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J. JOSEPH	05-FEB-10	03	SP-054070-04
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TITLE:

INSTALLATION, OPERATION, AND MAINTENACE PROCEDURE FOR TOM WHEATLEY (TW) SWING CHECK VALVE WITH EXTENDED SHAFT DESIGN AND GEARBOX ASSEMBLY

OVERVIEW

VENDOR: **Cameron Valves and Measurement**
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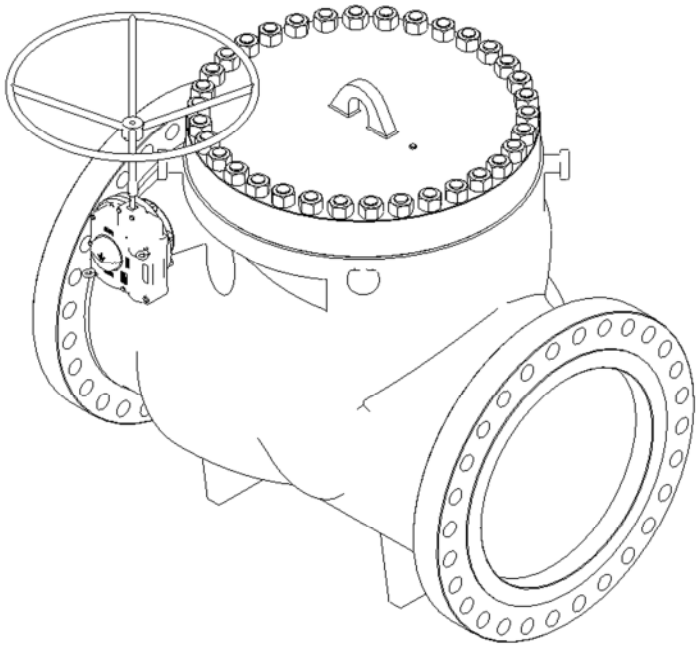
Contact: Engineering

Equipment: This operating and maintenance manual provides instructions for a Tom Wheatley swing valve with an extended shaft and a gear operator.



Warning: The following information, procedures, and instructions should be read completely and understood thoroughly prior to working with this equipment. Failure to do so may constitute abuse of the equipment and could result in serious injury to the operator.

Table of Contents

1.0. Introduction

The installation, operating and maintenance manual provides instructions for a Tom Wheatley swing check valve with an extended shaft assembly.

A check valve's primary function is to control the flow of a fluid in one direction to prevent pipeline issues such as backflow. The swing check valve design primary parts include the body, shaft, arm, and clapper. The clapper is attached to the arm which rotates about the shaft and its position varies based on the flow rate. When flow has ceased, the clapper automatically swings to the closed position thus preventing backflow into the pipeline.

The purpose of the gearbox is to allow the valve to have the ability of locking open for purposes such as pigging.

2.0. Safety

The following information, procedures, and instructions should be read completely and understood thoroughly prior to working with this equipment. Failure to do so may constitute abuse of the equipment and result in serious injury to the operator.

Cameron Tom Wheatley does not accept any responsibility for damage to people, property, or plant due to:

- Defective or incorrect installation
- Defective or incorrect maintenance of the valves by the client
- Incorrect use of the valves
- Using untrained personnel for maintenance operations that do not have a basic knowledge of valves
- Failure to comply with this manual and safety standards

2.1. Handling and Lifting

It is important that all handling operations are carried out by personnel trained in relation to the problems associated with handling heavy objects. Check the maximum lifting capacity of the cables available and the weights to be lifted.

The valve should be lifted using the lift lug located on the top side of the cover. Valve sizes 24” and above will have four lift points located on the body. It is necessary to use all four lift points to safely move the valve.

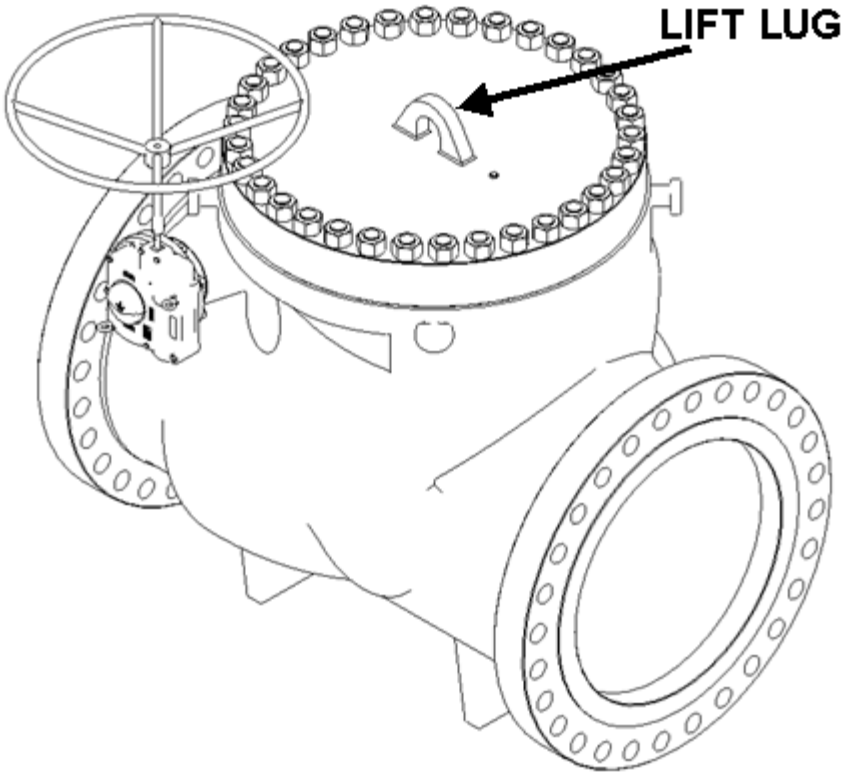


Figure 1: Cover lift lug shown

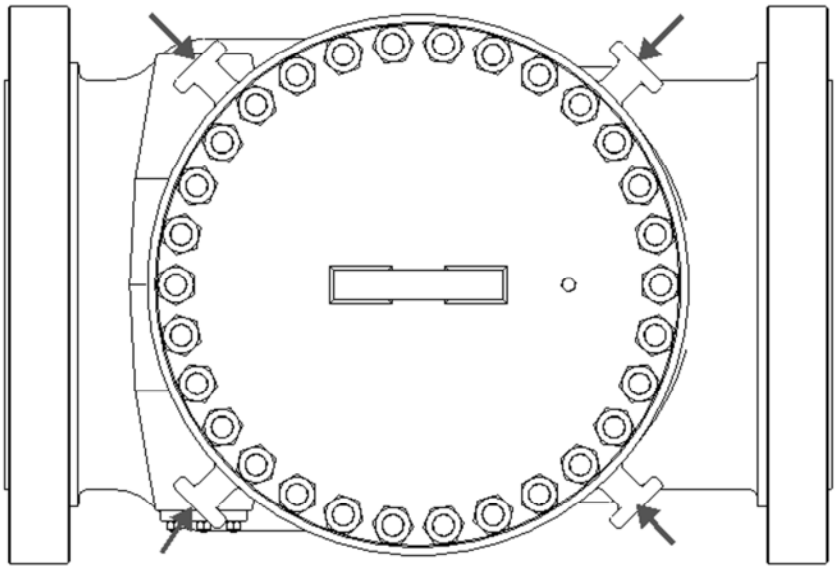


Figure 2: Lifting points shown for sizes 24" and above.

2.2. Pressure Limitations

Tom Wheatley swing check valves are designed to operate at the pressure limits of the pressure classes designated in API-6D/ISO 14313. Exceeding those pressure limitations could result in damage to the valve and/or serious injury or death to personnel. Consult the nameplate that is attached to the valve body for the pressure limits of the valve.

3.0. Preservation and Storage

When valves have to be stored on site for a prolonged period of time before being installed in the pipeline, they should be stored in a dry place, under cover. The integrity of packaging and protective materials must be maintained. Valves are supplied with suitable caps or end covers to protect the internal parts of the valve. These caps should not be removed unless carrying out maintenance or inspection. Afterward the caps should be refitted. If valves are to be stored for more than 6 months, it is recommended that silica gel packets or other suitable desiccant be place inside the valve to absorb moisture.

4.0. Valve Configuration and Components

4.1. Parts List

Table 1: Parts list for TW swing check valve with gearbox

ITEM	COMPONENT
1	BODY
2	COVER
3	ARM, LIFT COLLAR
4	CLAPPER
5	EXT. SHAFT
6	GLAND BODY
7	GLAND FLANGE
8	RENEWABLE SEAT
9	WORM GEARBOX
10	PRESSURE RELIEF FITTING
11	INJECTOR FITTING[1)]
12	INTERNAL CHECK VALVE[1)]
13	PIPE PLUG
14	STUD, COVER
15	NUT COVER
16	STUD, GLAND BODY
17	NUT, GLAND BODY
18	STUD, GLAND FLANGE
19	NUT GLAND FLANGE
20	STUD, GEARBOX
21	NUT, GEARBOX
22	HEAVY HEX NUT, CLAPPER
23	SET SCREW, SEAT
24	COTTER PIN
25	BEARING
26	SEAL, COVER
27	SEAL, CLAPPER
28	SEAL, SHAFT
29	SEAL, GLAND BODY
30	SEAL, GLAND FLANGE
31	SEAL, RENEWABLE SEAT
32	DOWEL PIN, GLAND BODY
33	DOWEL PIN, GLAND FLANGE

ITEM	COMPONENT
34	KEY, LIFT COLLAR
35	KEY, COUPLING
36	THRUST WASHER
37	GLAND COVER
38	LIFT COLLAR
39	BEARING

Note:

1) Not available with T1 gland option

4.2. Figures of Valve Assembly

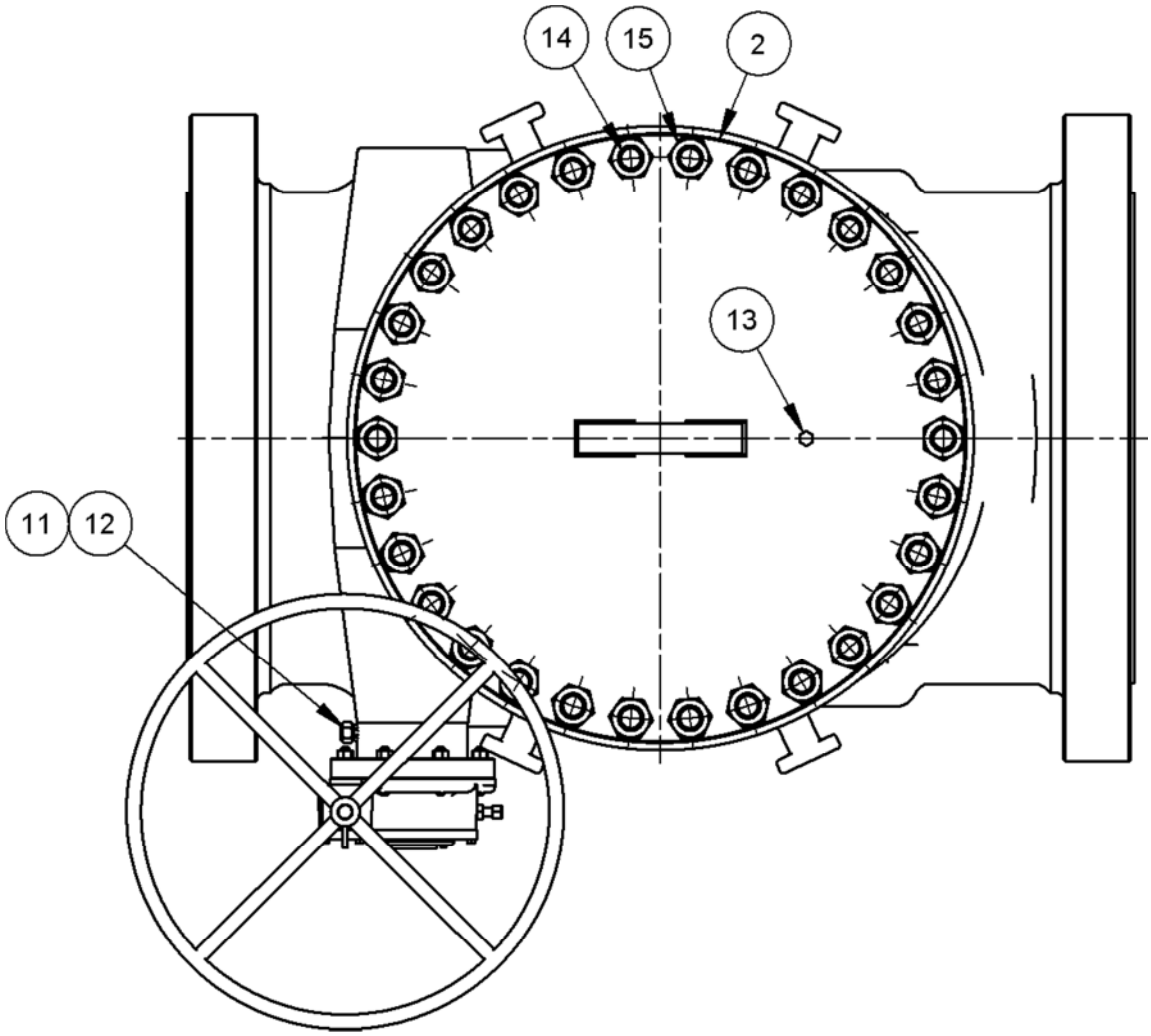


Figure 3: Top view of swing check valve with gearbox shown

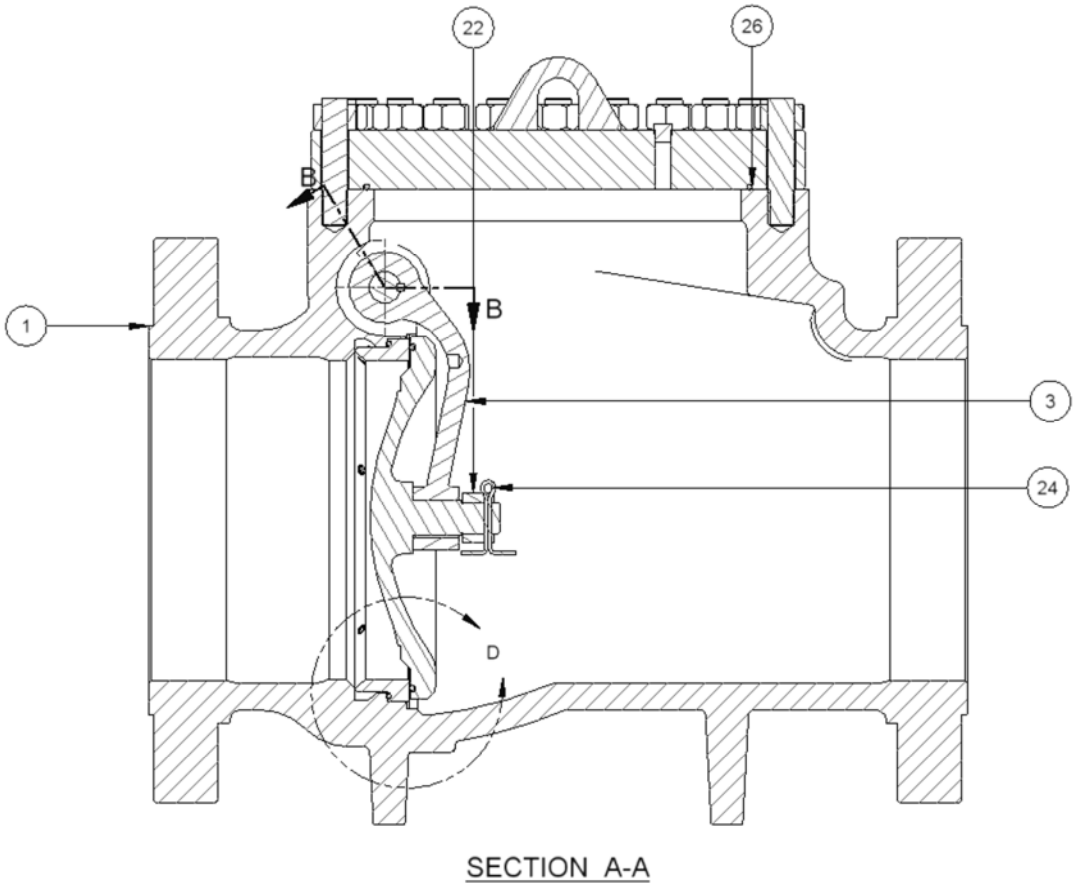


Figure 4: Cross-sectional view of swing check valve

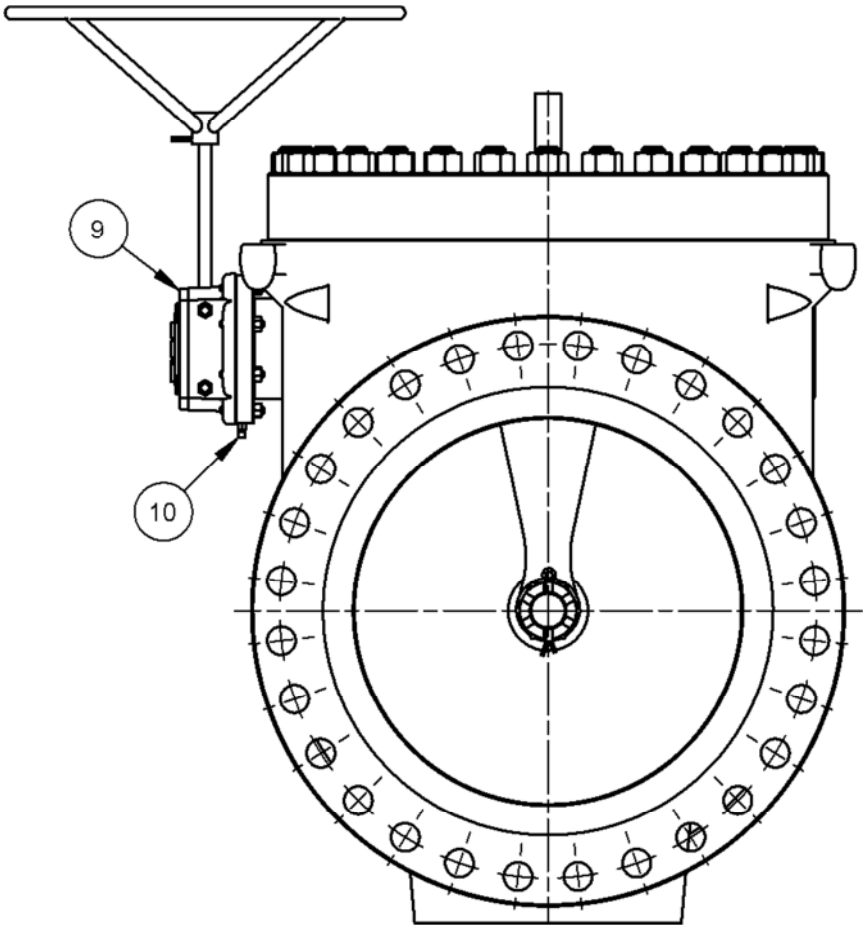


Figure 5: Side view of assembly with gearbox shown

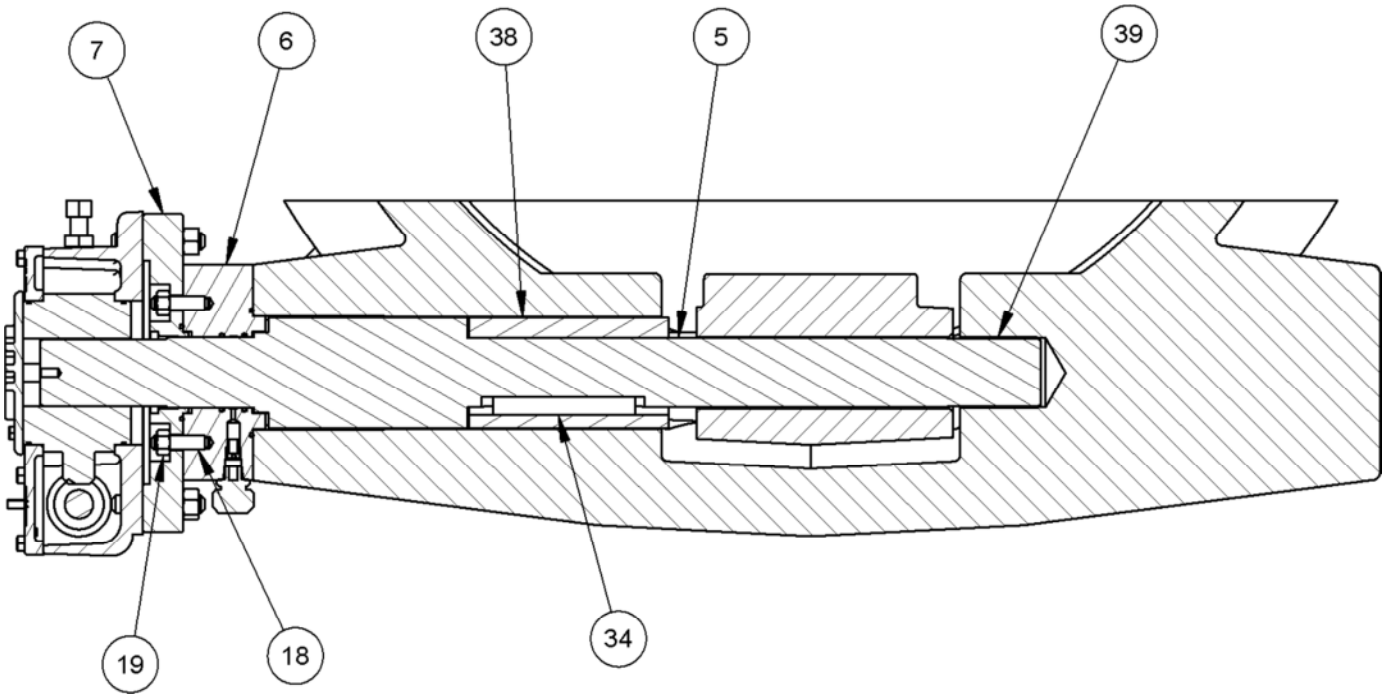


Figure 6: Cross sectional view of gland assembly (at 180°) shown

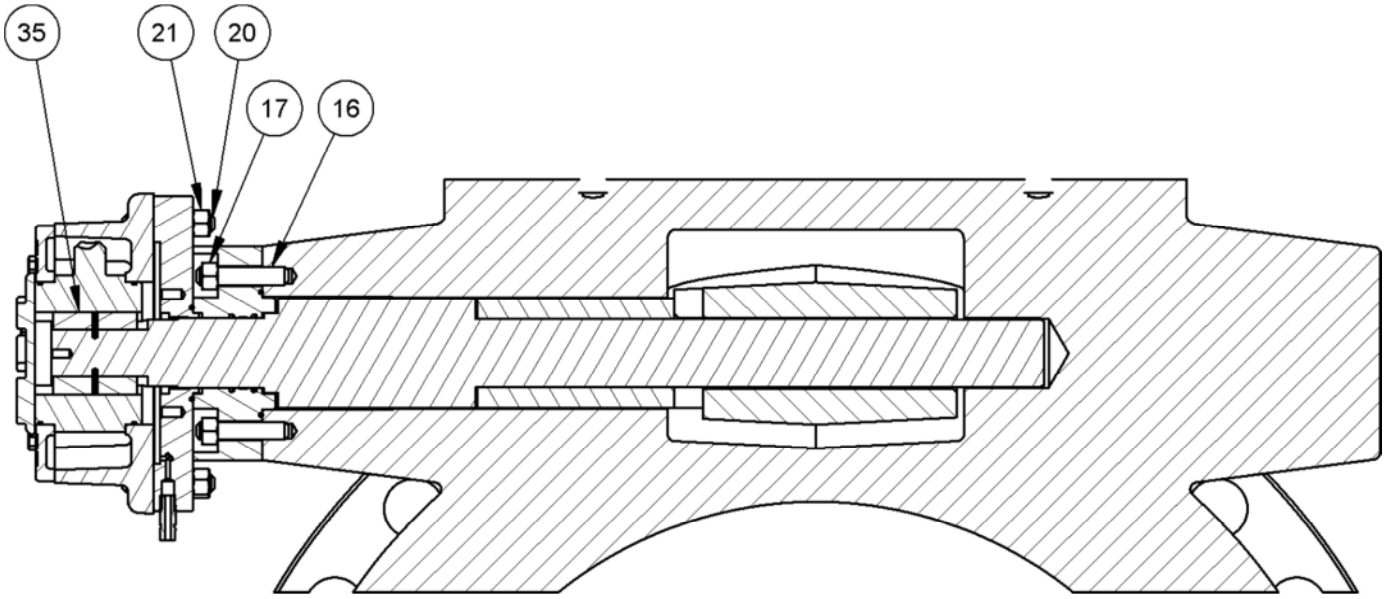


Figure 7: Cross sectional view of gland assembly (at 90°) shown

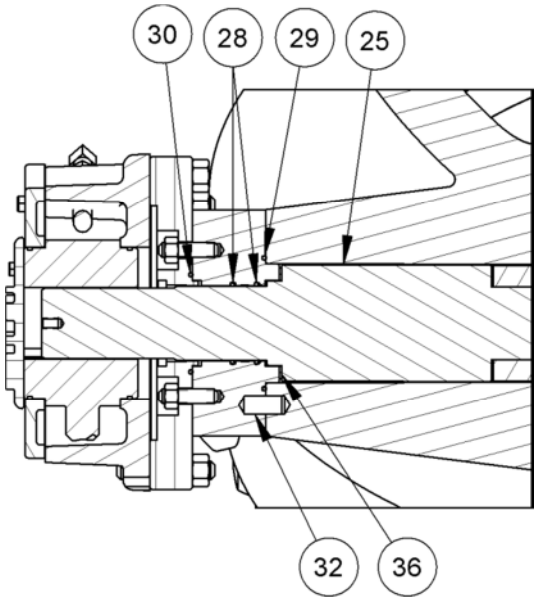


Figure 8: Detail view of gland assembly shown

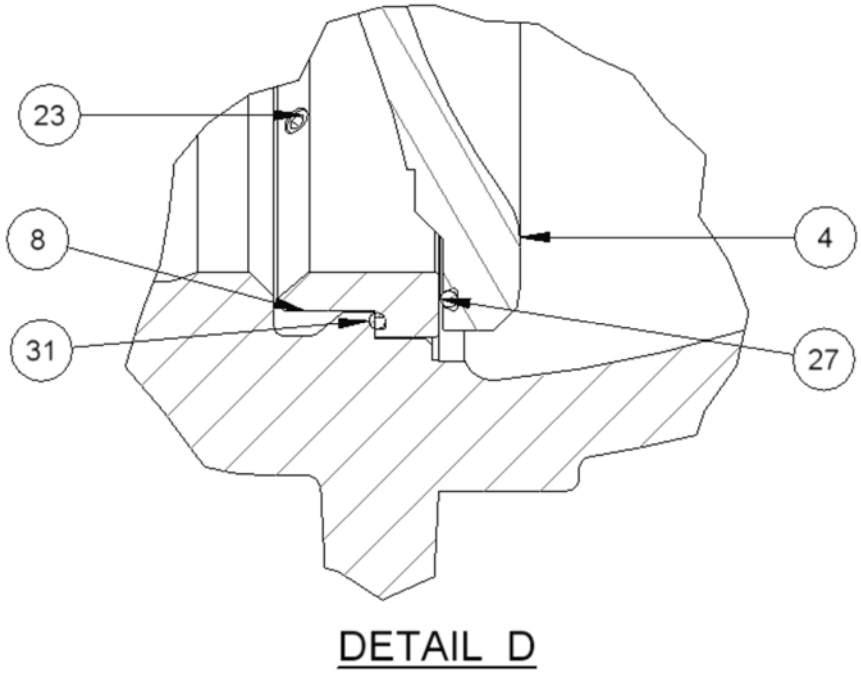


Figure 9: Detail view of renewable seat shown

5.0. Installation and Pre-commissioning

5.1. Unpacking the Valve

Remove the packing protective material. A wooden shipping member may have been placed inside the valve to immobilize the clapper during shipment. DO NOT install the valve until this component has been removed.

5.2. Installing the Valve in the Pipeline

When lifting or moving the valve, use the lifting points illustrated in Section 2.1.

For flanged end valves, install the valve in the pipeline with appropriate gaskets to seal the valve flanges to the pipeline flanges and fasten in place.

For weld end valves, install the valve in the pipeline and weld with an appropriate weld procedure. Cameron-Tom Wheatley does not recommend welding procedures as this is the responsibility of the pipeline constructor.

The check valve must be installed in a pipeline with the arrow (located on the outside of the body) in the direction of flow. Orientation of the extended shaft shall be horizontal to within ±5º. Under no circumstances shall the stated tolerances be exceeded. Since it is gravity that swings the clapper to the closed position, angling the outlet upwards will increase the pressure drop through the valve at a given flow rate while angling the outlet downwards will decrease the pressure drop.

5.3. Hydrostatic Testing

Test valve in accordance with API 6D.

The following are recommended practices for pressure testing the valve in the field, or any pressure testing required for pre-commissioning of the pipeline and/or when the valve is in service. The preferred method of filling the valve or pipeline is from the up-stream side of the check valve. The valve or pipeline should also be pressurized from the up-stream side.

CAUTION: The valve clapper should never be tested to pressures exceeding the original factory seat pressure tests.

If filling or testing of the line is required from the down-stream side, the valve clapper shall be rotated to the locked-open position, the indicator pointing to the "OPEN" position.

After all pressure tests are complete, the valve clapper shall be rotated to its normal operating position with the indicator pointing to the "CLOSED" position.

6.0. Valve Operation

6.1. Operation

6.1.1. General Design

The check valve is provided with a lock open device to allow easy opening of the check valve clapper and locking the valve in the open position. The clapper shaft is extended through the valve body. The extended shaft is keyed to a lift collar, that engages the arm, to lift the arm and clapper assembly. The end of the extended shaft is keyed to accept the gear operator. The lock open device is intended for applications requiring the occasional override of the normal check valve function. These applications may include locking open for test, line drainage, reverse pigging, or other reverse flow conditions. The shaft is sealed with either O-Ring or Lip Seals dependent on specific gland type provided with the assembly.

6.2. Routine maintenance

6.2.1. General

Tom Wheatley check valves have provided years of trouble free service with little or no maintenance. However, periodic visual inspections commensurate with the type of service and pressure rating are recommended.

