FLOWSERVE

USER INSTRUCTIONS

Installation
Operation
Maintenance

Durco® TX3
Triple Offset Butterfly Valve

Experience In Motion

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1. General Information and Precautions

1.1 Use

The following instructions are designed to assist in the unpacking, installation, operation and maintenance as required for Flowserve products. Product users and maintenance personnel should thoroughly review this manual prior to installing, operating or performing any maintenance. In most cases, Flowserve accessories, actuators and valves are designed for specific applications (e.g., with regard to medium, pressure and temperature). For this reason, they should not be used in other applications without first contacting the manufacturer.

1.2 Applicability

The following instructions are applicable to the maintenance and instal- lation of Flowserve TX3 Triple Offset Butterfly Valves. These instructions cannot claim to cover all details of possible product variations, nor can they provide information for every possible example of installation, operation or maintenance. This means the instructions include only directions to be followed by qualified personnel using the product for its defined purpose. If there are any uncertainties in this respect, particularly in the event of missing product-related information, clarification must be obtained via the appropriate Flowserve sales office. Flowserve user manuals are available at www.flowserve.com.

The following instructions are applicable to the valve body subassembly. Gear operators, actuators and accessories are covered in other manuals. Please refer to those manuals for mounting, setup, usage and maintenance for those items.

1.3 Terms Related to Safety

The terms DANGER, WARNING, CAUTION and NOTE are used in this document to highlight particular dangers and/or provide additional information on points which may not be clear.

☠ ***DANGER: Indicates that death, severe personal injury and/or substantial property damage will occur if proper precautions are not taken.***

⚠ ***Indicates that death or severe personal injury and/or property damage may occur if proper precautions are not taken.***

⚠ ***CAUTION: Indicates that minor personal injury and/or serious damage to property may occur if the appropriate precautions are not taken.***

❗ ***NOTE: Indicates and provides additional technical information which may not be obvious, even to qualified personnel.***

Compliance with other notes, which may not be particularly emphasized, with regard to transport, assembly, operation and maintenance and with regard to technical documentation (e.g., in the operating instructions, product documentation or on the product itself) is also essential in order to avoid faults, which can directly or indirectly cause severe personal injury or property damage.

1.4 Personal Protective Equipment

Flowserve products are often used in hazardous applications (e.g., under extremely high pressures with dangerous, toxic or corrosive mediums). When performing service, inspection or repair operations, always ensure the valve and actuator are depressurized, the valve has been cleaned as per applicable MSDS (Material Safety Datasheet) and procedures, and is free of harmful substances. In such cases, pay particular attention to personal protection (e.g., protective clothing, gloves, glasses, downdraft systems, etc.).

1.5 Qualified Personnel

Qualified personnel are people who on account of their education, expe- rience, training and knowledge of relevant standards, specifications, accident prevention and operating conditions have been authorized by those responsible for the safety of the plant to perform the necessary work, and recognize and avoid possible dangers.

1.6 Spare Parts

Use only Flowserve original spare parts. Flowserve cannot accept responsibility for any damages that occur from using spare parts or fastening materials from other manufacturers or unauthorized modifi- cation of original factory parts. If Flowserve products (especially sealing materials) have been stored for long periods of time, check them for corrosion or deterioration before putting them to use.

1.7 Service / Repair

To avoid possible injury to personnel or damage to products, safety terms must be strictly adhered to. Modifying this product, substituting non-factory parts, or using maintenance procedures other than those outlined in these installation, operation and maintenance instructions could adversely affect performance, be hazardous to personnel and equipment, and may void existing warranties.

Between the actuator and the valve there are moving parts. To avoid injury, Flowserve provides pinch-point protection in the form of cover plates, especially where side-mounted positioners are fitted. If these plates are

removed for inspection, service or repair, special attention is required. After completing work the cover plates must be refitted.

Apart from the operating instructions and the obligatory accident prevention directives valid in the country of use, all recognized regula- tions for safety and good engineering practices must be followed.

