

TRIPLE OFFSET BUTTERFLY VALVES

INSTALLATION, OPERATION AND MAINTENANCE

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SAFETY INFORMATION

The following general safety information should be taken into account in addition to the specific warnings and cautions specified in this manual. They are recommended precautions that must be understood and applied during operation and maintenance of the equipment covered in this I.O.M.



To avoid injury, never attempt disassembly while there are pressures either upstream or downstream. Even when replacing packing rings, caution is necessary to avoid possible injury. Disassemble with caution in the event all pressures are not relieved.



To prevent valve distortion, inefficient operation, or early maintenance problems, support piping on each side of the valve.



- A valve is a pressurized mechanism containing fluids under pressure and consequently should be handled with appropriate care.
- Valve surface temperature may be dangerously too hot or too cold for skin contact.
- Upon disassembly, attention should be paid to the possibility of releasing dangerous and or ignitable accumulated fluids.
- Ensure adequate ventilation is available for service.

This manual provides instructions for storing, general servicing, installation and removal of valves. Trust Valves refuses any liability for damage to people, property or plant as well as loss of production and loss of income under any circumstances but especially if caused by incorrect installation or utilization of the valve or if the valve installed is not fit for intended purpose. It is the sole responsibility of the user to ensure the valve type and materials are correctly specified.

DURING OPERATION, TAKE INTO ACCOUNT THE FOLLOWING WARNINGS:

- The valve's internal parts such as disc, stem, seat, shall be handled with care avoiding scratches or surface damage.
- All tools and equipment for handling internal critical sealing parts shall be soft coated.
- Seat & seals can include Viton, EPDM, Buna & Teflon hence high temperature will damage sealing components.
- Never part open or part close valve; valve must be full open or full closed to avoid seats damage.

For all operations, refer to position number on part list of the applicable drawing.

1 – OVERVIEW

1.1 – GENERAL NOTE

High performance butterfly valves have a Double eccentricity and can be used for automatic proportion control or isolation. However, for control valve use, valves must be metal to metal seated and throttling over 75% closed or under 25% open will still dramatically reduce seat & disc and valve body life, even more so at higher pressures and if service is not clean. Also for throttling/control applications, a special metal to metal seat design must be specified which is typically class IV or V shut off. However, normally the triple eccentric is specified for control valve use or class VI shut off isolation service is required. A simple and unique valve design enables the user to assemble and disassemble easily.

1.2 – TYPE

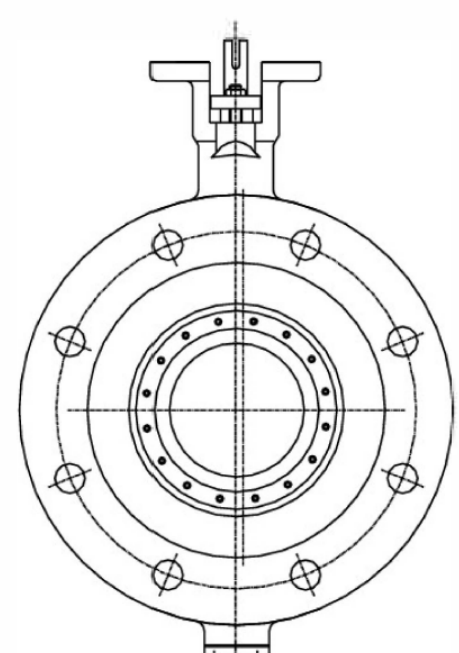
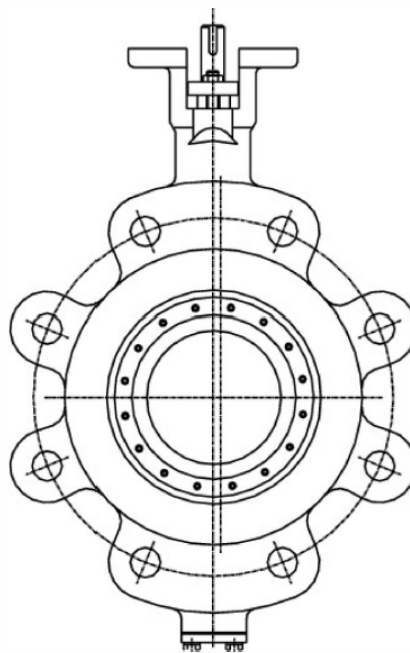
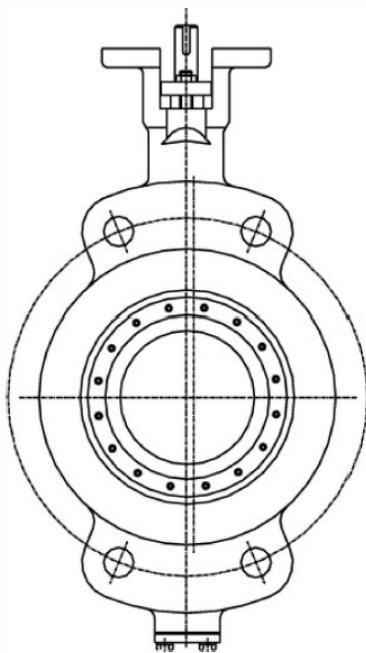
Valves are classified as Wafer Type, Lugged Type or Flanged. Their principal parts consist of body, disc, seat and stem. Material of each part is determined by the application and working condition of the valve.

