

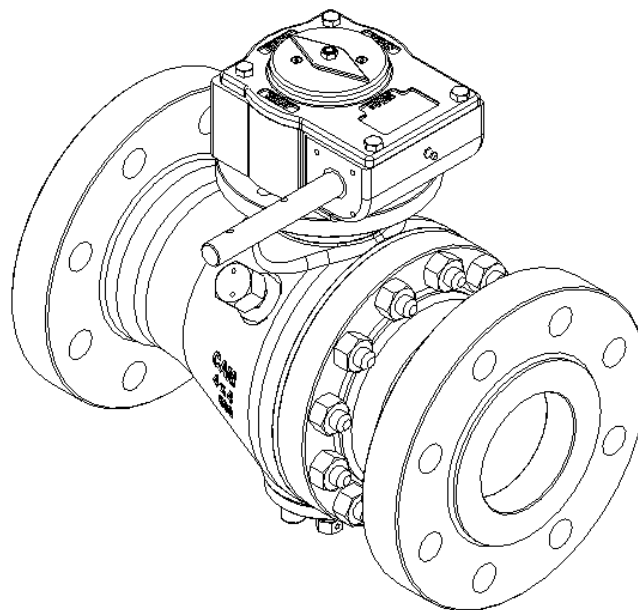
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# AOP Series D2 Trunnion Ball Valve 2"FP - 6" RP

## Installation, Operation, and Maintenance Manual



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File copies of this manual are maintained. Revisions and/or additions will be made as deemed necessary by Cameron. The drawings in this book are not drawn to scale, but the dimensions shown are accurate.

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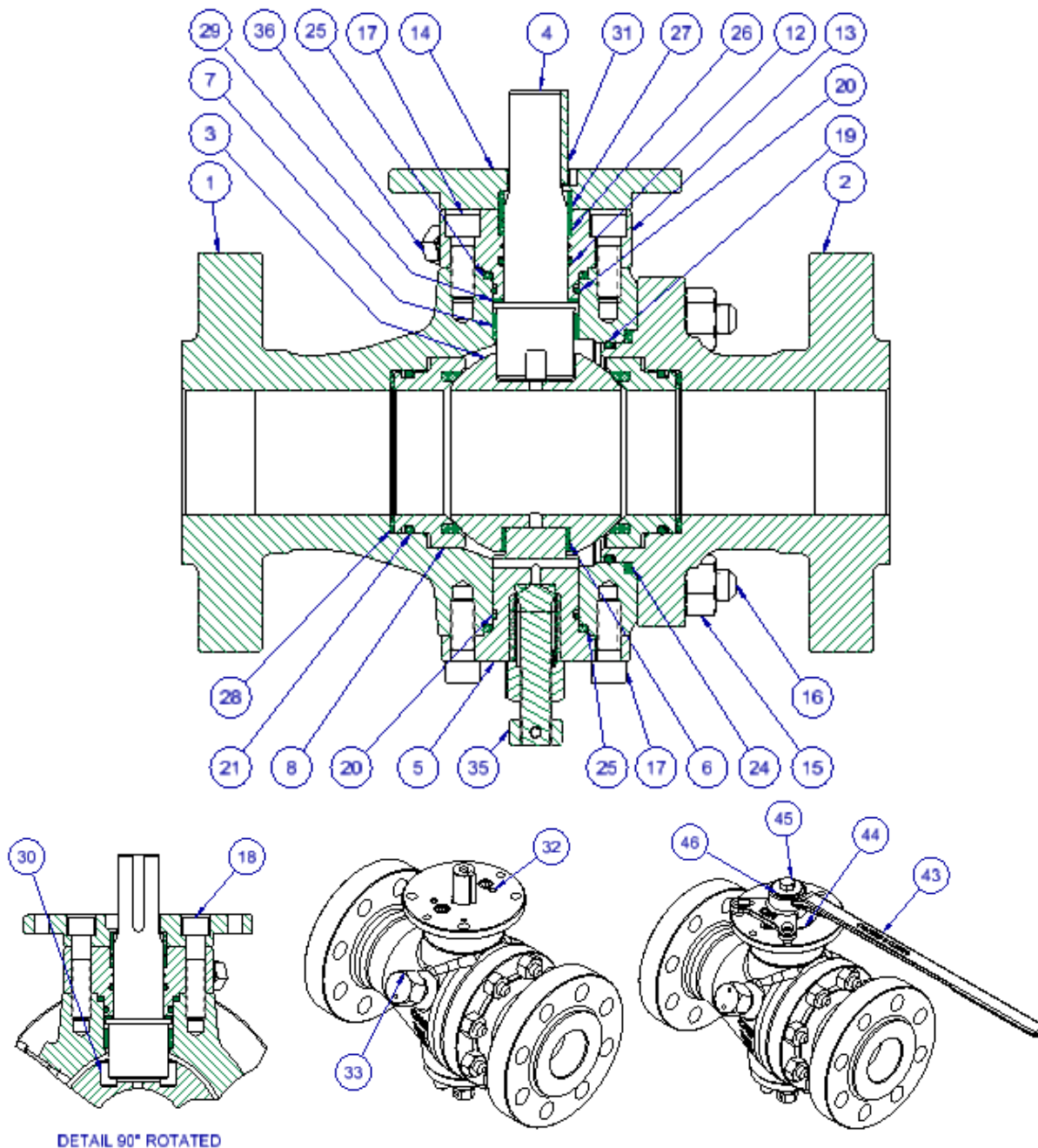
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**BILL OF MATERIAL 2" TO 4" FP & 6" RP CLASS 150 TO 600**