⚠ ***WARNING: Before products are returned to Flowserve for repair or service, Flowserve must be provided with a certificate that confirms the product has been decontaminated and is clean. Flowserve will not accept deliveries if a certificate has not been provided. (A form can be obtained from Flowserve.)***

1.8 Storage

In many cases, Flowserve products are manufactured from stainless steel or other corrosion-resistant alloys. Products not manufactured from stainless steel are provided with a corrosion-resistant coating specific to the application. Nevertheless, Flowserve products must be stored adequately in a clean, dry, enviromentally controlled area. Any spare parts should be stored in the original packaging and under the same conditions as the valve. Plastic caps are fitted to protect the flange faces and a coating of oil applied to protect the flange faces from corrosion. These caps should not be removed until valve installation.

2. Unpacking

2.1 While unpacking the valve, check the packing list against the materials received. Lists describing the valve and accessories are included in each shipping container.

2.2 When lifting the valve from the shipping container, use straps secured around the top and bottom bearing areas or around the valve neck area. Take care to position lifting straps to avoid damage to the tubing and mounted accessories.

⚠ ***WARNING: When lifting a valve, be aware the center of gravity may be above the lifting point. Therefore, support must be given to prevent the valve from rotating. Failure to do so can cause serious injury to personnel and damage to the valve and nearby equipment.***

⚠ ***WARNING: An automated valve assembly should never be lifted by the actuator.***

⚠ ***WARNING: Never pass a lifting device through the valve port opening or serious damage may occur.***

⚠ ***WARNING: For fail open valves, the disc will be in open position and care should be taken not to damage the seal ring while handling.***

2.3 Inspect the valve for damage that may have occurred during shipment. In particular, inspect the actuator, shaft, valve interior, valve body, valve seat and flanges. For proper operation of the valve, the valve seat and seal ring must be undamaged and free of foreign material. Contact your shipper immediately if there is shipping damage.

2.4 Should any problem arise, contact your Flowserve representative.

☠ ***DANGER: Before installation, check the order number, serial number and/or tag number to ensure the valve and actuator being installed are correct for the intended application.***

⚠ ***CAUTION: Do not insulate extensions that are provided for hot or cold services.***

3. Installation

3.1 Before installing the valve, clean the pipeline of all contamination, carbon deposits, welding chips and other foreign material. Carefully clean valve and pipe gasket surfaces free of dirt or oil to ensure a tight seal. Pipelines must be correctly aligned to ensure that the valve is not fitted under tension.

3.2 Any required fire protection must be provided by the user.

3.3 Check the direction of fluid flow to ensure the valve is correctly installed. The preferred flow direction is indicated by the arrow attached to the body, with the shaft oriented upstream. The best closure performance is obtained with flow in this direction, and a determination as to the best installation should be made to take advantage of this feature. Refer to applicable local facility valve datasheets for more details. This may not necessarily be the normal flow direction of the system.

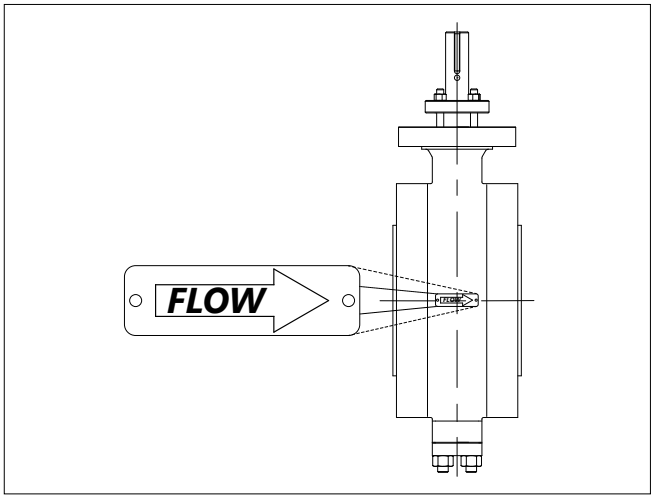

Figure 1: Flow arrow direction indication

☠ ***DANGER: To avoid serious injury, keep hands, hair, clothing, etc. away from the disc and seat when the valve is operated open or close.***

3.4 Whenever possible, the valve should be installed with the stem in a horizontal position to prevent pipeline debris from collecting around the bottom bearing.

⚠ ***CAUTION: Actuation that is installed in a horizontal position must be properly supported to prevent side-loading the valve stem. Consult actuator IOM or technical bulletin for additional guidelines.***

3.5 Make sure the valve is installed concentrically between the flanges in order to avoid damage to the disc and interference with the flange and pipeline.