6.2.2. Maintenance Schedule

It is recommended that the valve be operated at least once every 12 month. During this period of operation, the valve should be cycled three times (close-to-open-to-close being one cycle).

6.3. Locking Open the Valve

To lock open the valve; depressurize the line to zero pressure differential. Rotate the gearbox hand wheel in the counterclockwise direction (CCW) until the valve as reached full open which should be indicated on the legend plate of the gearbox.

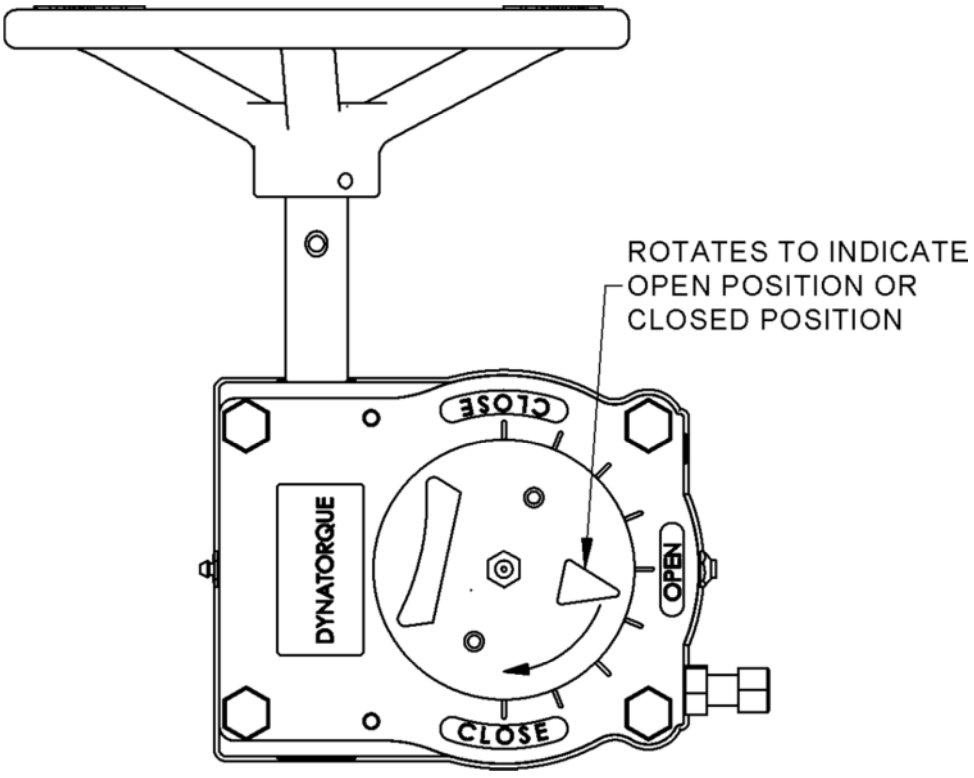


Figure 10: Gearbox

Reference the following table for recommended torques based on size, pressure class, and gearbox model.

Table 2: Torque values for gearboxes based on size/pressure class

Valve Size	Pressure Class	Valve Torque (in-lb)	Dynatorque Model	Mechanical Advantage (%)	Turns to Close 90 degrees	Gearbox Maximum Input Torque (in-lb)	Gearbox Maximum Output Torque (in-lb)
6"	150	110	DT12	13.68	14.25	1170	16000
6"	300	167	DT12	13.68	14.25	1170	16000
6"	600	267	DT12	13.68	14.25	1170	16000
6"	900	363	DT12	13.68	14.25	1170	16000
6"	1500	556	DT12	13.68	14.25	1170	16000
8"	150	203	DT12	13.68	14.25	1170	16000
8"	300	261	DT12	13.68	14.25	1170	16000
8"	600	361	DT12	13.68	14.25	1170	16000
8"	900	457	DT12	13.68	14.25	1170	16000
8"	1500	649	DT12	13.68	14.25	1170	16000
10"	150	379	DT12	13.68	14.25	1170	16000
10"	300	492	DT12	13.68	14.25	1170	16000
10"	600	687	DT12	13.68	14.25	1170	16000
10"	900	875	DT12	13.68	14.25	1170	16000
10"	1500	1299	DT12	13.68	14.25	1170	16000
12"	150	505	DT12	13.68	14.25	1170	16000
12"	300	617	DT12	13.68	14.25	1170	16000
12"	600	813	DT12	13.68	14.25	1170	16000
12"	900	1173	DT12	13.68	14.25	1170	16000
12"	1500	1579	DT12	13.68	14.25	1170	16000
14”	150	768	DT12	13.68	14.25	1170	16000
14”	300	973	DT12	13.68	14.25	1170	16000
14”	600	1306	DT12	13.68	14.25	1170	16000
14”	900	1775	DT12	13.68	14.25	1170	16000
16"	150	1062	DT12	13.68	14.25	1170	16000
16"	300	1256	DT12	13.68	14.25	1170	16000
16"	600	1594	DT12	13.68	14.25	1170	16000
16"	900	2287	DT12	13.68	14.25	1170	16000
16"	1500	3146	DT12	13.68	14.25	1170	16000
18”	150	1973	DT12	13.68	14.25	1170	16000
18”	300	2300	DT12	13.68	14.25	1170	16000
18”	600	2828	DT12	13.68	14.25	1170	16000

Valve Size	Pressure Class	Valve Torque (in-lb)	Dynatorque Model	Mechanical Advantage (%)	Turns to Close 90 degrees	Gearbox Maximum Input Torque (in-lb)	Gearbox Maximum Output Torque (in-lb)
18”	900	3666	DT12	13.68	14.25	1170	16000
18”	1500	5200	DT12	13.68	14.25	1170	16000
20"	150	2686	DT12	13.68	14.25	1170	16000
20"	300	2995	DT12	13.68	14.25	1170	16000
20"	600	3531	DT12	13.68	14.25	1170	16000
20"	900	4904	DT12	13.68	14.25	1170	16000
20"	1500	6418	DT12	13.68	14.25	1170	16000
24"	150	4870	DT12	13.68	14.25	1170	16000
24"	300	5332	DT12	13.68	14.25	1170	16000
24"	600	6131	DT12	13.68	14.25	1170	16000
24"	900	5629	DT21	22.5	15	1156	26000
24"	1500	11080	DT36	19	13.25	1895	36000
30"	150	11183	DT40	28.32	19.75	1412	40000
30"	300	12084	DT40	28.32	19.75	1412	40000
30"	600	13646	DT40	28.32	19.75	1412	40000
30"	900	18545	DT40	28.32	19.75	1412	40000
30"	1500	N/A	N/A	N/A	N/A	N/A	N/A
32”	150	16727	DT54	91.2	79.5	691	63000
32”	300	24804	DT54	91.2	79.5	691	63000
32”	600	21035	DT54	91.2	79.5	691	63000
32”	900	25057	DT54	91.2	79.5	691	63000
36"	150	23210	DT54	91.2	79.5	691	63000
36"	300	24767	DT54	91.2	79.5	691	63000
36"	600	27466	DT54	91.2	79.5	691	63000
36"	900	37530	DT90	49.2	60	1262	90000
36"	1500	N/A	N/A	N/A	N/A	N/A	N/A
42”	150	46736	DT200	120	112.5	1667	200000
42”	300	50636	DT200	120	112.5	1667	200000
42”	600	56947	DT200	120	112.5	1667	200000

6.4. Pigging

WARNING: The following must be read and thoroughly understood. All instructions shall be strictly adhered to. Failure to do so may constitute abuse of the equipment and can result in serious injury to the operator.

