanical stopper bolt in this position with the help of lock nut provided. This completes the setting of mechanical stopper bolts.

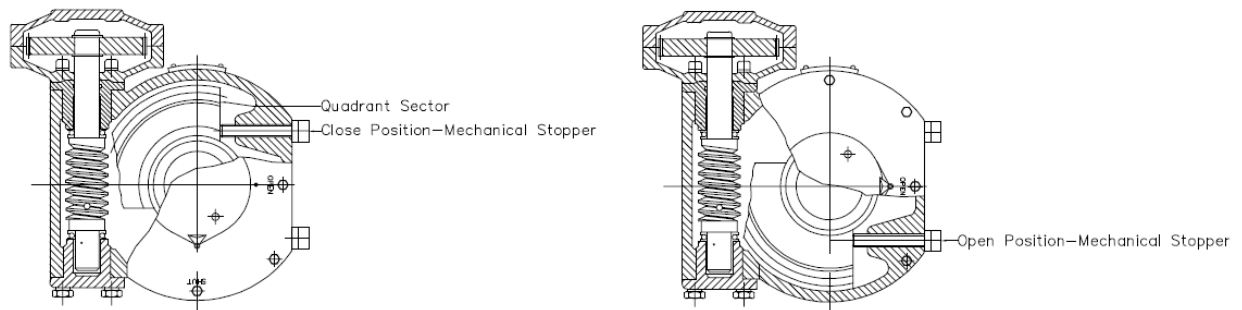


Fig. 4

Actuators

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

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

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
- Close the valve completely and loosen the bolts of gear unit. If Motor operated valve, remove the actuator prior to loosening of gear unit.
- Rotate the disc 180 degrees, such that the retainer side shall be opposite to body seat end.
- Remove the retainer screw, retainer and disc seal from the disc.
- Rotate the disc to its initial position and remove the gear unit.
- Remove the slotted cheese head screw (Top shaft) and slotted grub screw (Bottom shaft) from their respective disc housings.
- Remove the key from the top shaft and pull out the top shaft from the disc.
- Remove the bottom cover from the body.
- Remove thrust plate from the body and pull out the bottom shaft from the body.
- Remove the disc from the body.
- Remove the bearings from the body.

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

Assembly Procedure

- Check for cleanliness of all components i.e. body, disc, Shaft, bearing etc.
- Before insertion of bearing into their respective housings, apply Loctite 641/ Anabond 412 on its outer diameter.
- Apply Molykote 321R on the inner diameter of the bearing
- Insert the top shaft and bottom shaft bearing in their respective body housing.
- Insert top and bottom shaft in their respective body housing
- Insert the disc in to body and align disc hub centre to the body housing centre.
- Place the key in the shaft and fix the key to disc hub using slotted cheese Head Screw.
- Place the top shaft 'O' ring in their respective grooves provided in body, base plate or adaptor and fasten it with the valve top cover flange
- Insert the bottom shaft 'O' ring & Nylon washer in their respective grooves on the bottom side of body.

- Insert the thrust plate in the bottom shaft and place the bottom cover 'O' ring in the bottom cover before fastening with the body
- Assemble the gear unit to the top shaft and insert the key.
- Rotate the disc 180 degrees (such that the disc seal groove shall be opposite to the seat end) and insert the disc seal in the groove
- Assemble the retainer with disc.
- Fix the bottom shaft to the disc hub using slotted grub screw.
- Tighten the gear unit with the top cover flange of the body.
- For necessary tightening torque values refer Table 1 & 2.
- Before installing the valve in pipeline do conduct pressure test.
- Refer [assembly sequence](#) step file below for further details

Assembly Sequence Animation

- Step 1
- Step 2
- Step 3
- Step 4
- Step 5
- Step 6
- Step 7
- Step 8
- Step 9
- Step 10
- Step 11
- Step 12
- Step 13
- Step 14
- Step 15
- Step 16
- Step 17
- Step 18
- Step 19