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**Figure 1 – D2 Series Standard Seat (2" to 4" FP & 6" RP-class 150-600) Lever Operator**  
PARTS LISTING FOR PLASTIC INSERT SEATED VALVE – SEE FIG. 1

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Item	Description	Qty
1	BODY	1
2	TAILPIECE	1
3	BALL	1
4	STEM	1
5	LOWER TRUNNION	1
6	TRUNNION RADIAL BEARING	1
7	BALL RADIAL BEARING	1
8	SEAT WITH INSERT	2
12	O-RING,STEM	1
13	BONNET	1
14	ADAPTER PLATE	1
15	BODY STUDS	*
16	BODY HEX NUTS	*
17	CAPSCREW BONNET / TRUNNION	*
18	CAPSCREW ADAPTER PLATE	*
19	O-RING,TAILPIECE	1
20	O-RING,BONNET/TRUNNION	2
21	O-RING,SEAT RING	2
24	FIRE SEAL GRAPHITE BODY	1
25	FIRE SEAL GASKET BONNET/TRUNNION	2
26	FIRE SEAL GRAPHITE - STEM	1
27	BUSHING GLAND	1
28	BELLEVILLE SPRING	2
29	STEM THRUST BEARING	1
30	DRIVE PIN	2
31	KEY	1
32	TORQUE PIN	2
33	BODY VENT PLUG	1
35	BLEED PLUG	1
36	VENT PLUG	1
41	NAMEPLATE ( NOT SHOWN)	1
42	DRIVE SCREW ( NOT SHOWN)	1
43	HANDLE OR LEVER	1
44	WHEATER PROTECTOR	1
45	SCREW	1
46	WASHER	1

\* Quantities depending on size and class

**Table 1 – D2 Series Standard Seat (2” to 4” FP & 6” RP class 150-600) Lever operated Parts List**

**SCOPE**

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AOP D2 series ball valves 2” to 4” FP & 6” RP are full bore, through conduit, bi-directional, anti-blowout stem, double block and bleed with trunnion mounted ball for easy operation.

These valves are equipped with plastic seat made of Nylon insert; all the seats are self-relieve type seats to eliminate cavity pressure lock. All valves have a built-in sealant injection system for emergency seat seal and a stem sealant fitting for stem seal recovery. The trunnion ball valve uses metal- backed self-lubricating with bearings and thrust washers to reduce torque. The stem and lower trunnion are separated from the ball to eliminate side loads.

The lever and wrench head can be easily removed/ reassembled by means of screws.

The handwheel can be removed from the gear shaft by taking out the split pin or screws

**STORAGE**

After the valves have been assembled and tested, the valves are drained and painted. Sealing surfaces of connection flanges are greased and covered by protectors. All valves are delivered in fully open position, unless is actuated with a normal close position actuator. If the valve is lever operated, the lever may be separately packaged for easier handling and transportation. If the valve has a gear operator, the gear is installed on the valve and factory adjusted for open and closed position.