DIAGRAM 1

Wafer Type

Lug Type

Flange Type



1.3 – DESIGN

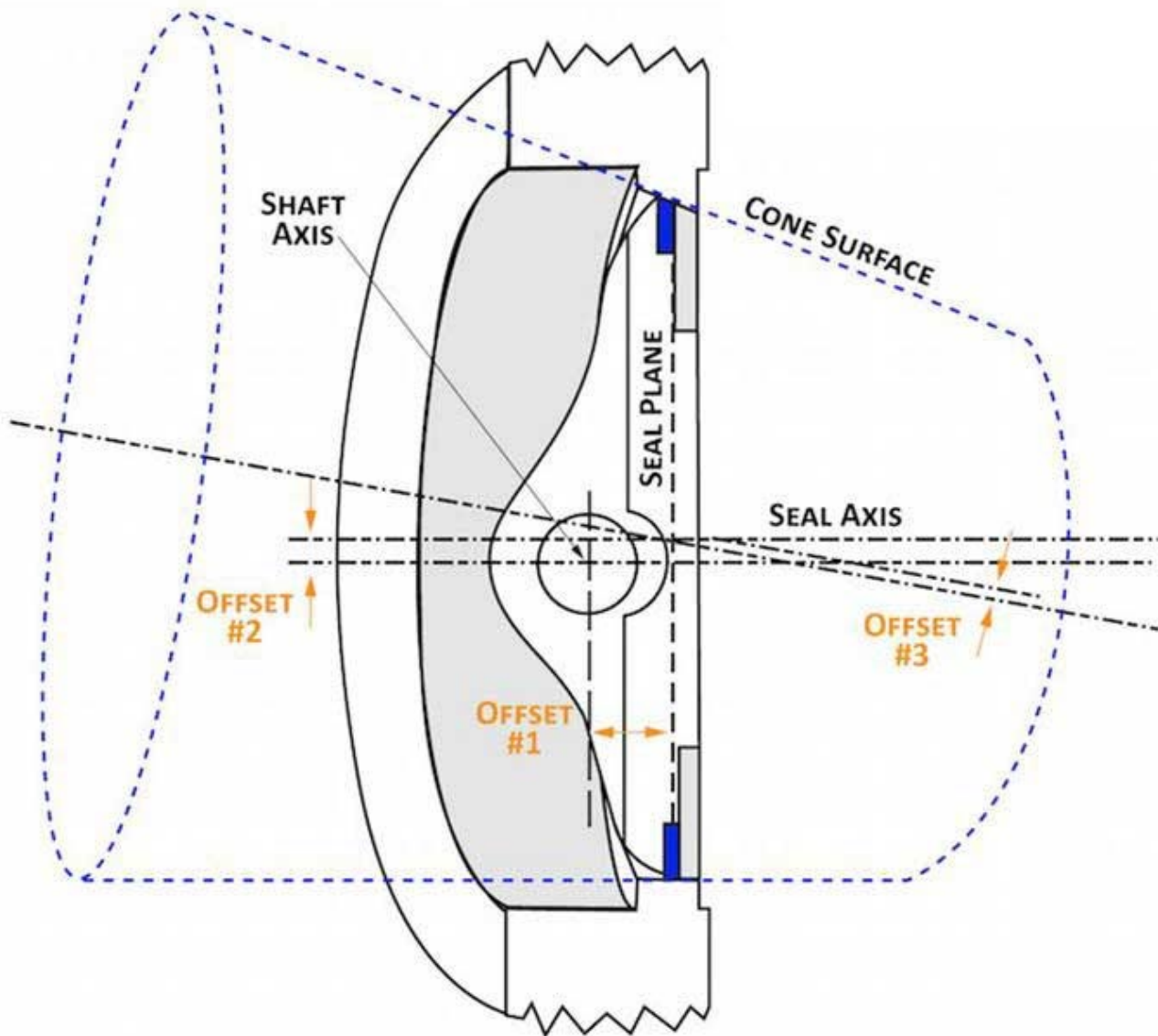
Triple offset metal seat butterfly valves provide a bi-directional and bubble tight shut-off, which is attributed to the geometry of the triple offset seat.

The valve stem is offset from the seat area (1st offset) and the valve seat surface center line is offset against the center line of the pipe (2nd offset) and the conical axis is offset from the valve center line (3rd offset: inclined cone). The 3rd offset completely eliminates rubbing or scraping.

The seat surfaces of the body and seal ring in this triple offset design, contact with an inclined "cone-in-cone", and this design requires precision seating tolerances and durability to ensure a slight precision lapped wedging effect.

In addition, the angle of contact between the body and seat ring provides a low opening and closing torque due to almost no wedging and no scraping action on opening or closing (unlike trunnion mounted ball valves). This eccentric triple offset design provides excellent sealing performance and seat durability and it hardly ever needs repair under normal service conditions.

The seat design can be all metal to metal (resilient design) or multiple laminated using resilient metal alternated with one or even two of the following laminations depending on service: graphite/aramid fiber/ceramic fiber.



1.4 – SCOPE

This manual describes the methods of installation and maintenance for high performance butterfly valves.

1.5 – OPERATION

The valve operator could be lever handle, manual gear, pneumatic actuator or electric motor actuator.

2 – STORAGE

2.1 – TEMPORARY STORAGE

If valves are to be stored before installation, the following should be observed:

- Keep the valves wrapped and protected as shipped from the manufacturer.
- Do not remove the protective ends covering until the valve is ready for installation. This will reduce the possibility of foreign material damaging the internal valve components.
- Valves stored outdoors should be positioned such that water does not accumulate in the valve body.
- We recommend you tropicalize bare and ends of valves if stored in humid or salt air environment.

2.2 – LONG-TERM STORAGE

If valves are to be stored more than one year, they should be prepared in the following manner:

- Remove the packing and apply a preservative to the packing chamber.
- Do not remove the protective end covering.
- Do not store the valves outdoor.

2.3 – PREPARATION

If storage in the field for a long time before installation is necessary, it is suggested to put valves in a dry and/or covered place. In this case the packaging and end covers integrity is especially important. All the valves are supplied with special plastic ends to cover and protect the internal parts. We recommend you do not remove them during storage period. Valves should be left in open position (unless actuated and set fail closed).

- Remove the valve end protection.
- The inside of the valve should be inspected and blown out with compressed air. Adjacent piping must be clean and free from debris to prevent damage to the valve.
- To prevent valve distortion, inefficient operation or early maintenance problems, support piping on each side of the valve.
- Make sure the valve is positioned such that there is sufficient space so that the handwheel is easily and safely reached and there is enough clearance for the stem when the valve is open.
- Install valve according to the flow indicator on the valve body where applicable.