CAUTION: Do not attempt to raise the clapper towards the open position if the clapper is subjected to any differential pressure. Pipeline pressure shall be equalized prior to any operation of lock open mechanism.

CAUTION: Pigging operations shall (whenever possible) be conducted in the direction of primary flow.

6.4.1. Pigging in the Flow Direction without clapper being locked open

6.4.1.1. Scraper, cleaning and gauging pigs can be passed through the valve without locking open the clapper.

6.4.1.2. Multi cup pigs can be used. Their design shall ensure continuous support throughout the valve and they should be designed with the minimum of flow bypass.

6.4.1.3. The valve clapper is designed to withstand the impact of a pig during normal pigging operations. To minimize the effects of pigs impacting onto the clapper, a bumper nose on the pigs is strongly recommended.

6.4.2. Intelligent Pigging

CAUTION: When performing intelligent pigging through the valve it must be locked open. This is necessary to prevent damage to delicate instrumentation and/or critical seal areas.

6.4.2.1. Lock open the valve as stated in Section 6.1.2.

6.4.2.2. Once the valve has been locked open, an intelligent pigging and/or isolation tool operation can be performed.

6.4.2.3. The distance between drive cups shall be sufficient to ensure that a drive cup is always in contact with a parallel section of the valve bore.

6.4.2.4. After intelligent pigging has been completed, the valve shall be returned to its normal operating position as stated in Section 6.3.

6.4.3. **Pigging in the Reverse Flow Direction**

WARNING: The valve shall be locked open any time pigging in the reverse flow direction is performed. Failure to do so can cause damage to the valve.

WARNING: The use of a tapered bumper nose on the selected pig is strongly recommended. The taper must be large enough to permit realignment with the bore as the pig traverse through the pipe.

6.4.3.1. Lock open the valve as stated in the above section.

6.4.3.2. Once the valve is locked open, intelligent pigging may be performed.

6.4.3.3. The distance between drive cups shall be sufficient to ensure that a minimum of one drive cup is always in contact with a parallel section of the valve bore.

6.4.3.4. To allow proper alignment of the pig a tapered bumper nose is strongly recommended. The nose should be manufactured from a ductile plastic material such as nylon or similar.

6.4.3.5. After reverse flow pigging is completed, the valve shall be returned to its normal operating position as stated in the above section.

6.5. Trouble Shooting

Malfunction	Probable Cause	Solution
Valve does not open when attempting lock open operations.	1. Turning the hand wheel in the wrong direction. 2. Differential pressure across the valve. 3. Gear operator does not work.	1. Check that hand wheel is being turned in the correct direction. 2. Make sure there is equalized or balanced pressure across the valve. 3. Check the internal parts and lubricate if necessary.
Leak from the body/cover seal.	Seal is damaged.	Contact Cameron Tom Wheatley for replacement parts and /or service.
Leak from the body/gland seal.	Seal is damaged.	Contact Cameron Tom Wheatley for replacement parts and /or service.
Leak through the shaft seals.	Seal is damaged.	Inject sealant into the gland as instructed in Section 6.5 to affect a temporary seal. Contact Cameron Tom Wheatley for replacement parts and/or service.[A)]
Valve leaks internally to the upstream side.	1. Clapper seal is damaged. 2. Debris stuck between the clapper and seat. 3. Debris in belly of valve inhibiting clapper movement.	1. Contact Cameron Tom Wheatley for replacement parts and /or service. 2. If possible, flush line or create flow through the pipeline to dislodge debris.

NOTE:

A) Sealant injection option only available for the S1 and S2 gland configurations

7.0. Valve Disassembly and Repair

7.1. Disassembly of Gearbox

7.1.1. Depressurize the valve line and make sure that there is a zero pressure differential on both the upstream and downstream ends of the valve.

7.1.2. Assure that valve is not locked open.

7.1.3. Attach sling to gearbox to allow for safe removal.

7.1.4. Remove heavy hex nuts from gland flange that fasten the gearbox to it.

7.1.5. Carefully remove the gearbox and place on workbench or shop floor.

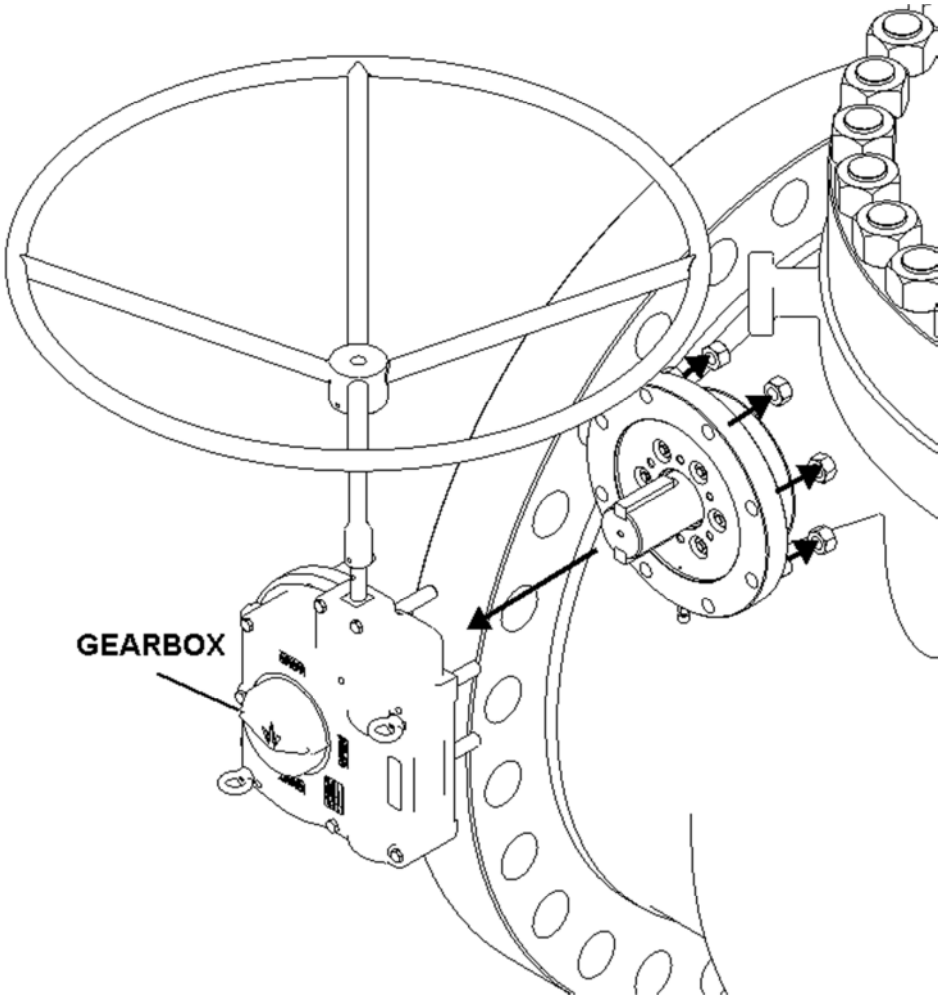


Figure 11: Removal of gearbox shown

7.2. Disassembly of Cover

7.2.1. After line depressurization, remove the vent plug located on top of the valve cover to release pressure that may be present.

7.2.2. Mark both cover and body with alignment marks.

7.2.3. Remove bonnet nuts.

7.2.4. Attach lift line with bolted shackle to lift eye located on cover, or the four lifting points located on the body (sizes 24" and up).

7.2.5. Carefully lift the cover clear of the valve body.

7.2.6. Inspect cover seal for imperfections.

7.2.6.1. *O-Ring Cover Seal* – Inspect for damage or imperfections and replace if necessary.

7.2.6.2. *Metal Cover Seal* – Replace cover seal with appropriate type because original cover seal will now be deemed useless.