The gear handwheel may be separately packaged for easier handling and transportation. All D2 valves should be stored in fully open position as received, with the flange seal surfaces and the bore greased, and the protectors installed on the flanges.

**INSTALLATION AND OPERTAION INSTRUCTIONS**

**BEFROE INSTALLATION SAFETY INFORMATION**

Valves shall be operated and maintained strictly in accordance with these procedures. Operation or maintenance outside of these procedures constitutes abuse of the product and voids all warranty and claims.

When special operation is required, a formal written request to the company must be made for approval to operate in this manner if warranty and product liability is to be maintained.

Before any work is performed on a valve, personnel working on the valve must obtain the proper work permits required by his employer. Personnel shall always use safety precautions set forth by the law and regulations required by his employer. Personnel shall also be aware that any venting or draining of fluids from the valve shall be done in accordance with safety and environmental procedures in force at the location.

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The maintenance personnel doing the repairs should be well trained, and familiar with all the information contained in this manual.

The valves shall be appropriately used for the intended purpose. Any safety or protection devices on the valve shall not be permanently removed or altered unless written approval is received from Cameron representative.

Transport, unpacking, lifting, connections to the different types of systems (electric, pneumatic, hydraulic systems, etc.) shall be made by expert and qualified personnel.

Should any difficulties or abnormalities arise which cannot be solved by the technician, contact a Cameron representative.

Any servicing not covered by these instructions must be made by an authorized service center, after preliminary approval has been given by Cameron representative.

**INSTALLATION**

Before installation, ensure the grease fittings and sealing surfaces of connection flanges are not damaged during transportation. Remove the connection flange protectors and ensure that no foreign materials are inside the valve bore. If pressure tests are conducted before installation, drain the valve to remove testing water.

Clearly identify the valve through its data plate, check its weight with the packing list or relevant documents and then place it on a horizontal surface, using suitable handling equipment. Handling equipment must be provided which is appropriate for the total weight of the package.

For D2 valves small size, light valves, use the line flange holes if the valve has flanged ends. Do not use lifting lugs or eyes provided on the gear or actuator, if present. Pay attention that slings do not damage the gear or actuator. Lift the valve and put it on a plane, horizontal surface, take care to avoid damaging the valve connections by using wooden saddles or other suitable equipment.

To avoid the ingress of debris or sand into the ball and seat area the protective covers should not be removed until the valve is ready to be installed in the line. When the valve needs to be installed in the line take away the protective plastic or wooden flange protectors.

During installation the valve must be fully open and the line sections, between which the valve will be installed, must be aligned, clean and correctly spaced. Should the valve be closed, the exposed face of the ball must be protected with grease or other anti-adhesive product.

When the valve has butt welding ends, welding on the line must be performed using the proper welding procedure. After welding, clean and check the weld bead and repair as required.



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AOP D2 valves may be installed in any position with either end facing upstream. The valve should be installed in such a way as to facilitate maintenance, easy access to the valve fittings and actuating operations.

When installing the valve allow for possible deformations caused by the expansion of the line. The valve must not support the line. Avoid any strain in the valve body.

**CAUTION: Do not overload the valve beyond the design piping loads stated on the requirements.**

Use studs, nuts and raised face gaskets or ring joints, as per size and class conforming to ASME B16.5. Tighten the studs alternately, cross pattern method, several times, using the torques recommended by ANSI or gasket manufacturer specification.

**CAUTION: While all AOP D2 trunnion ball valves have self-relieving seats as standard equipment, it is recommended that appropriate safeguards be put into place to prevent exceeding the pressure/temperature limits given by the manufacturer.**

**FIELD TESTING**

When field testing is required the following procedures are recommended:

1. Ensure that the test fluids are compatible with the valve seat and seal material.
2. Flush the system to remove foreign material that may be in the line as a result from installation procedures, to avoid damages to the ball and seats.
3. If performing line shell testing, the valve shall be in half open position. The maximum line pressure can be 1-1/2 times the valve maximum cold working pressure.
4. If performing seat testing, make sure the valve is fully closed. The maximum pressure for seat testing is the maximum cold working pressure.
5. After completion of testing, purge all test fluids from the valve.