3.6 The typical installation for a butterfly valve connected to an elbow would be to align the shaft axis to allow equal flow on each side of the shaft to minimize any dynamic torque effects due to uneven flow through the elbow (see Figure 2 below).

3.7 Always use an extension tube between a wafer check valve and the butterfly valve to eliminate potential interference between the butterfly disc and the check valve. Never connect them directly.

3.8 Refer to appropriate actuator or accessory IOM for proper procedures for installing and commissioning actuators and control accessories.

3.9 Install valve into pipeline, per good industry practice, complying with all local regulations and legal requirements.

3.10 Use care when welding valves into the pipeline to avoid excess heat buildup in the valve.

3.11 Confirm the capacity of all flange bolts to ensure a sufficiently tight gasket seal for the expected service conditions. It is the user's responsibility to select and install proper flange bolting according to local and industry standards and requirements.

4. Quick-Check

Before commissioning, check the valve installation by following these steps:

4.1 Check for full stroke by operating the valve actuator as appro- priate (manual gear, on-off solenoid or positioner-controlled). Observe the shaft position indicator located on the operator or accessory. The shaft should change position with a smooth turning movement.

4.2 Check any actuation and controls per appropriate IOM for air leaks.

4.3 Check packing box bolting for proper tightness, referring to Table 1.

⚠ ***CAUTION: Do not over-tighten packing box bolting. This can cause excessive packing wear and high stem friction that may impede shaft movement. After the valve has been in service for a short period, recheck the packing box nuts. If the packing box leaks, tighten the nuts enough to stop the leak.***

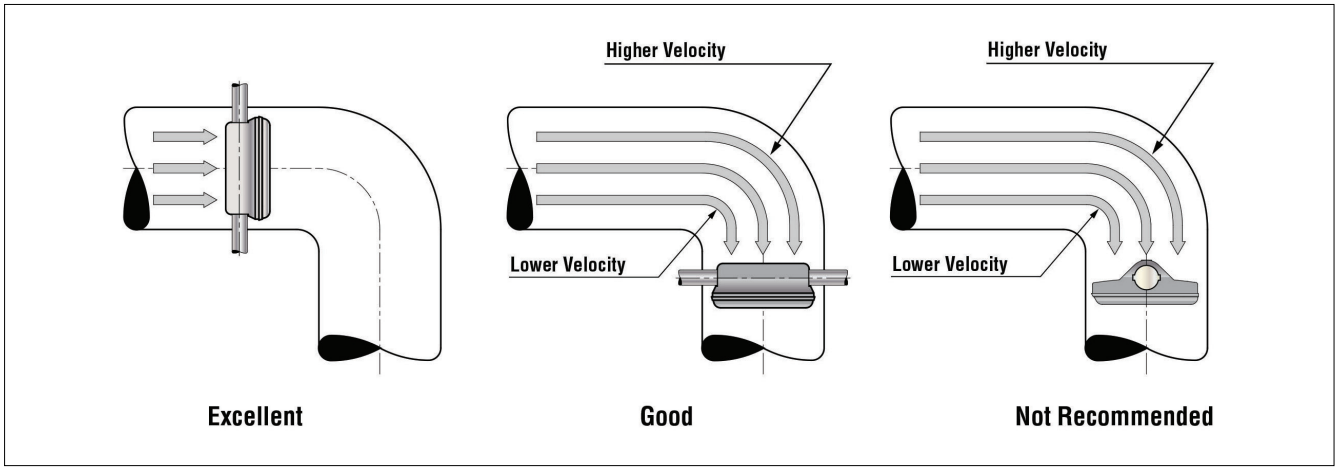

Figure 2: Piping diagram

Packing Box Bolting Torque						
	Class 150		Class 300		Class 600	
NPS	ft-lb	Nm	ft-lb	Nm	ft-lb	Nm
3	9	12	9	12	9	12
4	9	12	10	14	26	35
6	9	12	24	33	24	33
8	12	16	16	22	24	33
10	13	18	17	23	48	65
12	16	22	21	28	69	94
14	16	22	33	45	83	113
16	18	24	63	85	106	144
18	21	28	70	95	147	199
20	24	33	77	104	175	237
24	62	84	120	163	325	441

Table 1: Packing box bolting torque

4.4 For fail-safe applications, make sure the valve fails in the correct direction. Consult appropriate actuation and accessory IOMs for any potential corrective action.