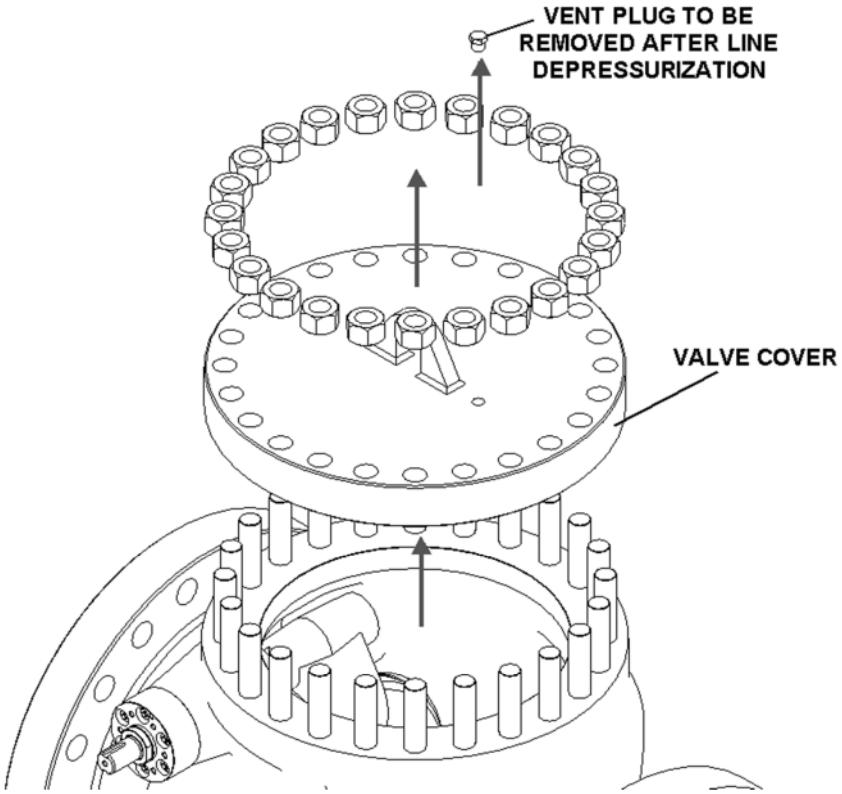


Figure 12: Removal of valve cover shown

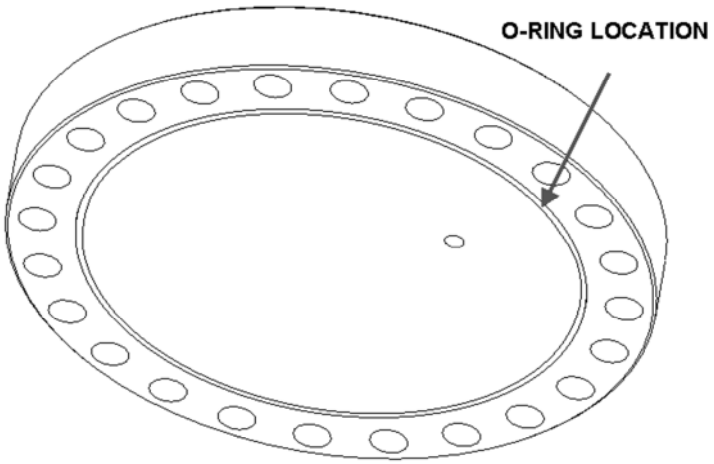


Figure 13: O-Ring for cover shown

7.3. Disassembly of Gland Flange

7.3.1. Remove the keys from the shaft coupling.

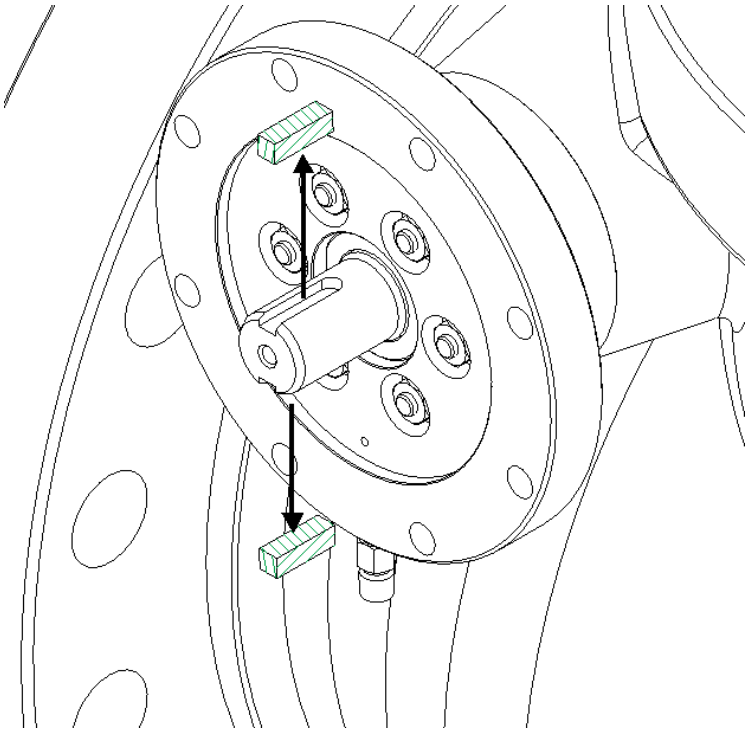


Figure 14: Removal of key coupling shown

7.3.2. Carefully remove the bleed fitting from the gland flange.

7.3.3. Unthread the heavy hex nuts that fasten the flange to the gland body.

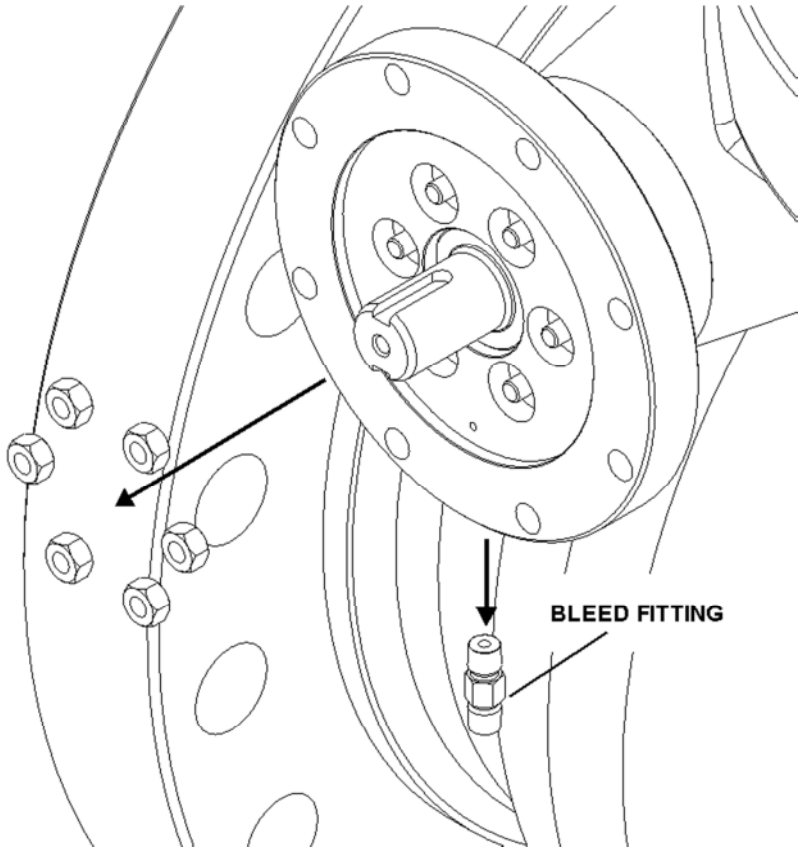


Figure 15: Removal of heavy hex nuts and bleed fitting shown.

7.3.4. Remove the gland flange.

7.3.5. Remove dowel pin which aligns the lift collar gland flange and gland body.

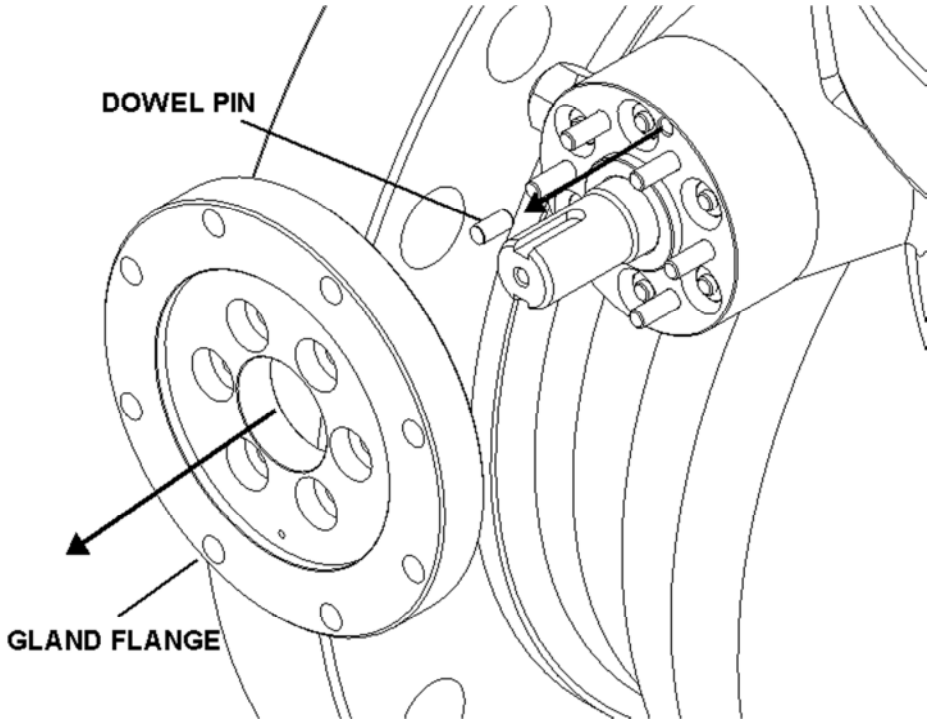


Figure 16: Removal of gland flange and dowel pin shown.