**CAUTION: If the seats are tested to a higher pressure than maximum cold working pressure, the seats can be permanently damaged. If a higher test pressure is desired contact Cameron representative for details.**

**OPERATION**

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AOP D2 series ball valves only work in the fully closed or fully open position; these valves work for on/off service only.

**WARNING: These valves shall never be operated partially open or partially closed. Throttling (partial opening) or “pinching” flow may cause non-uniform wear on seats and ball over the sealing surfaces where it is exposed to the flow line, preventing tight shut-off.**

To close the valve, turn the lever or gear handwheel clockwise until it stops; to open the valve turn the lever or gear handwheel counterclockwise until it stops.

All lever operated valves should have the lever in line with valve through bore when opened and perpendicular (90 degrees) with the through bore when closed.

All gear operated valves have the gear indicator aligned with valve through bore when opened and perpendicular with the through bore when closed. The gear has also “OPEN” and “SHUT” markings.

While opening or closing the ball must reseat, this reseating torque is higher than the run torque. If lever operated turn the lever until the stop plate stops on the stop screw. If gear operated turn the handwheel until the gear has a positive stop. If the valve is motor actuated read carefully the actuator operation manual.

**CAUTION: The end stops have shop set to assure the correct 90 deg. rotation from fully open to fully closed position. Do not change their adjustment. If the valve is not correctly resealed at the end of opening or closing, the ball and the seats can quickly be damaged when exposed to flow pressure, preventing tight shut-off.**

These valves can be operated by one person. It is recommended that no extensions be used for operating the valve.

**MAINTENANCE PROCEDURES**

The D2 series ball valves have a tight seat to ball seal insuring leak-free performance for a long period of time. However, all valves can be drained and lubed depend on application conditions or anytime if desired. Also, the gears are factory lubricated for long operation (on gear operated valves). If desired the gear can be lubricated using the lube fitting located on the side of the gear operator.

**DRAINAGE PROCEDURE**

Valves may accumulate water, scale, deposits and other foreign matter, during their service. These materials may damage the valve in the following ways:

1. At low temperature, ice may form inside the valve hindering its normal operation.
2. Foreign matters may prevent the valve from fully closing and the ensuing throttling may damage the ball or the seat seals. Foreign matter may get caught between the ball and the seat and damage their surfaces.

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A drainage schedule is the best way to prevent damage caused by foreign matter. However, it is recommended that drainage should be carried out in the following cases:

1. Whenever the valve does not close
2. Before the arrival of the cold season
3. After washing the line
4. After hydraulic test

For a drainage procedure, follow the below instructions:

1. Close the valve completely.
2. Slowly open the drain fitting (35) on the lower trunnion for smaller size valves up to 600 class; the drain fitting (36) located on the body for higher size valves.

**CAUTION: Open the drain valve slowly until the pressure in the body cavity has been discharged. Make sure the fitting body does not unscrew when untightening the fitting stem. If necessary, use a backup wrench to prevent the fitting body from unscrewing.**

LUBRICATION- GREASE INJECTION

The D2 series valves have been designed and tested in such a way that they do not require the use of lubricating or sealing grease during their normal service operation.

However, should the need arise, the D2 series ball valve 150 to 600 class is equipped with a body injection fitting through which lubrication/sealant can be injected directly into the body cavity of the valve; the D2 series grease injection fitting located on the body seat area – see Table 2 for recommended lubricants.

This may be necessary in the event of slightly damage to the seats caused by debris in the line; before operating the valve if the valve has been left in its position, either fully open or fully close, for long period of time; as soon as an increase of stem torque is noticed.

**CAUTION: Grease fittings should not be removed if there is pressure in line. Grease fittings should never be painted.**

**Table 2 – Lubrication Information**

Service Condition	Product	Cleaner / Sealant Manufacturer		
		Val-Tex	Sealweld	Lubchem