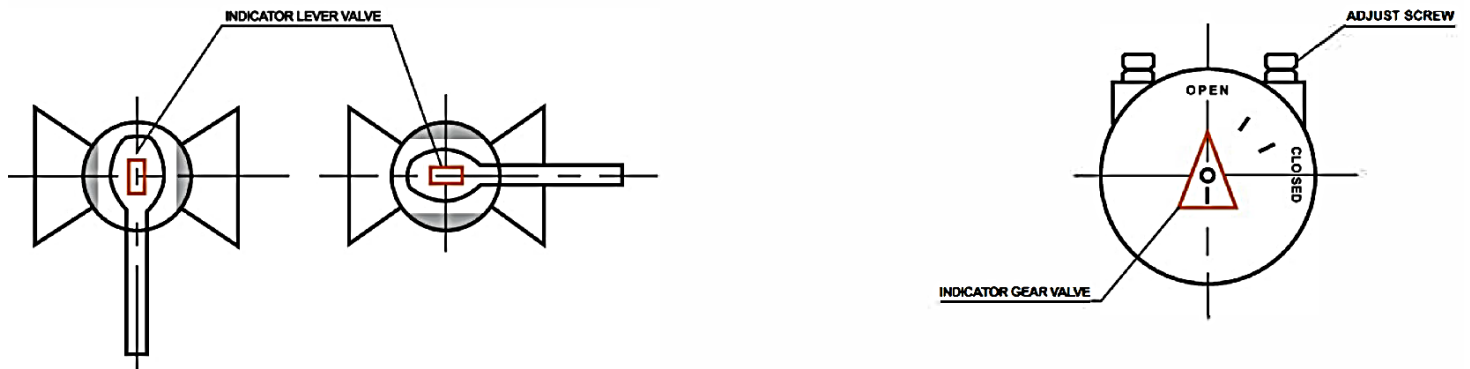
3 – OPERATION

The valve operator types include: lever handle, manual gear, pneumatic actuator and electric motor operated actuator. By rotating or closing the valve's disc, flow can be controlled through the pipeline by regulating the flow or shutting it off. (Generally, on-off direction is indicated on the operator). For control valve use, valves should preferably be metal to metal seated and throttling too far closed or at a small percentage of open for extended periods will still reduce seat & disc and valve body life, even more so at higher pressures and if service is not clean. For throttling/control applications, seat design may not have been specified as teak tight shut off.

3.1 – MANUAL OPERATION

Valve adjustment is performed by clockwise turning of the stem. Lever operated and gear operated valves have a position indicator to indicate open or closed (see Diagram 2). Valves must be full open or full closed. (See 3.0 above for control valve applications).

DIAGRAM 2



3.2 – LOCK DEVICE

Where provided (optional) the valve has a locking hole that allows valve to be locked in full open or full closed position.

4 – PRE-INSTALLATION

Before installation of the valve in the line, it is recommended to inspect the valves as below.

4.1 – INSPECTING VALVE & ACCESSORIES

- Ensure that there has been no damage to the valve during transportation.
- Remove the protective end covers just before installation and clean internals and face with an air gun or with a clean dust cloth.
- Check the tightness of all the bolts and nuts.

4.2 – INSPECTING PIPELINE

- Remove foreign materials such as a rust, welding slag, etc., which remain in the pipeline.
- Ensure flanges and gasket surface are clean.



When the fluid is flowing through the line, any foreign materials can damage the disc, seat and inner body causing leakage past the seat.

4.3 – PRESSURE TESTING OF PIPE SECTION

- First thoroughly flush newly installed line systems in order to flood out all foreign substances.
- The testing pressure of an opened valve must not exceed the value of 1.5 x PS (at 20°C/68° F). The component with the lowest PN limits the maximum permissible testing pressure in the line section. (PS = maximum permissible operating pressure, see also name plate).
- A closed valve must only be pressure-tested with 1.1 x PS.

4.4 – INSTALLATION IN PIPELINE

The sealing surfaces on valve ends are designed according to EN 1514-1 or ANSI B16.21. Mating must feature smooth sealing strips, e.g. shape e, D or E in accordance with the EN 1092 or EN 1759 standard. For a flange connection only suitable gaskets must be used.



To avoid any damage to valves with weld ends:

When welding the valve into the pipeline the welding process has to be controlled in such a way that the supplied heat is limited and a distortion of the valve body is avoided.



The actuator is adjusted for the operating data stated in the order:

The setting of the end stops "OPEN" and "CLOSED" must not be altered without the consent of Trust Valves.



No valve must be operated the permissible pressure/temperature range ("rating") of which is insufficient for the operating condition.

The non compliance of this instruction involves a risk to life and limb and may cause damage to the pipe system.

- Butterfly valves with a short face-to-face dimension: - mating flanges and/or pipe ends have to feature a clear span allowing for sufficient space for the open ed val ve disc so that the latter is not damaged when being swivelled out. Refer to dimensions on drawing.
- Prior to installation the valve and the down-stream pipeline have to be thoroughly cleaned of any contamination, especially of hard foreign substances.



Valves with a short face-to-face dimension have to be mounted with disc in closed position otherwise the valve disc could be damaged.

4.5 – SAFETY PRECAUTIONS

- Ensure the line is depressurised and drained.
- Check the pipeline media. Care should be taken for protection against toxic and/or flammable fluids.
- Never install the valve without an operator already attached to the valve shaft.
- Never remove the operator from the valve while the valve is in the pipeline under pressure.
- Always ensure that the disc is in the full-closed position before installing the valve.
- Take care handling the valve.

5 – INSTALLATION

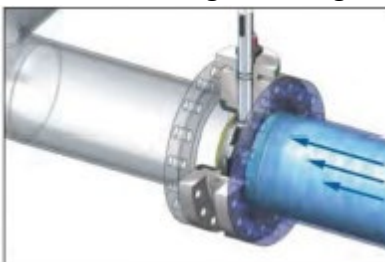
- Make sure the valve disc is fully closed. (Usually, valve is delivered with disc closed tightly to protect the seat ring).
- Check the preferred flow direction indicated by the arrow on the valve body where applicable.
- Be sure to place a gasket between the valve and pipe flange.
- Refer Appendix A for bolt tightening sequence example. Gradually tighten more each rotation.
- See Diagram 3.
- Before installing the valve, the user must check the valve model, connection dimension and flowing direction of the medium, ensure in accordance with requirement of valve. Confirm the construction material list on nameplates (service, pressure, temperature) are appropriate for the application intended and are as specified.
- Inspect the seat ring to make sure that it was not damaged during lifting & handling process. This is especially important in case of valves shipped with the disc in the open position and with 'fail-open' actuators.
- Define the preferred mounting orientation with respect to the system pressure. If any (see the arrow on body), identify the upstream side (high pressure) and downstream side (low pressure).
- Optimum valve installation is with the stem in a horizontal plane (with the actuator on top of the valve not below it as any packing leaks could damaged the actuator/gearbox) or worse case have the stem at an angle so as to minimise solid particles present in fluid that otherwise could deposit in the low bearing area.
- Check the packing gland to ensure it is properly tightened.
- During installation, the disc must be in closed position.
- For working temperature above 200°C thermal insulation of valve body is recommended.
- The installer must have skilled and experience in valve installation and maintenance.

The valve will operate in both directions, however, the valve must be installed so flow is in the direction indicated on the body as the valve may only be tested to isolate flow from one direction. Where the valve is tested in both directions the preferential flow direction may be indicated on the body.

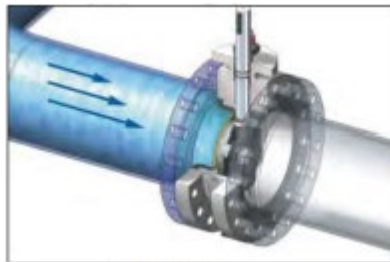


Over torque on the bolts might cause damage of gasket.