5. Preventative Maintenance

At least once every six months, check for proper operation by following the preventative maintenance steps outlined below. If local facility regulations allow, these steps may be performed while the valve is in-line and without interrupting service.

⚠ ***WARNING: Follow all local safety regulations and codes when working on any valve in service. If an internal problem is suspected, refer to Section 9, Troubleshooting.***

5.1 Look for signs of gasket leakage through the pipe end flanges and bottom flange. If necessary, re-torque the flange bolting.

5.2 Examine the valve for damage, such as damage caused by corrosive fumes or process drippings.

5.3 Clean the valve and repaint areas of severe oxidation.

5.4 Check the packing box for proper tightness. If there is a persistent leak, change the packing after referring to Section 6, Packing Ring Replacement. Refer to Table 1 above for appropriate packing bolt torques.

⚠ ***CAUTION: Do not over-tighten packing box bolting. This can cause excessive packing wear and high friction that may impede shaft movement.***

5.5 If possible, stroke the valve and check for smooth, full-stroke operation. Unsteady shaft movement may indicate an internal valve problem.

5.6 For actuated or control valves, consult appropriate actuator and controls IOM for preventative maintenance guidelines for this equipment.

6. Packing Ring Replacement

⚠ ***WARNING: Only properly trained and experienced technicians should perform the following maintenance steps.***

☠ ***DANGER: To carry out this operation, it is essential to disconnect the valve from the pipework. Depressurize line to atmospheric pressure and drain all fluids before working on the valve. Failure to do so can cause serious injury. Remove the valve from the pipeline. Follow local rules and requirements regarding decontamination prior to working on valve.***

Refer to Figure 3 to find parts according to the item numbers.

6.1 Start with the valve in the closed position. Clamp the valve body (01) securely to a suitable work table. Large valves (12” and larger) should be disassembled in a horizontal position. Lay the body flat on suitable wooden blocks, seat side down. Blocks should be sufficiently thick to allow the disc to open and close without touching. If possible, clamp the body securely such that the valve is stable on the blocks.

6.2 Remove Packing Nuts (28), Packing Gland Flange (26) and Packing Gland Follower (24).

6.3 Remove Packing Rings (23) from the packing bore. Inspect and clean shaft and packing bore. If either shaft or packing bore surfaces are worn or damaged, consult factory for repair.

6.4 Insert replacement Packing Rings into packing bore, taking care not to damage packing during installation.

6.5 Insert Packing Gland Follower into packing bore over Packing Rings. It may be necessary to lightly tap the Packing Gland Follower into the packing bore.

6.6 Slide Packing Gland Flange onto Packing Gland Follower, and thread Packing Nuts onto Packing Studs (27). Tighten Packing Nuts per torques shown in Table 1.

Num	Description
01	Valve Body
02	Seal Ring
03	Seal Ring Retainer
04	Disc
05	Shaft
06	Disc Pin
07	Key
08	Seal Gasket
09	Bottom Flange Gasket
10	Retainer Screws
11, 12, 13	Disc Lock screw
14	Bottom Flange
15	Bottom Flange Stud
16	Bottom Flange Nut
17, 18, 19	Bearings
20, 21, 22, 25	Spacers
23	Packing
24	Packing Follower
26	Gland Flange
27	Packing Stud
28	Packing Nut
29	Washer
30	Yoke
31	Stud
32	Nut
33	Pin Dowel
34	Thrust Washer Live load
35	Stud Live load
36	Nut Live load
37	Thrust Washer Live load