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Natural Gas	Flush	Valve flush	Valve cleaner	Valve saver
	Standard valve lubricant	2000 light lube	EQ 80	Lubchem '50-400"
	Standard sealant	80 bulk/ 80-HS stick	Total lube 911	Everlast No.1
	Standard low. Temp.	50 bulk / stick	Winterlub 7030	Everlast No.1 AG
	Severe leak sealant	80+PTFE bulk / stick	Sealweld #5050	Formasil RS
Sour Gas	Flush	Valve flush	Valve cleaner	Valve saver
	Standard valve lubricant	2065 light lube	EQ 80	Lubchem '50-400"
	Standard sealant	65 bulk / stick	Total lube 911	Lubchem '50-400"
	Standard low. Temp.	65 bulk / stick	Winterlub 7030	Lubchem '50-300"
	Severe leak sealant	80+PTFE bulk / stick	Sealweld #5050	Formasil RS
Dry Co2	Flush	Valve flush	Valve cleaner	Valve saver
	Standard valve lubricant	2300 light lube	Sealweld Silicone Lubricant	Everlast WR
	Standard sealant	302 bulk / stick	Sealweld Silicone Lubricant	Everlast WR
	Standard low. Temp.	65 bulk / stick	Sealweld Silicone Lubricant	Everlast WR
	Severe leak sealant	80+PTFE bulk / stick	Sealweld Silicone Sealant	Formasil CO2
Crude Oil	Flush	Valve flush	Valve cleaner	Valve saver
	Standard valve lubricant	2000 light lube	EQ 80	Lubchem '50-400"
	Standard sealant	80 bulk/ 80-HS stick	Total lube 911	Lubchem '50-400"
	Standard low. Temp.	50 bulk / stick	Winterlub 7030	Lubchem '50-300"
	Severe leak sealant	80+PTFE bulk / stick	Sealweld #5050	Formasil WR

**Valve cleaner/ sealant manufacturers:**

Val - Tex

Valves Incorporated of Texas  
10600 Fallstone Rd.  
Houston, TX 77099  
281/530-484

Sealweld

7240 Brittmore Suite 120  
Houston, TX 77041  
Schlumberger-Private  
800/237-0564

Lubchem Inc. P.O. Box 2626

Spring, TX 77383  
281/350-9600

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### VALVE RECONDITIONING

The D2 series valves can be rebuilt if it is necessary. The disassembly the valve requires proper lifting equipment and normal maintenance tools.

Spare parts are determined by the individual customer specification; however, the following list is suggested as a minimum for typical maintenance operations:

1. All bearings (stem and trunnion)
2. Stem thrust washer and ball thrust washer
3. All O-rings
4. All back-up rings – as applicable
5. All fire safe seals
6. Bushing Gland
7. Seat springs
8. Seat subassemblies (rings with inserts)
9. Drain fitting
10. Grease injection fittings

**CAUTION: Prior to disassembly, the valve must first be isolated from system pressure and flow. Operate the valve at least two times and drain the valve to make sure there is no residual pressure left into the body.**

After observing the above precautions, remove the valve from the pipeline system. Set the valve in a clean place free of dust and/or metallic chips. Operate the valve to the closed position.

### DISASSEMBLY

1. Valve should be closed position.

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**CAUTION: Prior to disassembly, verify that there is no pressure in the body cavity. Operate the valve at least two times to bleed any residual pressure.**

2. Stand the valve on the body end flange. Care should be taken to avoid damage of the sealing surface of the raised portion or ring groove (as applicable).
3. If lever operated valve - remove the lever, wrench head, snap ring and stop plate. Unscrew the bearing housing cap screws, remove the bearing housing.
4. If the valve is gear operated - loosen the gear nuts, at the same time lift the gear until it comes off the stem. Remove stem key. Unscrew the adapter plate cap screws, remove the adapter plate.
5. Unscrew the bonnet cap screws and pull the stem assembled with the bonnet out from the valve body, paying attention not to damage the soft seals. Remove the stem drive pins from their holes on the top of the ball.
6. Carefully push the stem out of the bonnet, paying attention not to damage the soft seals, and then remove the upper thrust washer from the stem.
7. Remove the gland-bushing with the stem fire safe seal, the stem O-rings and the bonnet O-ring from the respective grooves on the gland plate.
8. Remove the gland plate fire safe seal from its housing on the body.
9. Unscrew the lower trunnion cap screws and pull the lower trunnion out of the valve body, paying attention not to damage the soft seals.
10. Remove the trunnion O-ring from the trunnion groove and the lower trunnion fire safe seal from its housing in the body.
11. Remove the body stud and nuts.
12. Lift the Tailpiece off the body paying attention not to damage the body O-ring.
13. Remove the Tailpiece O-ring from the groove on the Tailpiece and the Tailpiece fire safe seal from its recess.
14. Pull the seat ring unit out of the Tailpiece, paying attention not to damage the soft seals.
15. Slip the seat O-ring off the seat ring.