Bi-directional Tight Sealing Design

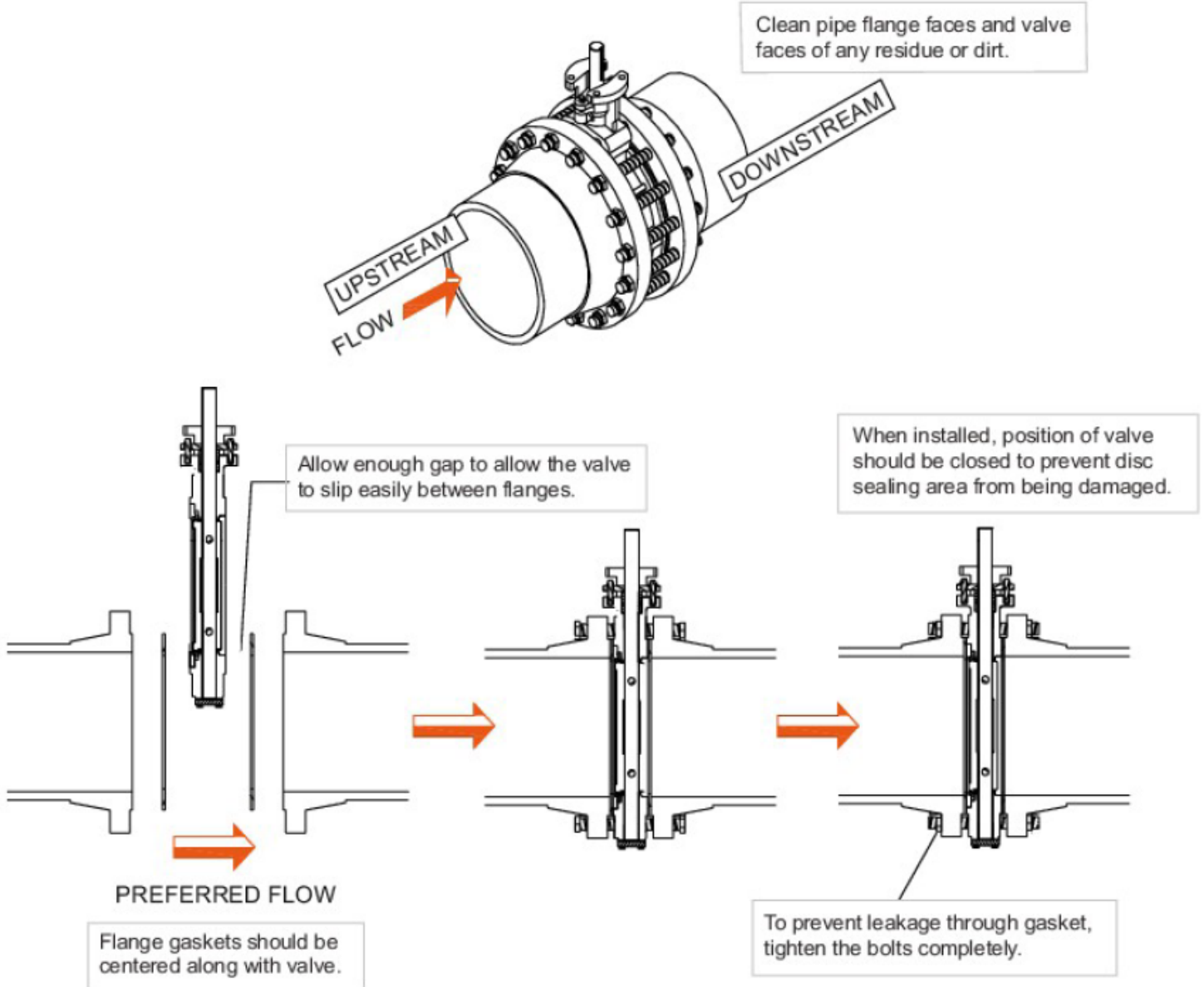


Preferred Direction



Non-Preferred Direction

DIAGRAM 3



Piping should be properly aligned and supported to reduce mechanical loading on the end connections.

5.1 – INSTALLATION POSITIONS

Butterfly valves should be installed as indicated in Diagram 3.

5.2 – PREPARATION FOR INSTALLATION

- Remove protective end caps or plugs and inspect valve ends for damage to threads or flange faces.
- Thoroughly clean adjacent piping system to remove any foreign material that could cause damage to seating surfaces during valve operation.
- Verify that the space available for installation is adequate to allow the valve to be installed and to be operated.



Ensure sufficient clearance for the stem in the full open position. Inadequate clearance for valves may add mechanical loading to the valve ends.

6 – MAINTENANCE

No maintenance is required unless the valve leaks. However, routine inspection is recommended for safety and a longer lifetime. Reconditioning or internal repairs to the valve should only be undergone by a Trust Valves approved repairer. Normal maintenance for a Butterfly Valve is limited to adjustment of the shaft packing by tightening down evenly on the gland flange using the gland flange stud and nuts. Over tightening of the gland should be avoided since this will shorten the life of the packing. During commissioning, it is common for dirt and foreign objects to be left in the pipeline during construction. This debris can damage the HP Butterfly Valve seat or disc edge which will prevent the valve from providing tight shut-off. In such cases seat replacement may be necessary.

- Inspect the body, disc and packing after the valve has been in service for a long period of time.
- Check the valve if any abnormal sounds or resistance is noticed during operation.
- Regularly ensure the tightness of each body bolt.

It is recommended that the valve be periodically at least partially stroked to ensure the valve functions and will prevent seizure/galvanization of any mating surfaces in stem chamber or seat area. Duration depends on service, criticality, etc.

All repair work (disassembly and replacement etc.) of our valve should be performed by well-trained maintenance personnel. Only a Trust Valves approved service center should attempt major repairs. Our repair center can arrange reconditioning if required. Information in this IOM is only a general guide to serve as an example. The design is different depending on size, class, seat option, trim type, body style, service & client specification. Refer the as-built drawing for actual parts.