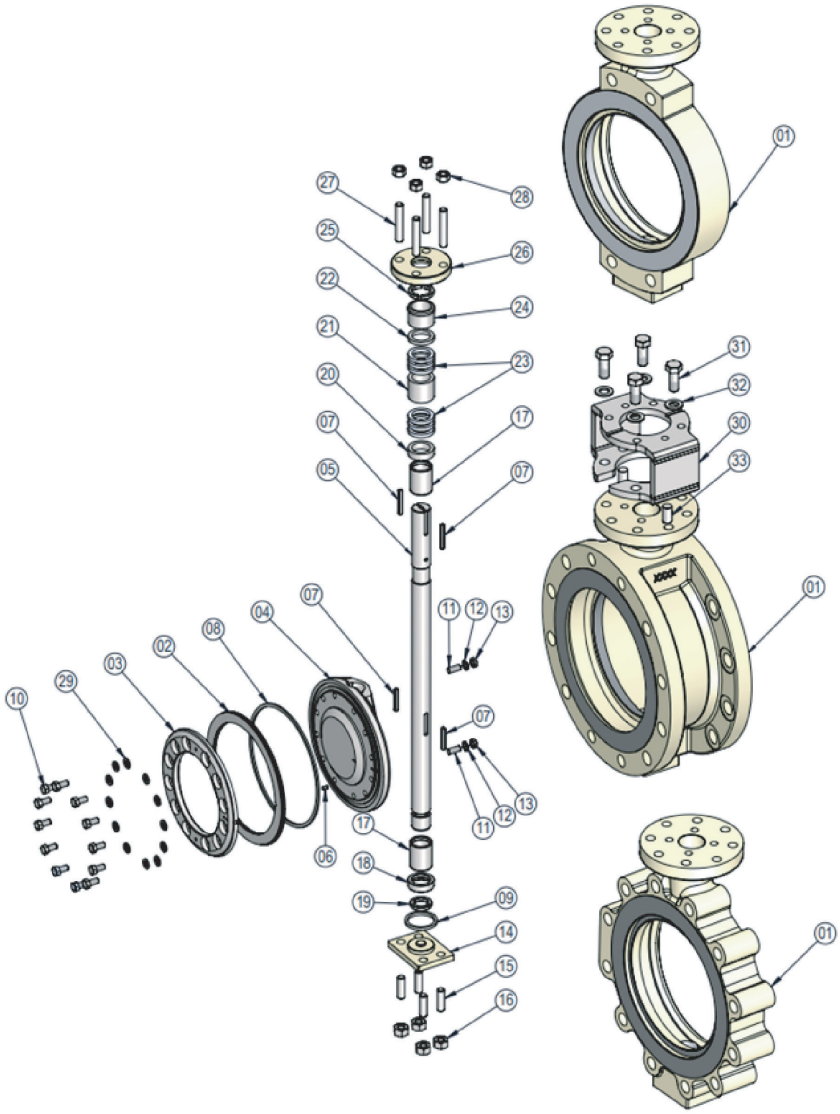

Figure 3: Exploded view

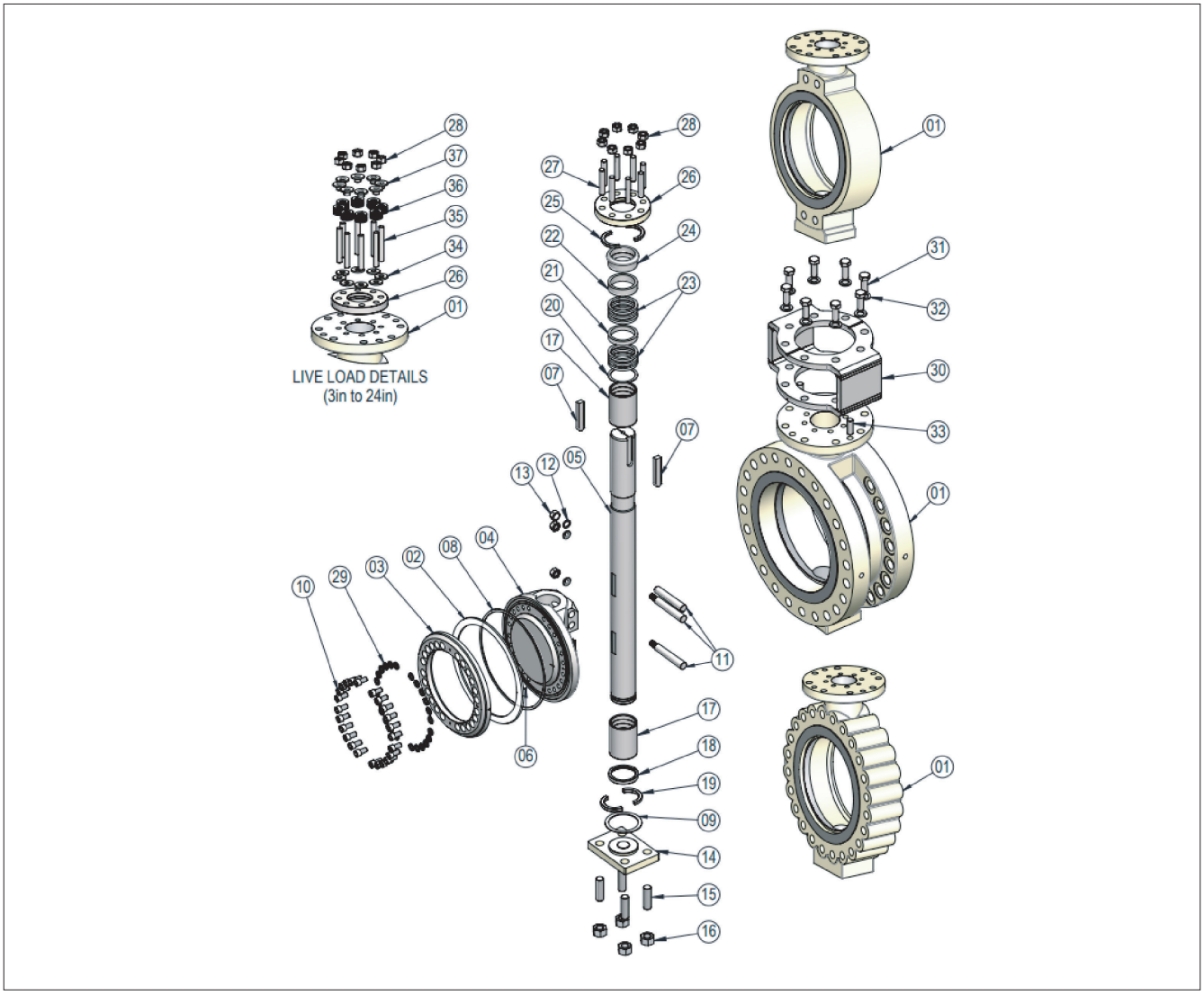

Figure 4: Exploded view for 24in Valves

7. Seal Ring and Seal Ring Gasket Replacement

⚠ ***WARNING: Only properly trained and experienced technicians should perform the following maintenance steps.***

☠ ***DANGER: To carry out this operation, it is essential to disconnect the valve from the pipework. Depressurize line to atmospheric pressure and drain all fluids before working on the valve. Failure to do so can cause serious injury. Remove the valve from the pipeline. Follow local rules and requirements regarding decontamination prio to working on valve.***

Refer to Figure 3 to find parts according to the item numbers.

7.1 Start with the valve in the closed position. Clamp the valve body (01) securely to a suitable work table. Large valves (12” and larger) should be disassembled in a horizontal position. Lay the body flat on suitable wooden blocks, seat side down. Blocks should be sufficiently thick to allow the disc to open and close without touching. If possible, clamp the body securely such that the valve is stable on the blocks.

7.2 Loosen the Seal Ring Screws (10) and Seal Ring Washers (29). Remove all but two sets of screws and washers to keep Seal Ring Retainer (03) from falling in the next step.