**CAUTION: The seal ring consists of an insert pressed into the seat ring by the manufacturer.**

**Do not attempt to remove the seat insert from holder.**

16. Remove the seat Belleville spring from their housing in the Tailpiece.

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17. Remove the ball from the body cavity.
18. Pull the trunnion bearing from the bottom of the ball.
19. Repeat steps 14-16 for removal of the body seat ring.
20. Remove the stem bearing from the body stem bore.
21. Remove the drain fitting.
22. Remove the grease fittings.
23. Remove the body and stem vent plug.

**CLEANING**

**Chemical Resistant Vinyl or Rubber Gloves Should Be Worn During Cleaning Operations**

Remove any foreign and corrosive products within the body.

**CAUTION: Abrasive cleaning could never be used, especially on sealing area. If water jetting is used, dry with compressed air.**

Clean all metallic parts with soft cloth saturated with a solvent. Observe all sealing surfaces. Clean the grease fittings and if present the grease channels. Clean the sealing rings and the gaskets with a soft cloth. If necessary, wash them with soap and rinse them with clean water.

**INSPECTION**

After cleaning, all valve components should be inspected for damages, dents, scoring, wear or corrosion. If any damage is found, proceed with the repair where possible, or with substitution of the parts.

For a complete inspection procedure, the following operations shall be carried out:

1. Check the metallic parts for damage along the sealing surfaces and on moving surfaces. Attention should be paid to surface nicks and corner damage.
2. Make sure that the sealing rings and gaskets are not slashed, extruded and/or otherwise damaged.
3. Check for scratches, plating defects, the surfaces of the bearings, the thrust washers, the gland bushing, the ball and the seat components.
4. Inspect all spares that are going to be used to ensure damage has not occurred in storage or transportation.

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- If any damage is found, the minor repairs should be carried out by trained persons, otherwise contact a representative.

The minor repairs that may be carried out on site by maintenance personnel shall be in accordance with the following points:

- Use standard engineering practices to repair the damage on metallic surfaces.
- Remove surface nicks on ball and stem by using a mild abrasive.
- Remove all corner damages by using a mild abrasive or with a bearing scraper.
- Replace all faulty parts and components.
- Flush lube and sealant while the valve is disassembled.

## REASSEMBLY

### LEVER OPERATED VALVES-2" TO 4" (FP & 6" RP) CLASS 150 TO 600

After inspecting the parts and getting the new replacement parts as required, use the following procedure to assemble the below steps:

- Place the body on the flange, on a clean solid surface so it will hold the weight of the assembled valve securely. Attention should be given to the sealing surfaces not to damage.
- If studs have been removed, install the studs in the body with the ID stamping up, and screw them down completely by hand. Remove any particles which may have flaked off the studs.
- Inspect the seats, paying careful attention to the insert sealing surfaces. Reject and replace all seats with dings, scratches, or any other physical defects. Install the O-rings as shown in Fig. 3 Apply lubricant until completely covering the O-rings.