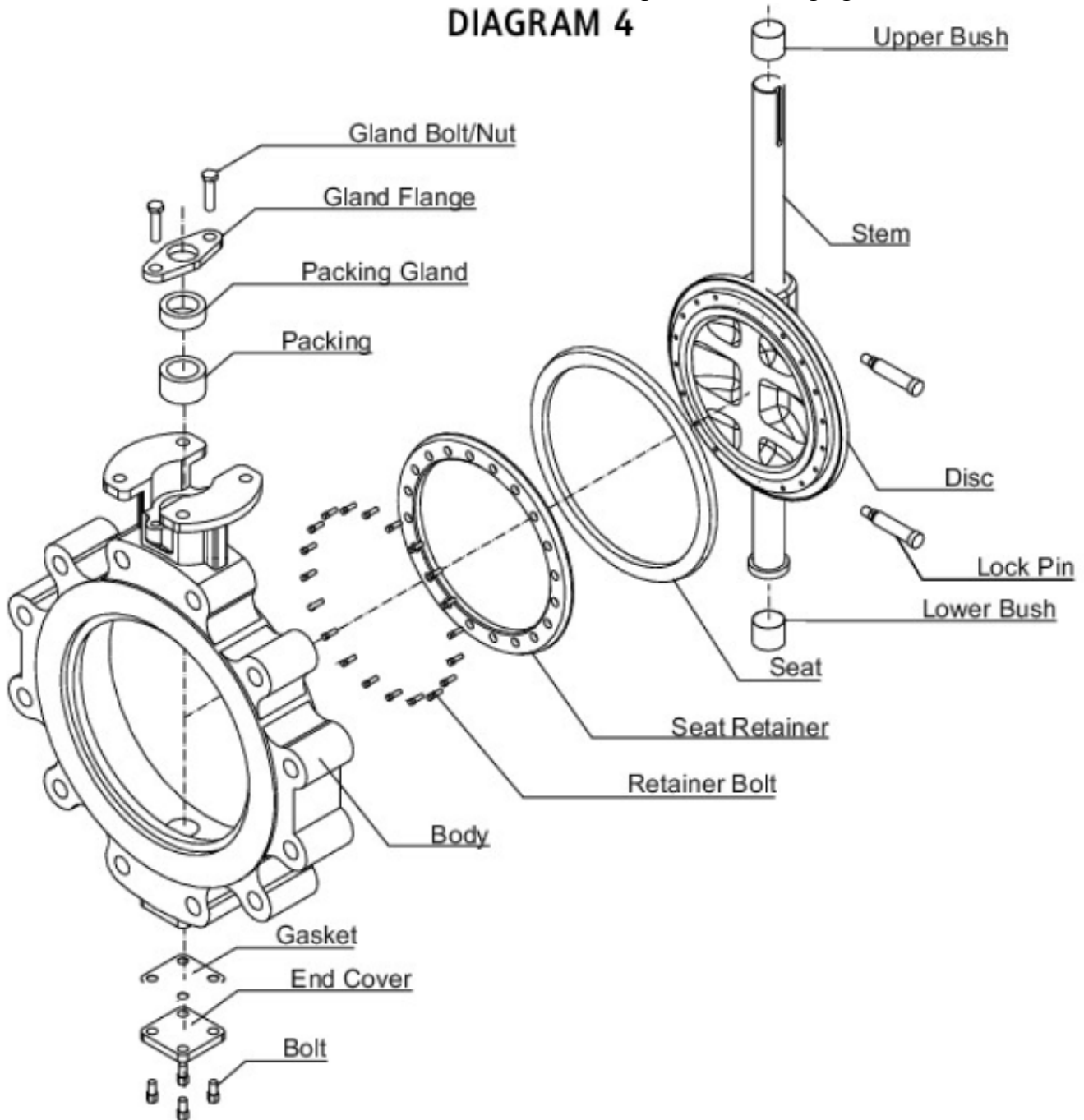
6.1 – PACKING

Leakage from the packing area of the valve can be prevented by tightening of the gland flange's nuts and bolts. If the leakage doesn't stop, packing replacement may be required instead. In this case, see 6.5 for the method of packing replacement.

6.2 – SEAT RING SEAT RETAINER

Before installation in the line, check the condition of the seat ring and the bolting tightness of the seat retainer.

DIAGRAM 4



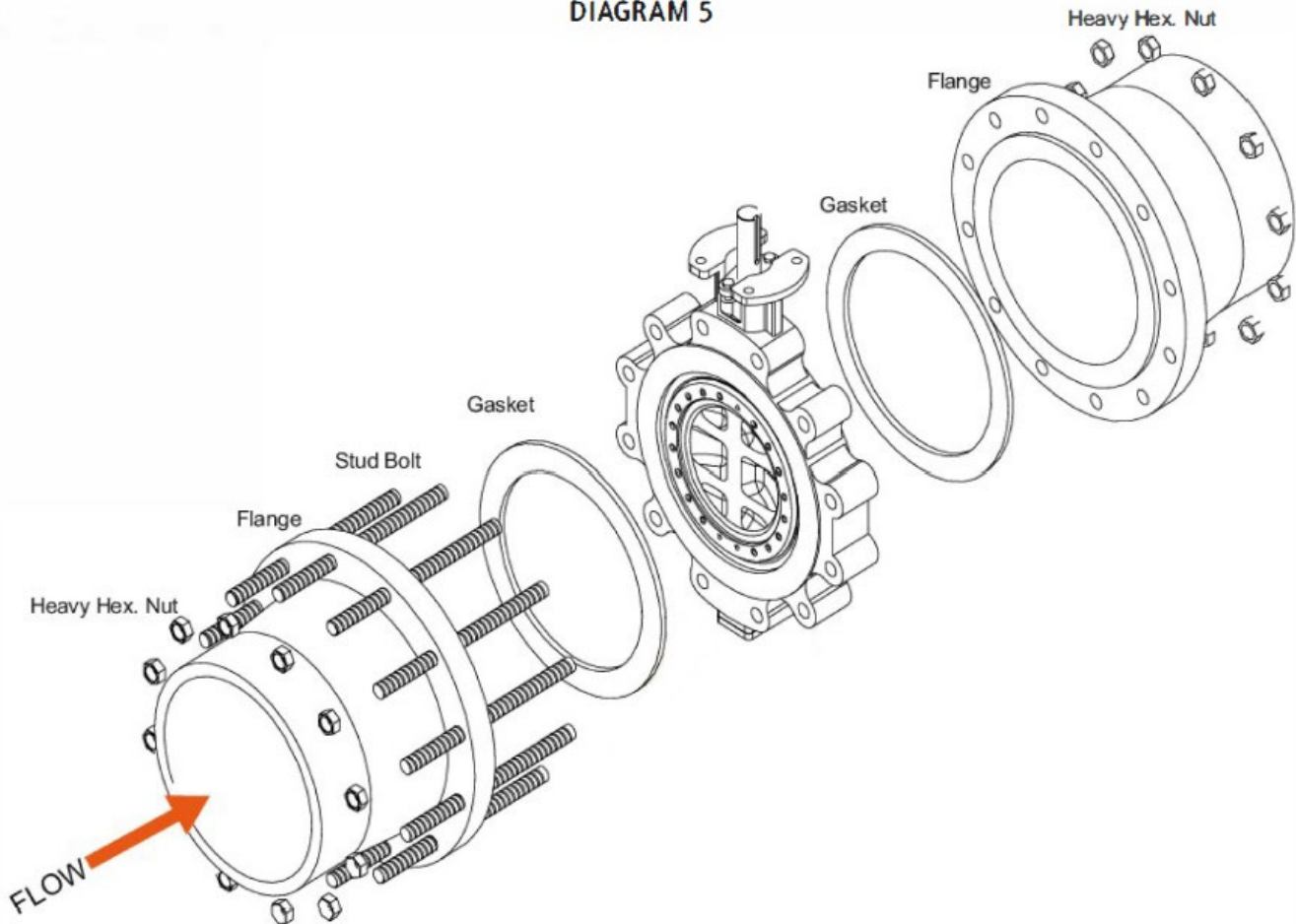
Indicative explosion only, design will vary depending on size, class, seating type, trim, end connections, etc.
Refer to as-built drawing.