7.3 Open the valve and remove the Seal Ring and Seal Ring Gasket (08). Inspect the seating surface on the body, the Disc (04) and Seal Ring Retainer for damage. If either of these components are damaged, consult factory for repair.

7.4 Loosen the Disc Pin (06) to allow Disc to float during installation of Seal Ring.

7.5 Clean the Disc in preparation to install the seal ring. Install Seal Ring Gasket and then place the Seal Ring onto the disk. Align the Seal Ring with the dowel pin to ensure correct orientation of the seal ring cone.

7.6 Place the Seal Ring Retainer on to the Disc. Insert the Seal Ring Washers and Seal Ring Screws into the Seal Ring Retainer and hand-tighten them. The Seal Ring Screws should be loose enough to allow the Seal Ring to float or move within the Seal Ring Retainer.

❗ ***NOTE: Prior to installation, apply an approved thread lubricant to the fastener threads. For standard service, use a nickel-based, anti-seize compound. Contact facility for other applications.***

7.7 Clean the seating surface on the body in preparation to close the valve.

7.8 Close the Disc into the seat. The Seal Ring is self-centering on the seat when closed. Cycle the valve 5 to 10 times for proper alignment of Seal Ring. When properly performed, there should not be any gaps between the Seal Ring and the seating surface in the body.