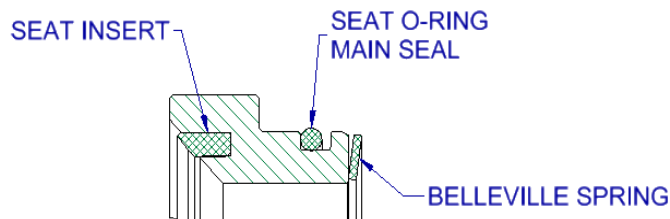


Fig.3 Seat Detail for 2" to 4" FP & 6" RP

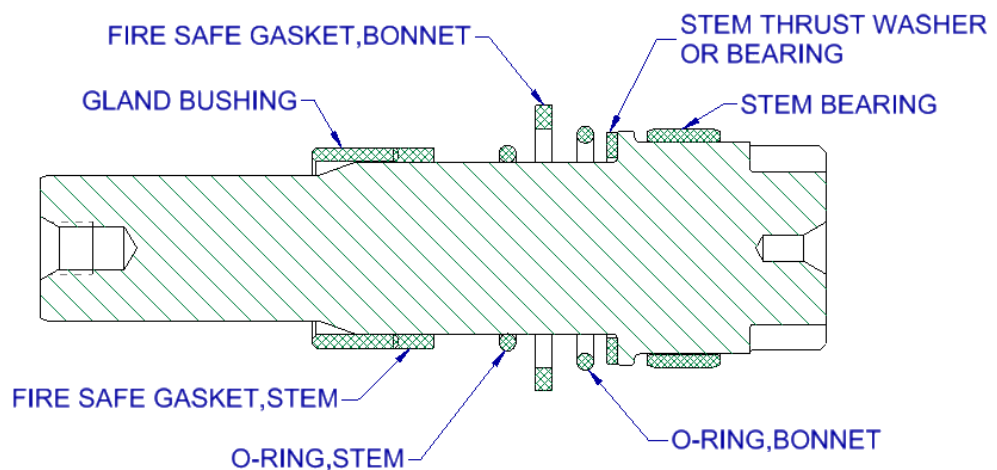
- Install the O-rings to the tailpiece and cover. Position of the O-ring towards the flange of the part as shown in details Fig. 1 and Fig. 2.



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5. Drive the stem radial bearing into body stem hole using a stem and a soft face hammer. The bushing should be driven in so that it contacts the retaining lip in the bore. This operation can be done safely on the smaller valves with the body lying on the trunnion pad and using the stem as a driver. As shown in details Fig. 4
6. Place the stem thrust washer over the stem. The Teflon side of the washer should point up.
7. Install the ball thrust washer (if applicable) and the trunnion radial bearing in the ball trunnion bore.
8. Grease the ball drive pin holes and install the drive pins. Make sure the drive pins are placed correctly in the holes and do not stick above the ball.



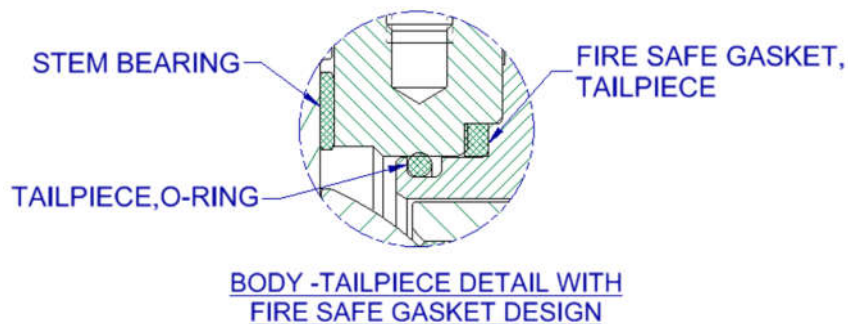
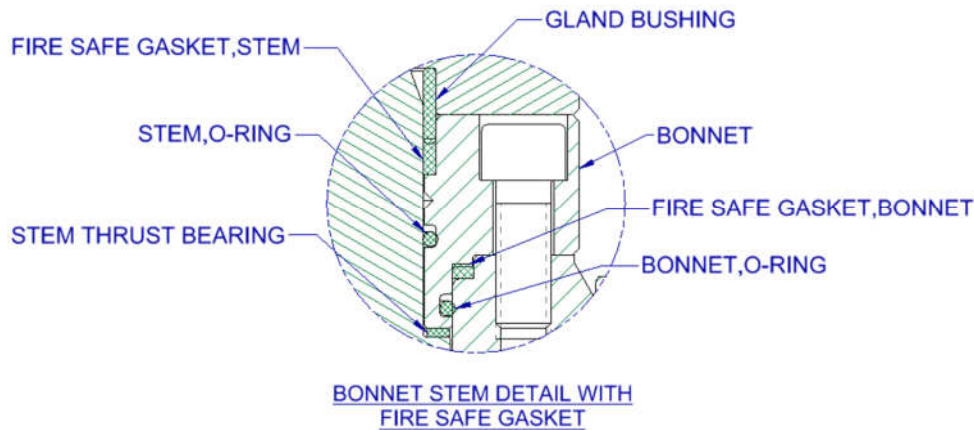
**Fig 4 Stem sealings for 2" to 4"**