Next Step

Previous Step

Play All Steps

Troubleshooting

Problem	Reason	Action
Leakage through the valve Fully Closed Condition	Deformed or Damaged Disc Seal	Replace the Disc seal (Refer Maintenance Chapter)
	Disturbed Setting of limiting stoppers in gear unit For Open/Close Position not allowing the disc to close fully	Set the gear unit mechanical stoppers (Refer Maintenance Chapter)
	Loose Retainer bolting / failure	Tighten/ replace bolts (Refer Appendix-A2)
Leakage through Shaft & Cover Flange	Worn out or damaged 'O' Ring	Replace the 'O' Ring (Refer Maintenance Chapter)
	Damaged Bearing	Replace the Bearing (Refer Maintenance Chapter)
Leakage through end flange facings	Inadequate tightening of flanged joint	Re tighten the Flanged joint
	Gasket damage	Replace the gasket
Noise /Vibrations while opening or closing of the valve	Inadequately supported / fixed valve and its assembly	Support / fix upstream / downstream piping and Valve foundation bolts (wherever applicable)

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

AWWA C504	Rubber Seated Butterfly Valves
IS EN 558	Industrial Valves-Face-to-Face and Center-to-Face Dimensions of Metal Valves for use in Flanged Pipe Systems -PN and Class Designed Valves
AWWA C516	Large diameter Rubber Seated Butterfly Valves

End Connections

AWWA C207	Steel Pipe Flanges for Water Works Service -Sizes 4 in Through 144 in. (100mm THROUGH 3600 mm)
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)
IS 6392	Specification for Steel Pipe Flanges
EN 1092-1	Flanges and their Joints-Circular Flanges for Pipes, Valves, Fittings and Accessories, PN-Designated
ASME B16.25	Butt Welding Ends

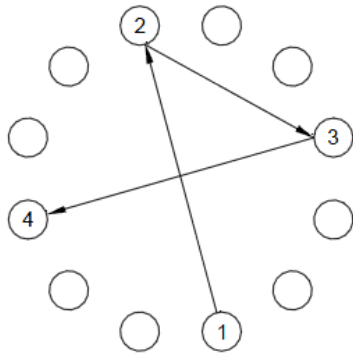
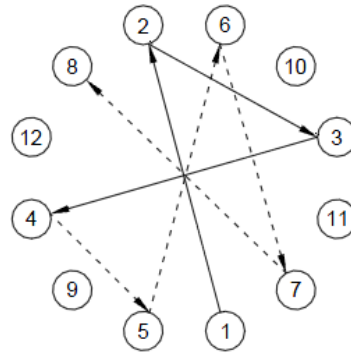
Testing Standard

AWWA C504	Rubber Seated Butterfly Valves
EN12266 PART-1	Industrial Valves - Testing Of Valve
AWWA C516	Large diameter Rubber Seated Butterfly Valves

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. 5 Initial Tightening

Fig. 6 Sequence of Tightening
Table 1 Tightening Torque values

THREAD SIZE, mm-Pitch	TORQUE, Nm		
	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
M4-0.7	2	2	2
M5-0.8	5	5	3
M6-1	7	7	5
M8-1.25	15	15	10
M10-1.5	30	30	20
M12-1.75	55	55	35
M14-2	85	85	55
M16-2	130	130	85
M18-2.5	180	180	120
M20-2.5	255	255	170
M22-2.5	345	315	230
M24-3	440	400	295
M27-3	645	525	430
M30-3	905	740	605
M30-3.5	875	715	580
M33-3	1230	820	820
M33-3.5	1190	795	795

M36-3	1625	1085	1085
M36-4	1530	1020	1020
M39-3	2095	1395	1395
M39-4	1980	1320	1320
M42-3	2645	1765	1765
M42-4.5	2445	1630	1630
M45-3	3290	2195	2195
M42-4.5	2445	1630	1630
M45-3	3290	2195	2195
M45-4.5	3060	2040	2040
M48-3	4025	2685	2685
M48-5	3675	2450	2450
M52-3	5175	3450	3450
M52-5	4760	3175	3175
M56-4	6275	4180	4180
M56-5.5	5915	3945	3945
M60-4	7795	5195	5195
M60-5.5	7385	4920	4920
M64-4	9545	6365	6365
M64-6	8920	5945	5945
M70-4	12630	8420	8420
M72-3	14200	9465	9465



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