7.9 Move the Disk to closed position, and then tighten the Seal Ring Screws to the required torque per Table 2.

Bolt Size (in.)	A193-B7; A193-B16 A320-L7 (lubricated)		A193-B7M A320-L7M (lubricated)		A193-B8 Cl 1 A193-B8M Cl 1 (lubricated)		A193-B8 Cl 2 * (lubricated)	
	Ft-lb	N-m	Ft-lb	N-m	Ft-lb	N-m	Ft-lb	N-m
5/8-11UNC	80 ± 8	110 ± 11	70 ± 7	90 ± 9	60 ± 6	80 ± 8	80 ± 8	110 ± 11
3/4-10UNC	150 ± 15	200 ± 20	120 ± 12	160 ± 16	110 ± 11	150 ± 15	150 ± 15	200 ± 20
7/8-9UNC	240 ± 24	320 ± 32	190 ± 19	260 ± 26	180 ± 18	240 ± 24	190 ± 19	260 ± 26
1-8UNC	350 ± 35	480 ± 48	280 ± 28	380 ± 38	270 ± 27	360 ± 36	280 ± 28	380 ± 38
1 1/8-8UN	520 ± 52	710 ± 71	420 ± 42	570 ± 57	390 ± 39	530 ± 53	390 ± 39	530 ± 53
1 1/4-8UN	740 ± 74	1010 ± 101	590 ± 59	800 ± 80	560 ± 56	760 ± 76	560 ± 56	760 ± 76
1 3/8-8UN	1010 ± 101	1370 ± 137	810 ± 81	1100 ± 110	760 ± 76	1030 ± 103	760 ± 76	1030 ± 103
1 1/2-8UN	1340 ± 134	1820 ± 182	1070 ± 107	1450 ± 145	1010 ± 101	1370 ± 137	1010 ± 101	1370 ± 137
1 5/8-8UN	1560 ± 156	2110 ± 211	1250 ± 125	1690 ± 169	1170 ± 117	1590 ± 159	NA	NA
1 3/4-8UN	1980 ± 198	2680 ± 268	1580 ± 158	2140 ± 214	1490 ± 149	2020 ± 202	NA	NA
1 7/8-8UN	2460 ± 246	3340 ± 334	1970 ± 197	2670 ± 267	1850 ± 185	2510 ± 251	NA	NA
2-8UN	3020 ± 302	4100 ± 410	2420 ± 242	3280 ± 328	2270 ± 227	3080 ± 308	NA	NA
2 1/4-8UN	4380 ± 438	5940 ± 594	3500 ± 350	4750 ± 475	3290 ± 329	4460 ± 446	NA	NA
2 1/2-8UN	6090 ± 609	8260 ± 826	4870 ± 487	6610 ± 661	4580 ± 458	6210 ± 621	NA	NA
2 3/4-8UN	7550 ± 755	10240 ± 1024	NA	NA	6170 ± 617	8370 ± 837	NA	NA
3-8UN	9890 ± 989	13420 ± 1342	NA	NA	8090 ± 809	10970 ± 1097	NA	NA
3 1/4-8UN	12680 ± 1268	17200 ± 1720	NA	NA	10370 ± 1037	14060 ± 1406	NA	NA

Table 2: Seal retainer and bottom flange bolting torque

7.10 With the Disc centered, tighten the Disc Set Screw to lock the disc in place.

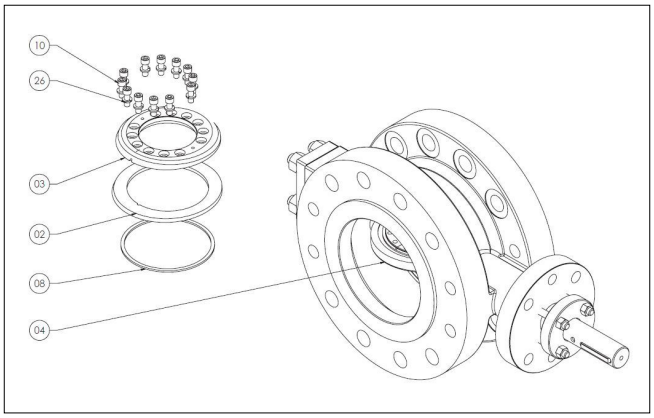

Figure 5: Seal ring replacement

8. Bottom Flange Gasket Replacement

⚠ ***WARNING: Only properly trained and experienced technicians should perform the following maintenance steps.***