7.4. Disassembly of gland and shaft

7.4.1. Remove studs from gland body.

7.4.2. Remove injector fitting located on the side of the gland body. (S1 and S2 glands only)

7.4.3. Remove the internal check valve located within the same port of the injector fitting. (S1 and S2 glands only)

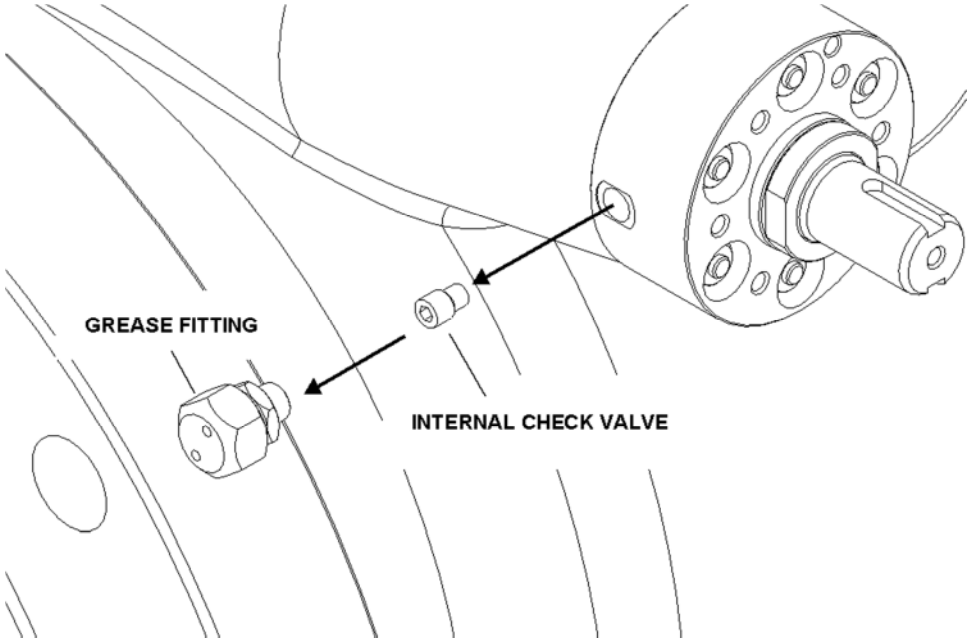


Figure 17: Removal of grease fitting and internal check valve shown

7.4.4. Remove hex nuts securing the gland body to the valve body.

7.4.5. Remove gland body.

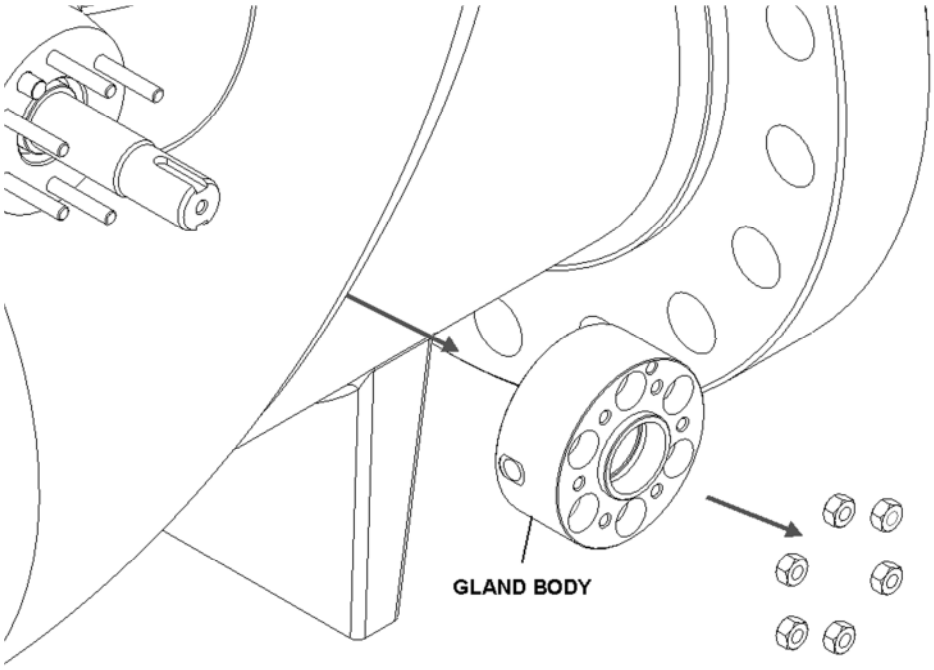


Figure 18: Removal of gland body shown

7.4.6. Check for any damage or imperfections on shaft seals located within the gland body. Replace if necessary.

7.4.7. Check for any damage or imperfections to the gland seal. Replace if necessary.

NOTE: ***THE FOLLOWING FIGURES ILLUSTRATE THE VARIOUS SEALS THAT ARE ASSOCIATED WITH THE RESPECTIVE GLAND TYPE***

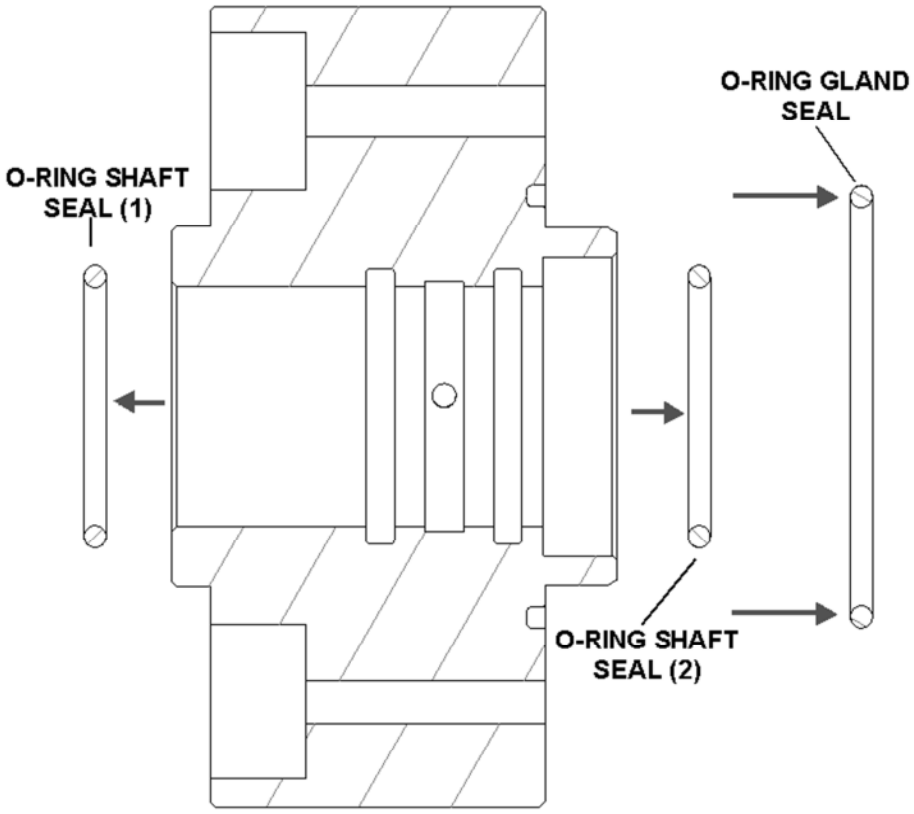


Figure 19: Removal of S1 gland body seals shown

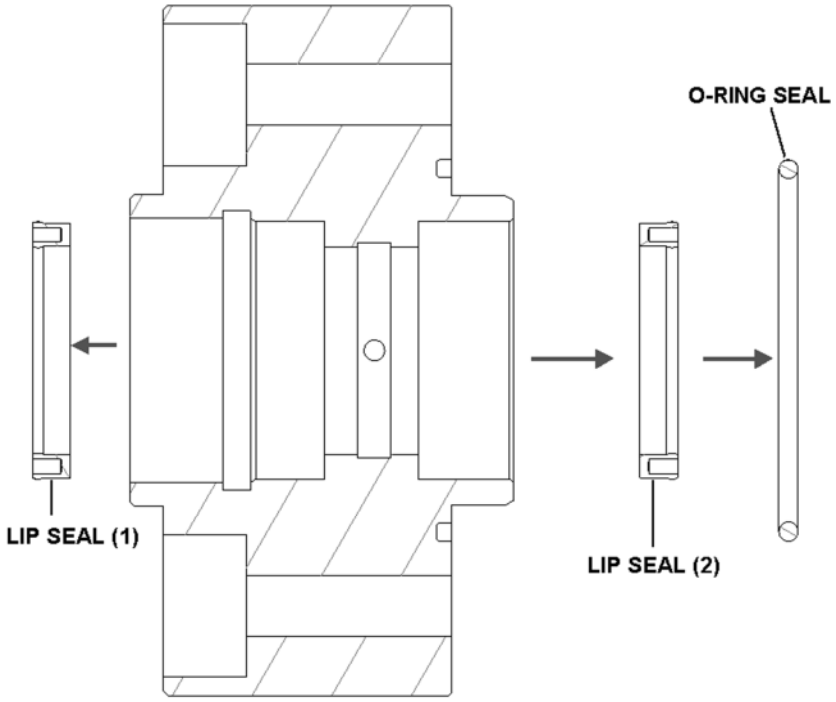


Figure 20: Seal removal for S2 gland body shown

7.5. Disassembly of arm and clapper

7.5.1. Secure crane to arm and slowly raise crane to suspend arm-clapper assembly.

7.5.2. Remove thrust washer from shaft.

7.5.3. Carefully extract the extended shaft.

7.5.4. If necessary, remove key from shaft and lift collar.

7.5.5. Using crane, lift arm-clapper assembly and place on work table leaving the sealing area visible for inspection.

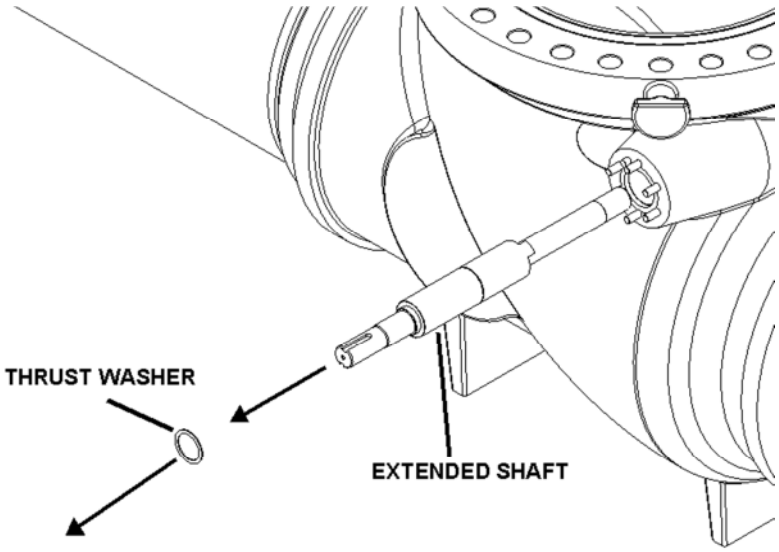


Figure 21: Removal of extended shaft shown

7.5.6. Remove lift collar from shaft by sliding the lift collar off (if necessary).

7.5.7. Remove key from shaft (if necessary).

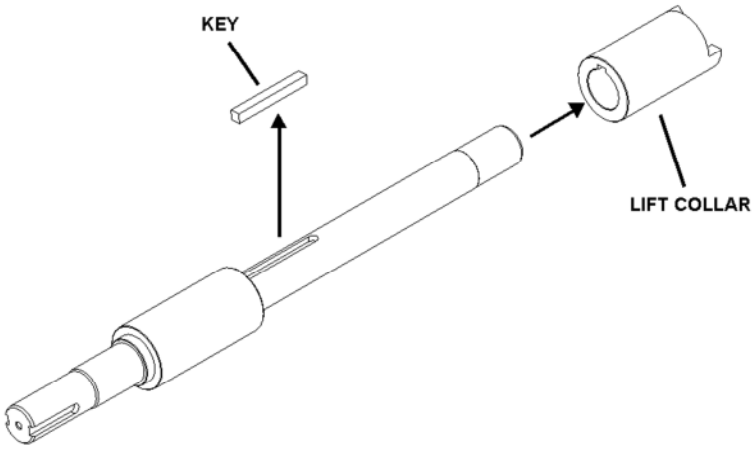


Figure 22: Removal of key and lift collar shown

7.6. Disassembly of arm-clapper assembly (if necessary) – Conduit Clapper shown

7.6.1. Straighten the bent ends of the cotter pin and remove pin from the slotted

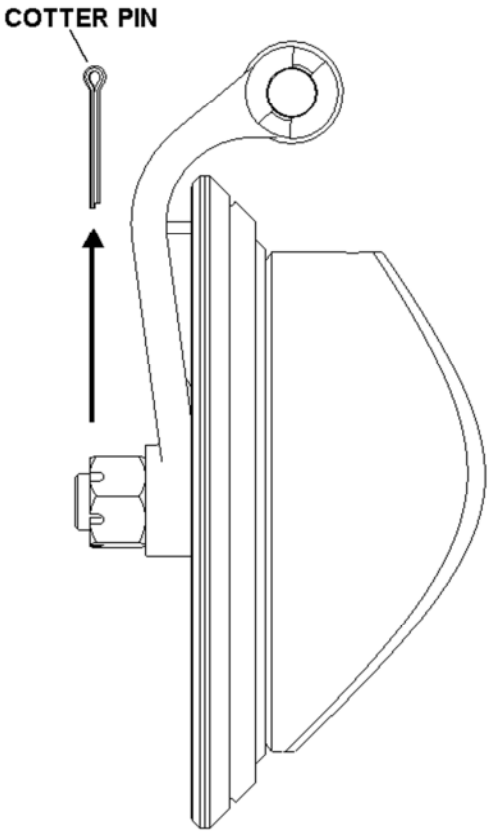


Figure 23: Removal of cotter pin shown

7.6.2. Unthread the slotted nut from the assembly.
7.6.3. Remove the arm from the clapper.

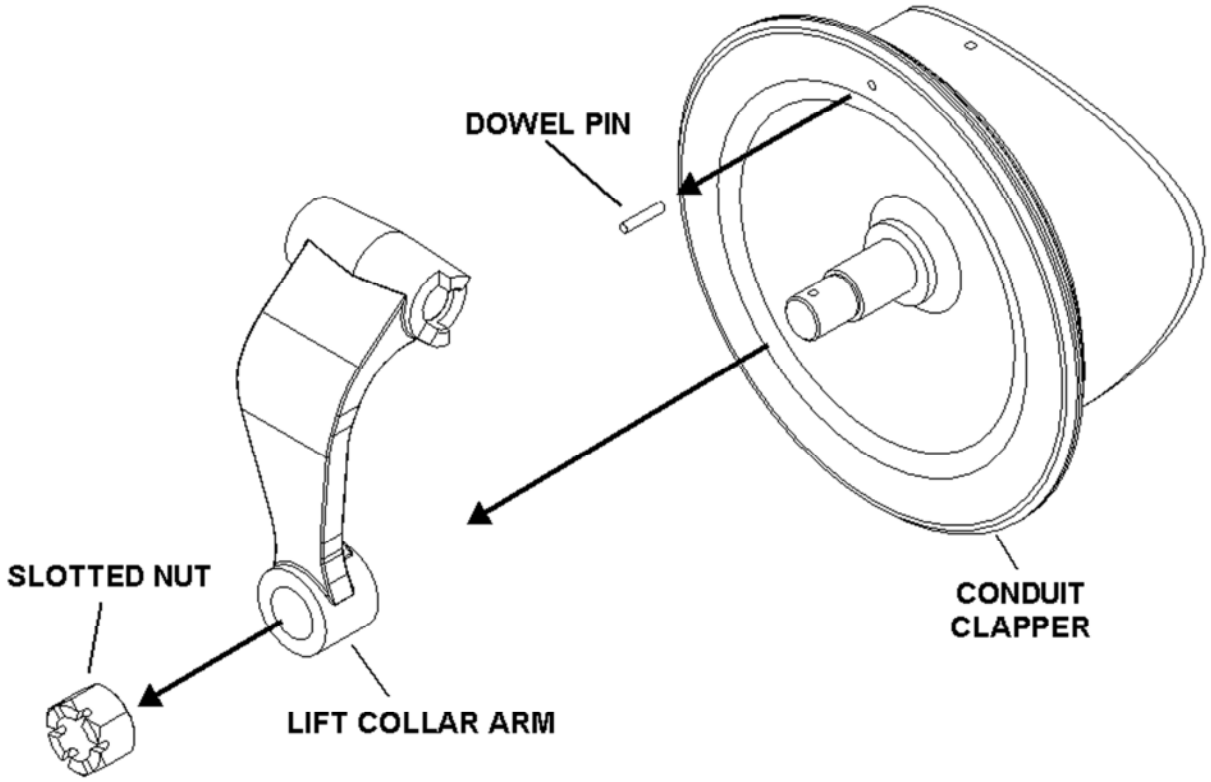


Figure 24: Disassembly of clapper-arm shown

7.7. Disassembly of renewable seat (if so equipped)

7.7.1. Remove set screws from within valve body that are secured to the renewable seat.

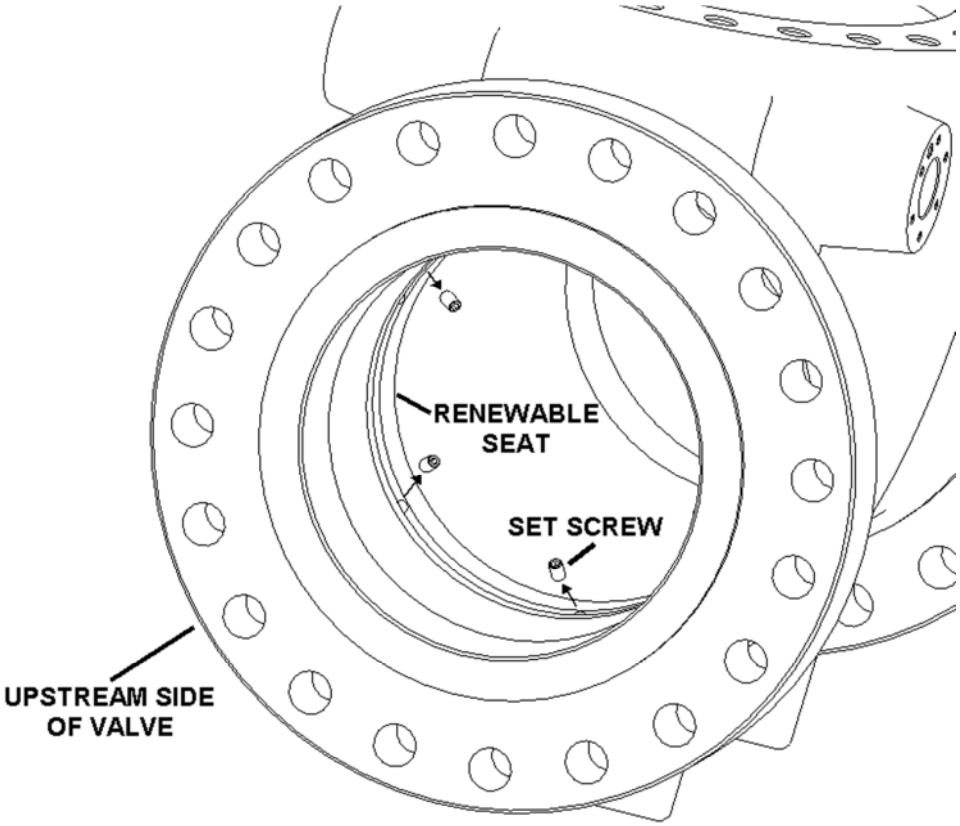


Figure 25: Removal of set screws from seat

7.7.2. Extract seat from within valve body and remove through valve bonnet bore.

7.8. Recommended spare parts

Table 3: Spare Parts List

1	RENEWABLE SEAT
2	SEAL, COVER
3	SEAL, CLAPPER
4	SEAL, SEAT
5	SEAL, GLAND BODY
6	SEAL, SHAFT

8.0. Reassembly

8.1. Pre-Assembly Inspection and Fit-up

8.1.1. Inspect cover-sealing surfaces for any damage.

8.1.2. Inspect clapper-sealing surfaces for any damage.

8.1.3. Inspect gland-sealing surfaces for any damage.

8.1.4. Inspect gland flange-sealing surfaces for any damage. (T1 gland only)

8.1.5. Inspect seat-sealing surfaces for any damage.

8.1.6. Insert extended shaft into valve shaft bore.

8.1.7. Insert gland body and thread gland retainer into the valve boss.

8.1.8. Rotate shaft to determine that the shaft rotates freely when assembled. If shaft does not rotate, freely grind areas of interference on the valve shaft bore. Repeat until shaft rotates freely. Remove gland body, retainer, and shaft.