6.3 – REMOVING VALVE FROM THE LINE

To repair a leaking valve, the valve must be removed from the pipeline and the parts dismantled as below by experienced, qualified personnel:

- Shut down the line and ensure that there is no pressure in the pipeline.
- Drain all product from the pipe.
- Completely close the disc of the valve.
- Remove the valve from the pipe.

DIAGRAM 5



Indicative drawing only, design will vary according to size, class, trim and seating type, etc.



Packing leakage could result in personal injury. Valve packing is tightened prior to shipping but may require adjustment to meet specific service conditions. If the fluid is hazardous or toxic then proper protection is required before the removal of the valve.



Always be sure that the valve is de-pressurized and isolated prior to performing any maintenance work. Disconnect any operating lines providing air pressure, control signals or electrical power to actuators. Do not attempt to repair valve in-line if volatile, dangerous, hazardous or flammable service.

6.4 – DISMANTLE THE SEAT RING & SEAT RETAINER

Reconditioning or internal repairs to the valve should only be undergone by a Trust Valves approved repairer. This is only a general guide to serve as an example. The design is different depending on size, class, seat option, service, etc. Refer the as-built drawing.

- Open the disc of valve (90 degree) with operating device.
- Remove the tightened retainer bolts on the seat retainer plate.
- Remove the seat retainer by lifting up with the jacking tap. First mark exact position of the seat. Due to offset machining, it can only be reinstalled in exactly the same position.
- Take out the inner seat. Be careful not to scratch or damage the seat ring. Clean the retainer plate and seat as well as the other parts of the valve with a soft dust cloth or air blaster.
- Refer to Diagram 6 & 6A below for disassembly of the seat retainer & seat ring. This is an example only as there are numerous configurations, refer to as-built drawing.

DIAGRAM 6

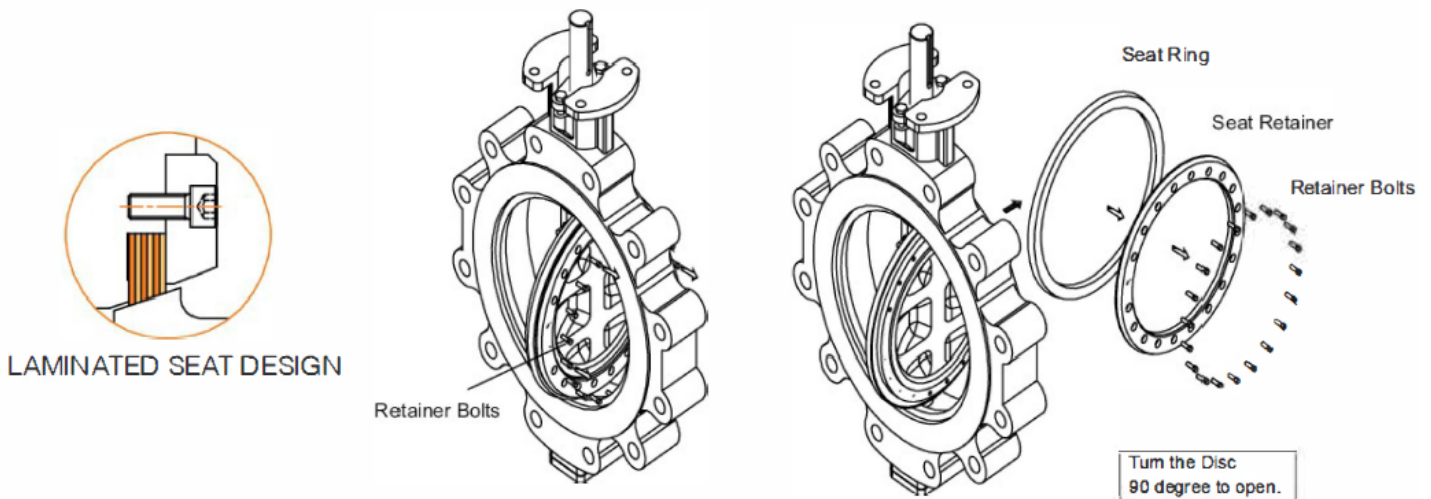
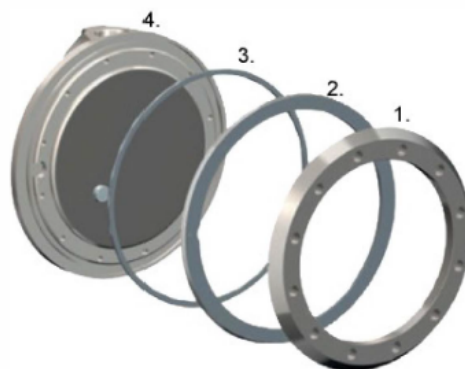


DIAGRAM 6A

Multiple laminated disc seating option

Key components

1. Disc retainer
2. Seal ring triple laminated
3. Spiral wound or graphite gasket
4. Disc and reference pin



Indicative explosive view only, design will vary depending on size, class, trim, end connections, trim seating type, etc. Refer to as-built drawings.