☠ ***DANGER: To carry out this operation, it is essential to disconnect the valve from the pipework. Depressurize line to atmospheric pressure and drain all fluids before working on the valve. Failure to do so can cause serious injury. Remove the valve from the pipeline. Follow local rules and requirements regarding decontamination prior to working on valve.***

8.1 Start with the valve in the closed position. Clamp the valve body (01) securely to a suitable work table. Large valves (12” and larger) should be disassembled in a horizontal position. Lay the body flat on suitable wooden blocks, seat side down. Blocks should be sufficiently thick to allow the disc to open and close without touching. If possible, clamp the body securely such that the valve is stable on the blocks.

8.2 Remove the Bottom Flange (14) by loosening the Bottom Flange Nuts (16). Hold the Thrust Bearing (17) while removing the Bottom Flange.

8.3 Remove the Bottom Flange Gasket (09) and clean the gasket seating face in the body and the flange.

8.4 Clean the top face of the Thrust Bearing and apply approved lubricants to the cleaned surface.

8.5 Place a new Bottom Flange Gasket in the gasket groove in the Valve Body (01).

8.6 Assemble the Bottom Flange, along with the Thrust Bearing.

8.7 Apply approved anti-seize lubricants to the Bottom Flange Studs (15) and tighten the Bottom Flange Nuts per the torques shown in Table 2.

9. Troubleshooting

Failure	Probable Cause	Corrective Action
Valve moves to failure position, regardless of input signal	1. Failure of cylinder actuator O-ring	1. Refer to actuator manufacturer's installation, operation and maintenance manual for guidance
	2. Faulty positioner or solenoid valve	2. Refer to actuator manufacturer's installation, operation and maintenance manual for guidance
Jerky shaft rotation	1. Overtightened packing	1. Re-tighten packing box nuts per recommended torque in Table 1
	2. Cylinder wall of actuator not lubricated	2. Refer to actuator manufacturer's installation, operation and maintenance manual for guidance
	3. Worn piston O-ring allowing piston to gall on cylinder wall	3. Refer to actuator manufacturer's installation, operation and maintenance manual for guidance
	4. Worn actuator stem O-ring causing actuator stem to gall on stem collar	4. Refer to actuator manufacturer's installation, operation and maintenance manual for guidance
	5. Worn or damaged thrust bearings, shaft bearing or packing followers	5. Consult factory for repair
Excessive leakage through valve	1. Improper adjustment of Operator stroke stops	1. Refer to actuator manufacturer's installation, operation and maintenance manual for guidance
	2. Improper Seal Ring, Seal Ring adjustment or Seal Ring damaged	2. See Section 7: Seal Ring and Seal Ring Gasket Replacement
	3. Worn or damaged seat	3. Consult factory for repair
	4. Improper hand-wheel adjustment acting as limit stop	4. Adjust hand-wheel until disc seats properly
Leakage through line flanges	1. Dirty line gasket surfaces	1. Clean gasket surfaces and reinstall valve
	2. Improper sealing of line flanges	2. Tighten line flanges evenly and completely
	3. Flange or pipe misalignment	3. Reinstall valve in-line; check piping system
Leakage through packing box	1. Loose packing box nuts	1. Re-tighten packing box nuts per recommended torque in Table 1
	2. Worn or damaged packing	2. Replace packing per Section 6: Packing Ring Replacement
	3. Dirty or corroded packing	3. Clean body bore and stem; replace packing per Section 6: Packing Ring Replacement
Valve slams, won't open or causes severe water hammer	1. Improper valve installation	1. See step 3 in Section 3: Installation; correct flow direction
Shaft rotates; disc remains open or closed	1. Broken shaft	1. Consult factory for repair
Actuator operates; shaft does not rotate	1. Broken internal actuator parts	1. Refer to appropriate actuator manufacturer's installation operation and maintenance manual for guidance
Leakage from end flange	1. Loose bolting or damaged gasket	1. Tighten bolting as recommended in Table 2: Seal retainer and bottom flange bolting torque
	2. Dirty gasket surfaces	2. Clean gasket surfaces; replace gaskets and re-tighten bolting per Table 2

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