8.1.9. Inspect shaft for sharp corners where seals may get damage. Deburr any sharp corners that may exist.

8.2. Assembly of renewable seat

8.2.1. After replacing seal (if applicable), insert seat through valve bonnet bore.

8.2.2. Secure seat by inserting set screws into appropriate threaded holes on the seat.

8.2.3. Tighten to torque per Table 1 in Appendix A.

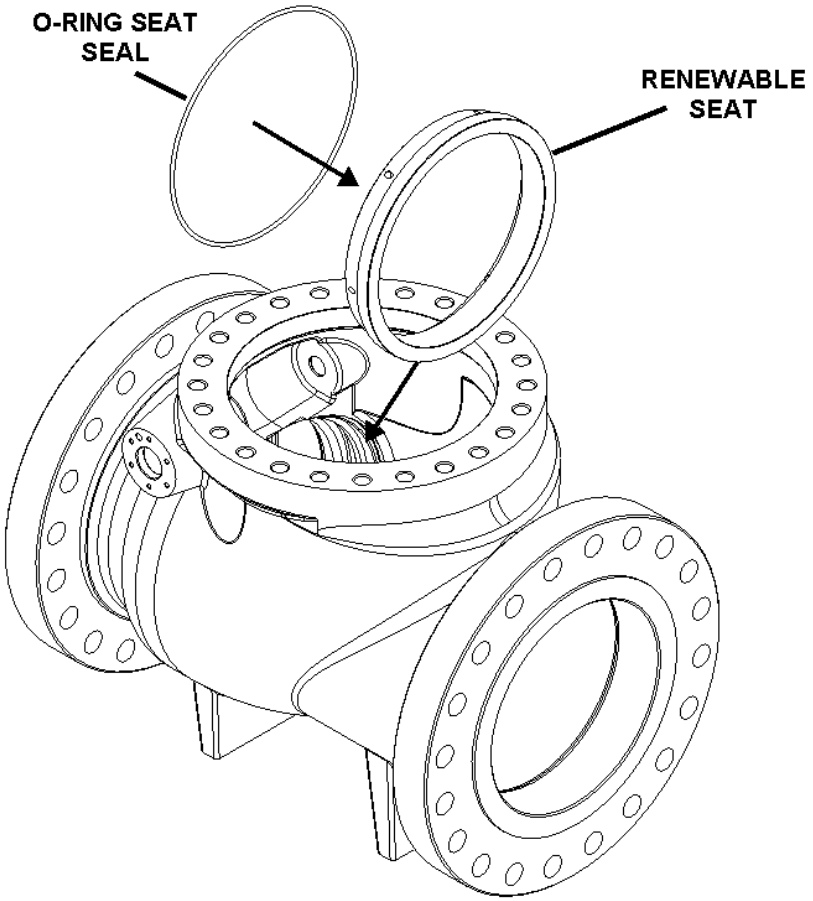


Figure 26: Insertion of seat through valve bonnet shown

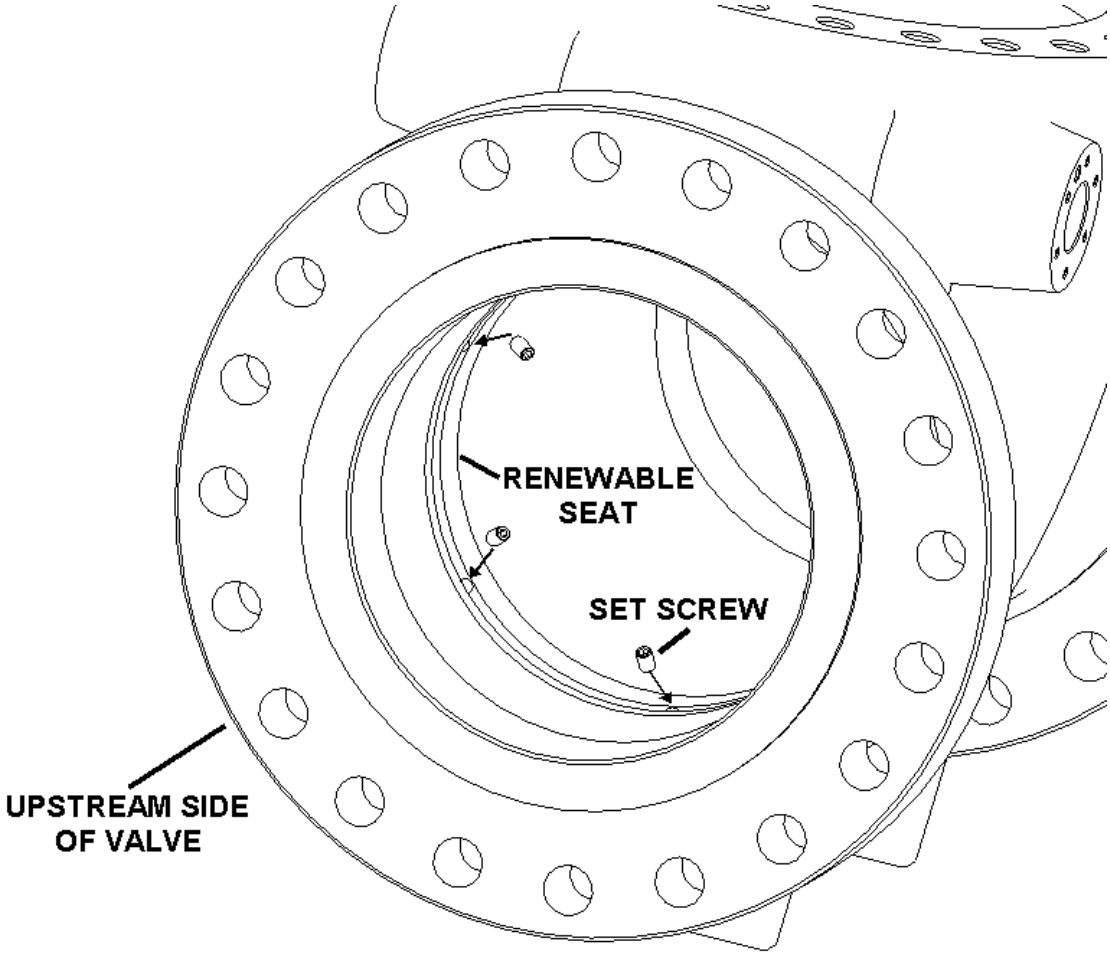


Figure 27: Insertion of set screws to secure seat shown

8.3. Assembly of arm-clapper assembly.

8.3.1. After replacing clapper seal (if applicable), place arm onto clapper stem. The arm should be of keyed design.

8.3.2. Thread slotted clapper nut onto clapper. There should be a clearance of 0.07 in [1.778 mm] between the clapper nut and arm. It is best to align the clapper stem hole with a slot on the nut.

8.3.3. Insert cotter pin through slot on clapper nut. Bend the ends of the pin to assure the nut cannot unthread.

8.3.4. Attach sling to arm-clapper assembly. Carefully lift the arm-clapper assembly and place into the valve body arm-pocket using the sling previously attached. Care should be taken to prevent damaging the sealing surface of the clapper.

8.4. Assembly of Shaft

8.4.1. Insert thrust washer onto shaft.

8.4.2. If necessary, insert key into key slot.

8.4.3. Insert bearings (if necessary) into the blind end of the shaft bore and also into the valve boss.

8.4.4. Insert shaft through valve boss while aligning with hole in the clapper-arm and inserting the key into the keyway of the arm.

8.4.5. Continue to slide shaft into bore until it bottoms out.

8.5. Assembly of gland body (S1, S2)

8.5.1. Insert dowel pin (if necessary) into appropriate hole located on valve boss.

8.5.2. Insert studs (if necessary) into appropriate holes located on valve boss.

8.5.3. Insert shaft seals into the gland body and the gland seal onto the gland body. Reference the following figures for the respective gland body type.