6.5 – PACKING REPLACEMENT

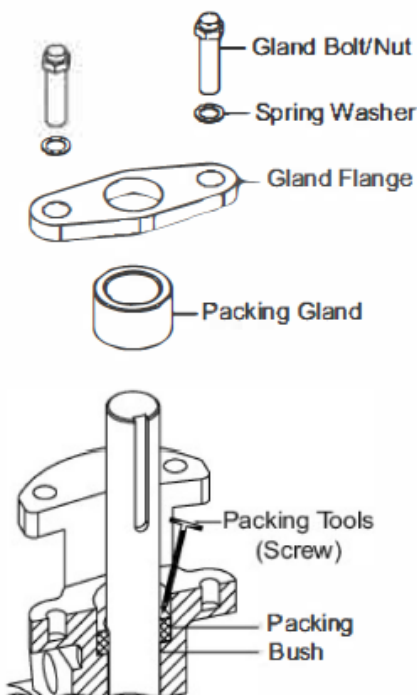


The packing cannot be replaced while the valve is in-line.

For replacement of packing, please take the following steps:

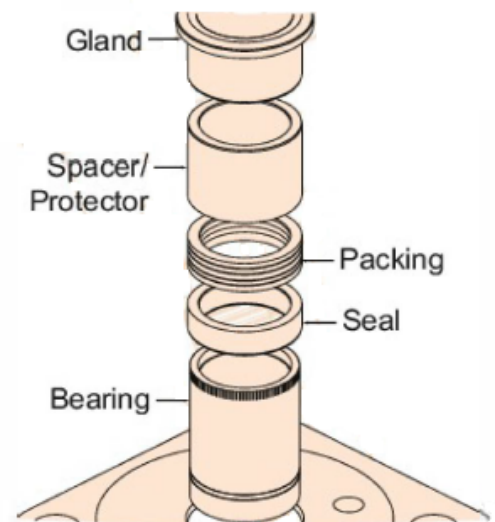
- Remove the Gland Flange after loosening the nuts of the gland flange.
- Slightly lift the packing gland up and remove it.
- Remove the packing using a packing extractor such as a screw or awl and gimlet.
- When you remove the packing with tools (packing extractor), be careful not to scratch and damage the packing housing wall or the valve stem because such damage may cause leakage.
- Insert a new set of packing in the packing housing after carefully cleaning the packing housing.
- After inserting the packing, assemble the packing gland and gland flange.
- The nuts of gland flange should be tightened sufficiently. Be careful not to over tighten the nuts as this may increase operating torque.

DIAGRAM 7



Packing Replacement

DIAGRAM 7A



Top Bonnet Parts



Check the packing box for pressurized process fluids even after the valve has been removed from the pipeline, particularly when removing packing hardware or packing rings, or removing packing box pipe plug.



If a gasket seal is disturbed while removing an adjusting gasketed part, Trust Valves recommends installing a new gasket while reassembling. A proper seal is required to ensure optimum operation.

6.6 – END COVER REPLACEMENT

For replacement of packing, take the following steps:

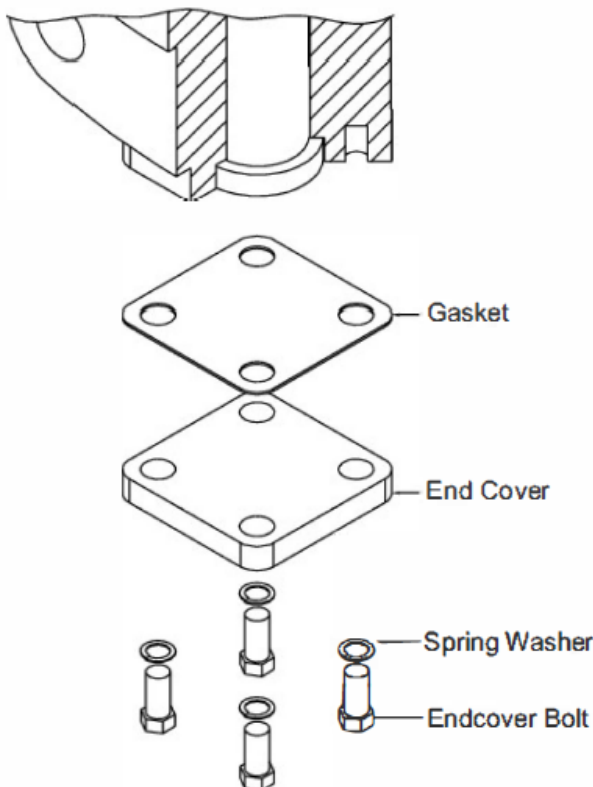
- Remove the bolts and end cover.
- Remove the gasket.
- After removing the gasket, clean the neck of the body prior to replacement of new gasket.
- Insert the new gasket.
- Put the end cover on & tighten the end cover bolts.

Diagram 8 & 8A are examples only. Refer to as-built drawing.



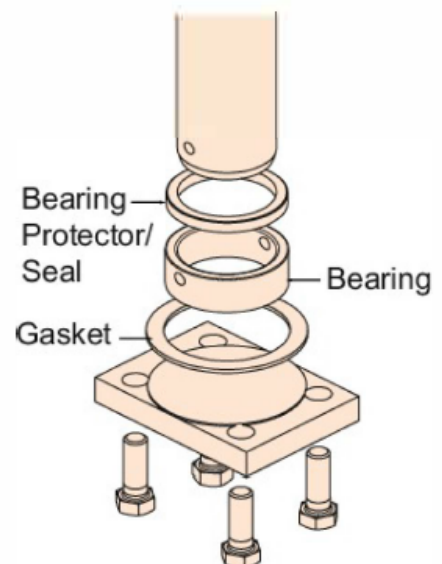
Over tightening of the bolts may cause thread damage. Bolt tensions shown in Appendix Table 1 must be decreased by 25% when no lubrication is used. Non lubricated bolts can have an efficiency of up to 50% less than the torque of valves stated.

DIAGRAM 8



Bottom Bonnet & Gasket (where applicable)

DIAGRAM 8A



Bottom Bonnet Parts (where applicable)

6.7 – SEAT RING REPLACEMENT

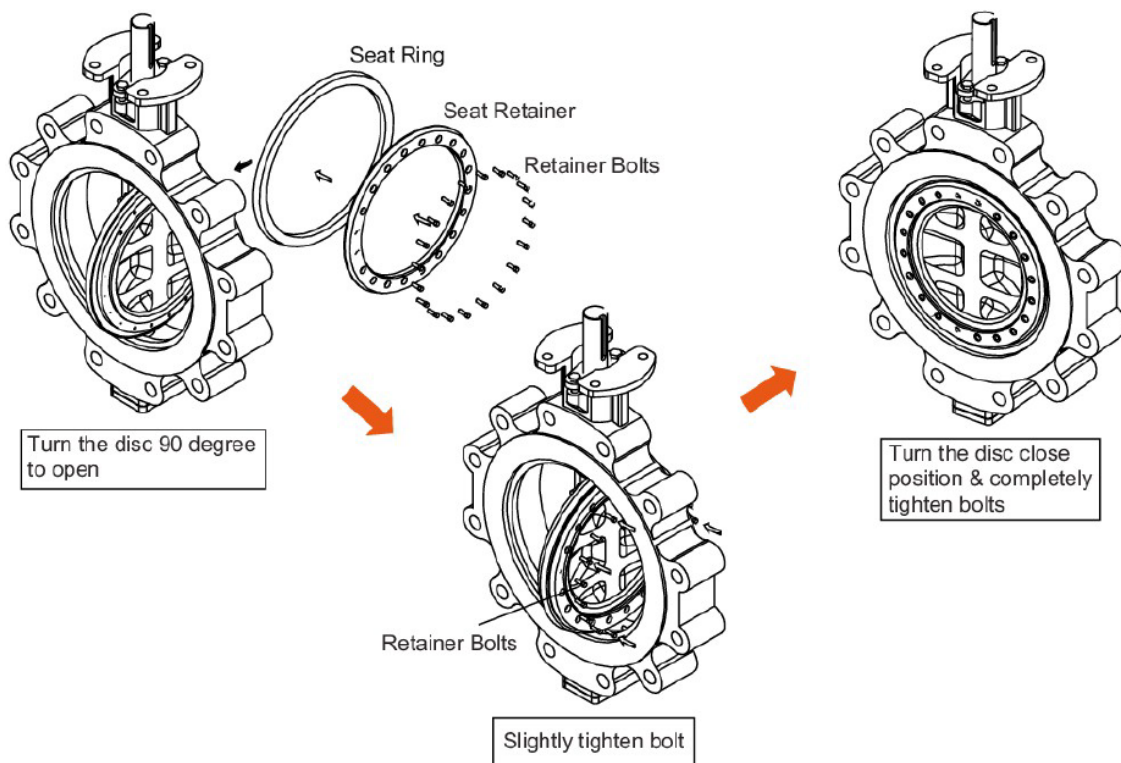
If fluid cannot be shut-off under the full closing position of disc, then seat damage is suspected. In the case of seat damage, replacement should be carried out as follows:

- Refer to 6.4 for instructions on disassembly of seat ring/seat retainer.
- Replace the damaged seat ring with a new one. Important: higher shut off classes may need to be precision mated lapped by an expert on triple eccentric valves.
- New seat ring should be seated to 90° to the disc opening angle. The correct matching seat angle is essential. Depending on the class of the shutoff, the seat may require blue metal precision lapping to match disc. Any replacement seat will be provided with installation position marking.
- For re-assembling of the seat retainer, reverse the steps of the previous disassembly.
- Slightly tighten the seat retainer bolts up to the closing position. The seat can only go in one way as it is precision offset matched to the disc.
- Then gently hit with a rubber mallet until 100% closed. Rotate the disc a couple of times and then tighten the bolts completely.
- Finally, rotate the disc several times to ensure the correct position of the seat. The above needs to be done to get the seat settled in position.
- Install the valve on the pipeline with disc fully closed.

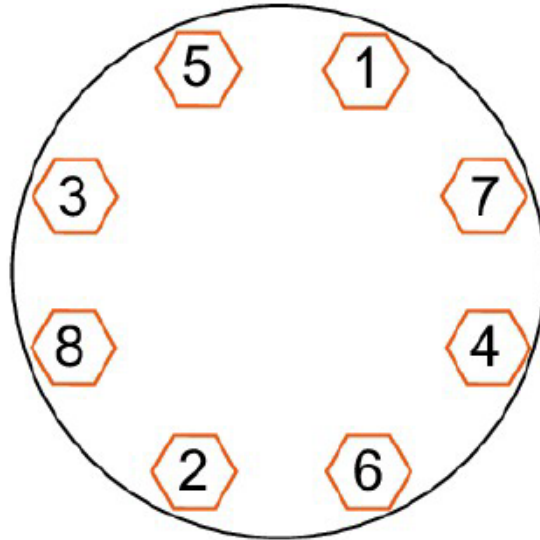


Over tightening of bolts may cause damage to bolts or valve. Always lubricate bolts before installation. Bolt tensions shown in Appendix Table 1 must be decreased by 25% when other or no lubrication used. Non lubricated bolts can have an efficiency of up to 50% less than the torque of values stated.

DIAGRAM 9



Indicative drawing only, design will vary according to size, class, end connection, trim, seat type, etc.

APPENDIX A
DIAGRAM 10

TABLE 1
Indicative Bonnet Bolting (Bolted Bonnet) Torque ft·lb (N·m)

Stud Size	Bolting Material			
	B7M / L7M	B7 / B16 / L7	B8 / B8M CL.1	B8 / B8M CL.2
3/8 – 16 UNC	15 (20)	20 (27)	15 (20)	20 (27)
7/16 – 14 UNC	25 (34)	30 (41)	22 (30)	25 (34)
1/2 – 13 UNC	40 (54)	50 (68)	35 (47)	45 (61)
9/16 – 12 UNC	55 (75)	70 (95)	55 (75)	65 (88)
5/8 – 11 UNC	75 (102)	100 (136)	70 (95)	85 (115)
3/4 – 10 UNC	135 (183)	170 (231)	125 (170)	150 (203)
7/8 – 9 UNC	200 (271)	270 (366)	170 (230)	200 (271)
1 – 8 UNC	350 (475)	400 (542)	219 (298)	350 (475)
1 1/8 – 8 UN	500 (678)	520 (705)	256 (398)	450 (610)
1 1/4 – 8 UN	675 (915)	850 (915)	321 (498)	650 (881)

Note:

- (1) Torques shown are for A193 B7/B16/B7M/B8/B8M and A320 I7/I7M/B8/B8M.
- (2) Torque tolerance $\pm 10\%$.
- (3) For temperatures above 750°F (400°C) use 75% of the torque values.
- (4) Above torque values are with the bolts lubricated.
- (5) Values above are based on 30,000 psi (206.85 Mpa) bolting stress and lubricated with heavy graphite and oil mixture or a copper based anti-seize grease.
- (6) Do not exceed by more than 25% of values stated when emergency torquing is required.
- (7) All bolts shall be torqued in the pattern as shown in Figure 6 over page to ensure uniform gasket loading
- (8) Optimum torque can vary depending on type of body gasket but do not increase torque more than 10% above those shown.
- (9) Consult Trust Valves for other bolt material.
- (10) Most B8M and B8 bolts are class 1 so do not assume class 2 unless you are sure.

For any technical request or assistance, feel free to contact Trust Valves Quality Department at:

quality@trust-valves.com – +39 02 9675 4324