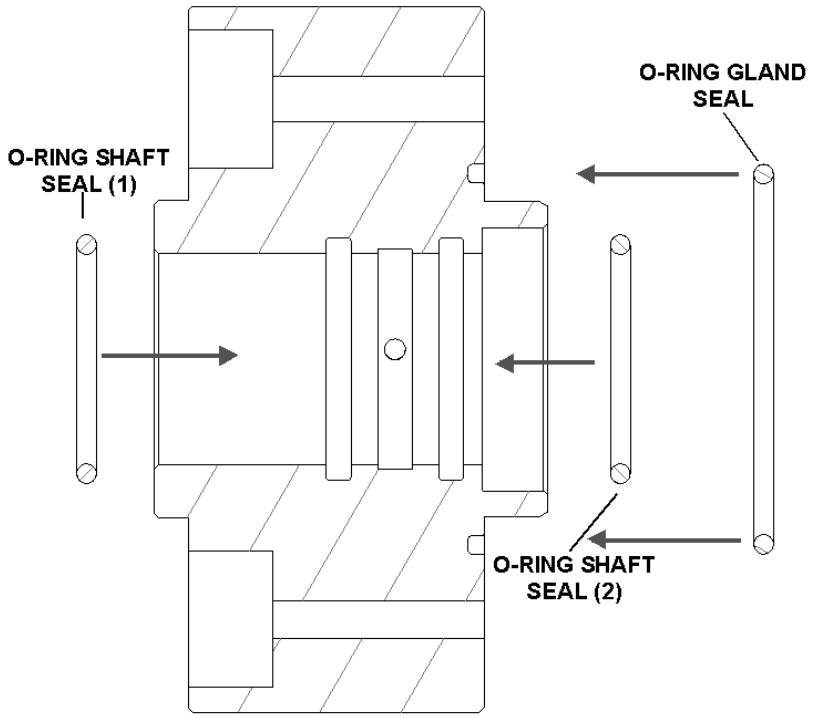


Figure 28: Insertion of seals into S1 Gland body shown

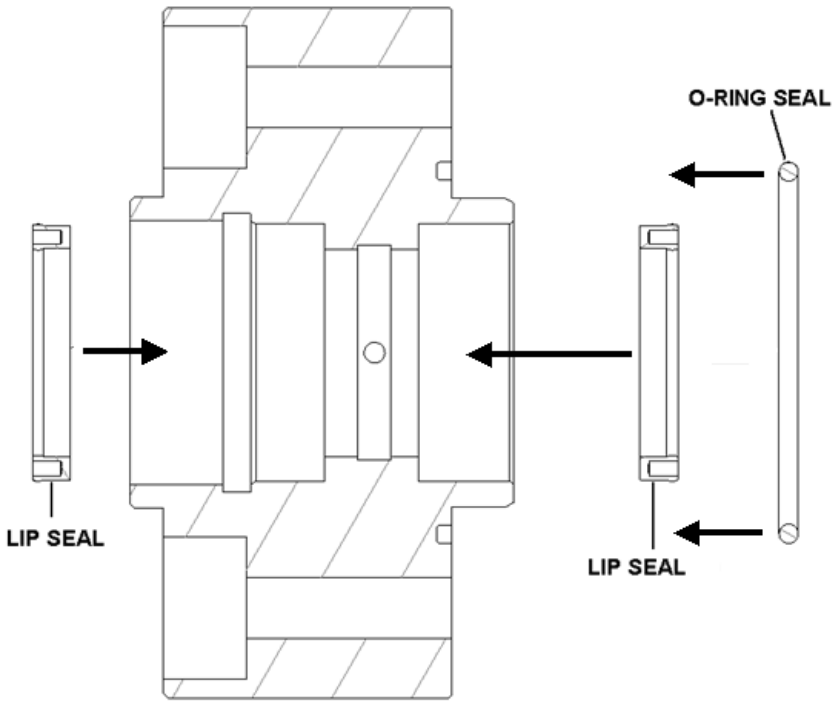


Figure 29: Insertion of seals to S2 gland body shown

8.5.4. Insert gland body onto shaft and align with dowel pin hole and stud holes.

8.5.5. Insert hex nuts to secure gland to valve body. Tighten to torque as per Table 4 in Appendix A.

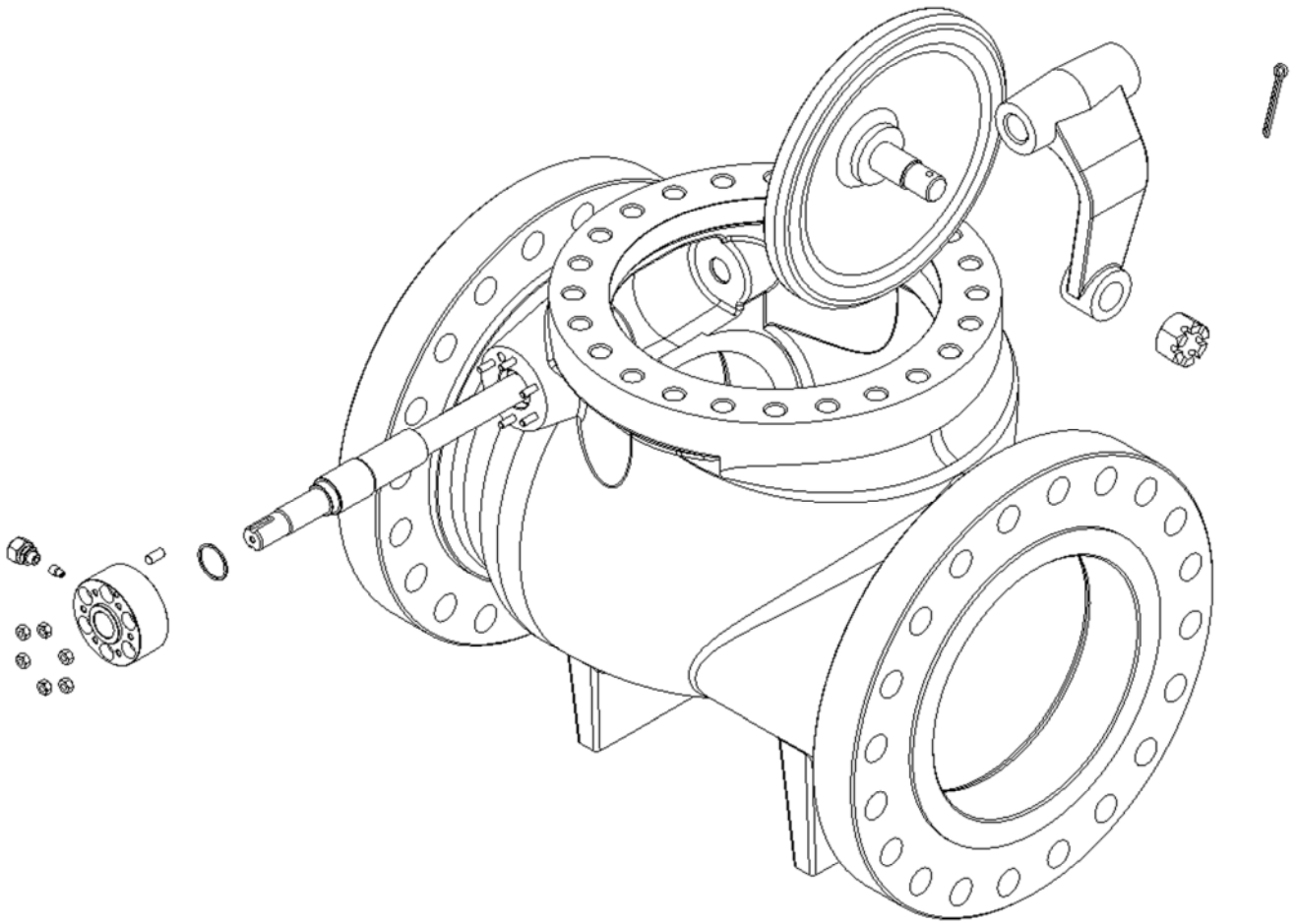


Figure 30: Insertion of arm-clapper assembly and shaft assembly shown

8.6. Assembly of Gland Flange

8.6.1. Insert appropriate studs into the gland body.

8.6.2. Insert gland flange onto gland body and secure with heavy hex nuts.

8.6.3. Torque heavy hex nuts per Table 4.

8.6.4. Insert bleed fitting.

8.6.5. Insert key coupling to shaft.

8.7. Assembly of Cover

8.7.1. If necessary, place cover seal on to its appropriate seal groove.

8.7.2. Lower valve cover onto body using the cover lift lug while making sure alignment marks line up.

8.7.3. Tighten cover nuts in a star pattern to assure uniform loading of cover seal. Cover nuts should be tightened per Table 4.

8.7.3.1. RTJ/BX Cover Seal – There should be no visible gap between the cover and valve bonnet.

8.7.3.2. R-TYPE Cover Seal – There should be a ¼" to $\frac{1}{8}$" visible gap between the cover and valve bonnet.

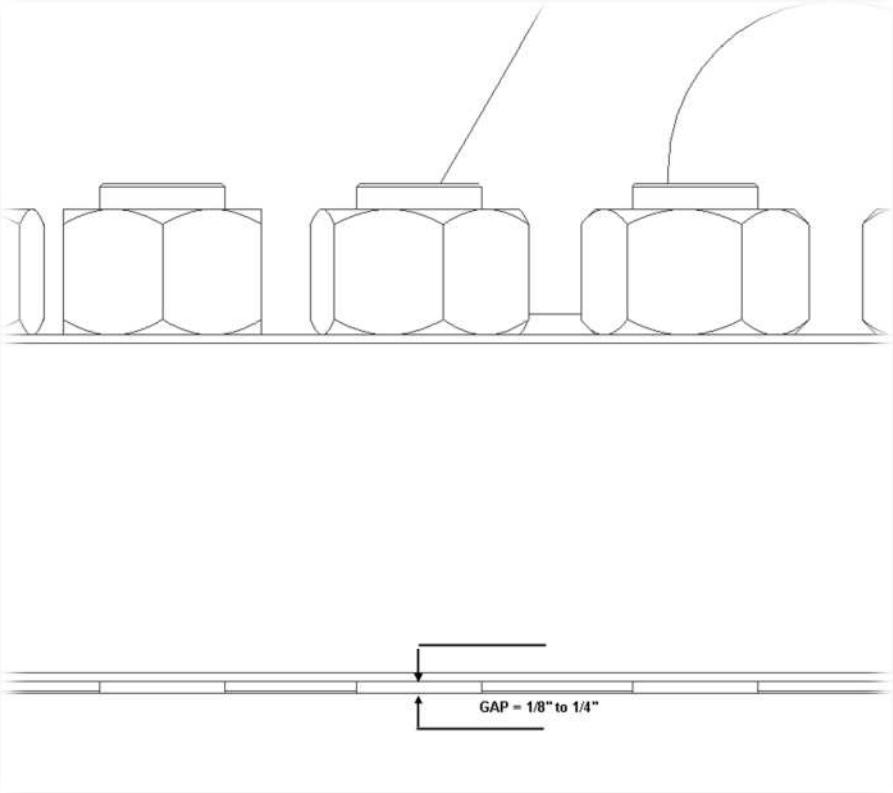


Figure 31: Required gap for RX gasket seals shown

8.7.4. Insert pipe plug onto cover and tighten to torque per Table 5.

8.8. Assembly of Worm Gearbox

8.8.1. Thread studs into gearbox if necessary.

8.8.2. Attach sling to gearbox and carefully lift and align bolt holes of gland flange with the studs on the rear of the gearbox. Be sure the hand wheel is in the vertical up position.

8.8.3. Thread on heavy hex nuts onto back of gland flange to secure the gearbox.

8.8.4. Torque nuts per Table 5.

Appendix A

Table 4: Tightening Torques for Nuts/Studs and Socket Head Cap Screws

Stud Size (Unified Thread)	Torque (Ft·Lb)			Torque (N·M)		
	Dry	Lubed[1)]	Teflon	Dry	Lubed[1)]	Teflon
1/4 – 20 UNC	3	2.5	1.2	4	3	2
3/8 – 16 UNC	10	7	4	14	9	5
1/2 – 13 UNC	60	55	30	81	75	41
5/8 – 11 UNC	120	105	60	163	142	81
3/4 – 10 UNC	210	190	105	285	258	142
7/8 – 9 UNC	340	300	170	461	407	231
1 – 8 UNC	510	450	250	692	610	339
1 1/8 – 8 UN	750	660	360	1,017	895	488
1 1/4 – 8 UN	1,050	900	500	1,424	1,221	678
1 3/8 – 8 UN	1,400	1,250	650	1,899	1,695	882
1 1/2 – 8 UN	1,850	1,650	850	2,509	2,238	1,153
1 5/8 – 8 UN	2,200	1,950	1,000	2,984	2,645	1,356
1 3/4 – 8 UN	3,050	2,650	1,400	4,137	3,594	1,899
1 7/8 – 8 UN	3,750	3,300	1,750	5,086	4,476	2,374
2 – 8 UN	4,600	4,050	2,100	6,239	5,493	2,848
2 1/4 – 8 UN	6,600	5,800	3,050	8,952	7,867	4,137
2 1/2 – 8 UN	9,100	8,000	4,150	12,342	10,850	5,629
2 3/4 – 8 UN	12,300	10,900	5,600	16,682	14,784	7,595
3 – 8 UN	16,000	14,200	7,300	21,701	19,259	9,901
3 1/4 – 8 UN	20,000	18,200	9,300	27,126	24,685	12,614
3 1/2 – 8 UN	25,600	22,800	11,600	34,721	30,924	15,733
3 3/4 – 8 UN	31,800	28,200	14,300	43,130	38,248	19,395

Metric thread [2)]

Stud Size (Metric)	Torque (Ft·Lb) (Lubed[1)])	Torque (N·M)(Lubed[1)])	3)	Stud Size (Metric)	Torque (Ft·Lb) (Lubed[1)])	Torque (N·M)(Lubed[1)])
M8×1.25	17	23		M52×3.00	4,544	6,164
M10×1.50	33	45		M56×4.00	5,482	7,436
M12×1.75	58	79		M60×4.00	6,819	9,249
M14×2.00	82	111		M64×4.00	8,374	11,358
M16×2.00	128	174		M68×4.00	10,164	13,786
M18×2.50	175	238		M72×4.00	12,172	16,509
M20×2.50	251	340		M76×4.00	14,409	19,542
M22×2.50	346	469		M80×4.00	16,924	22,954
M24×3.00	433	588		M85×4.00	20,458	27,747
M27×3.00	642	871		M90×4.00	24,455	33,169
M30×3.50	867	1,177		M95×4.00	28,899	39,196
M33×3.50	1,020	1,383		M100×4.00	32,972	44,719
M36×3.00	1,410	1,912		M105×6.00	36,522	49,535
M39×3.00	1,825	2,476		M110×4.00	40,598	55,063
M42×3.00	2,307	3,128		M120×4.00	53,126	72,055
M45×3.00	2,880	3,906		M150×6.00	102,165	138,567
M48×3.00	3,530	4,788				

(Based on bolt pre-stress of 50,000 lbs/in^2, for ASTM A193 B7/B7M, A320 L7/L7M, or equivalent, value can be ±10%)

1) For studs and nuts coated with anti-seize lubricant
2) Data from Cameron UTP562
3) For Teflon coated studs and nuts, use half of values for lubed or per bolting manufacturer's instruction

Table 5: Pipe Plug Torque Values

RECOMMENDED PIPE PLUG TORQUE (FT-LB)		
NPT	HEX AND SQUARE HEAD	HEX SOCKET HEAD
1/16	12	11
1/8	20	18
¼	50	40
3/8	100	78
½	150	133
¾	250	433
1	350	592
1 – ¼	450	1,033
1 – ½	575	-
2	789	-