9. At this time the fire safe seals can be placed over the Tailpiece shoulder, the lower trunnion (or lower trunnion cover) and bonnet (gland plate).
10. Apply a coat of lubricant on the entire surface of body and tailpiece seat pockets and install the seat springs into the seat pockets.
11. Lower one seat assembly, with the insert facing up, into the body pocket. Press the seat using a proper tool until the O-rings and back-up rings are completely engaged in the pocket. Take care to avoid damaging the seat insert.
12. Apply a coat of lubricant on the entire surface of body and tailpiece seat pockets and install the seat springs into the seat pockets.
13. For 2" to 4" install the Belleville spring on the seat ring. See the configuration on Fig. 5.0 & 5.1

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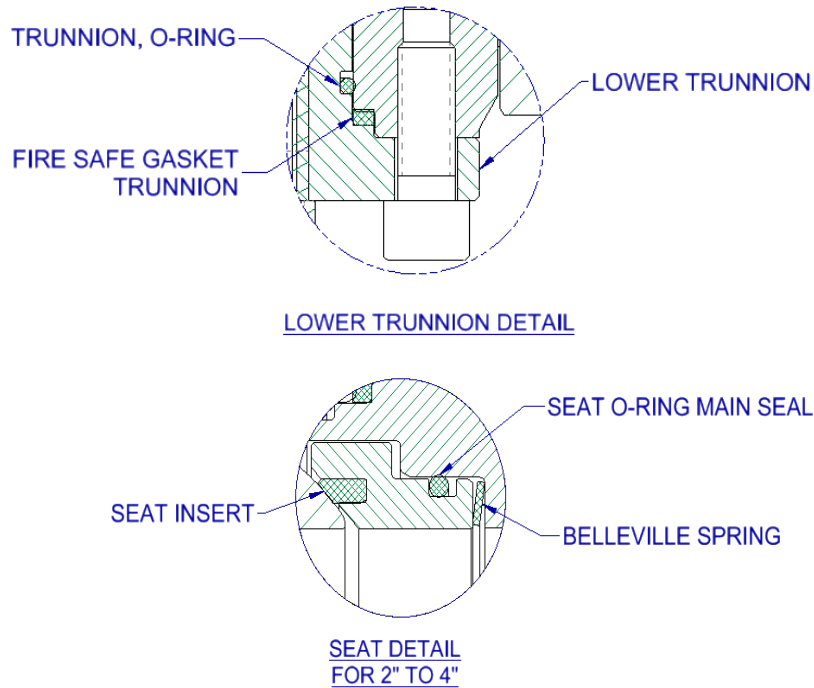
14. On piece seat assembly, with the insert facing up, into the body pocket. Press the seat using a proper tool until the O-rings are completely engaged in the pocket. Take care to avoid damaging the seat insert. See below Fig. 5.1
15. The O-rings can now be added to all the parts. O-rings are positioned towards the pressure side of the groove. See below Fig. 5.0 & 5.1 for details:
16. Wrap all the external fittings thread with Teflon tape. **Note:** The hole in the drain fitting should not be covered with tape.



**Figure 5.0 – Sealing Details on Bonnet**

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**Figure 5.1 – Sealing Details**

17. Insert the lower trunnion bearing into the ball by using the trunnion or a small arbor press.
18. Install the seats into the body and Tailpiece recess. Caution should be taken not to damage the seat insert material.
19. Place the ball into the body cavity in the fully closed position. Using a caliper and a marker, mark the center of the ball for close position. Check the marking measuring from both sides of the ball hole.
20. Place the trunnion into the body, until it is fitted into the lower ball radial bearing. Loosely secure the trunnion with cap screws.
21. Flip the tailpiece over using the proper lifting equipment. Lift the tailpiece and start lowering it onto the body. Before the tailpiece engages the studs, orient it such that the grease fittings of the tailpiece are on the same side as the grease fittings of the body, towards the front of the valve or aligned with the stem bore (if applicable). At the same time, the tailpiece end flange bolt holes must be aligned with the body end flange bolt holes. After these two alignments are completed, slowly lower the tailpiece onto the body until it rests on the ball.
22. Install two nuts, 180° apart, and tighten sequentially until the tailpiece is contacting the body around the entire flange. Install the remainder of the nuts. Install and tighten two body stud nuts on opposite sides of

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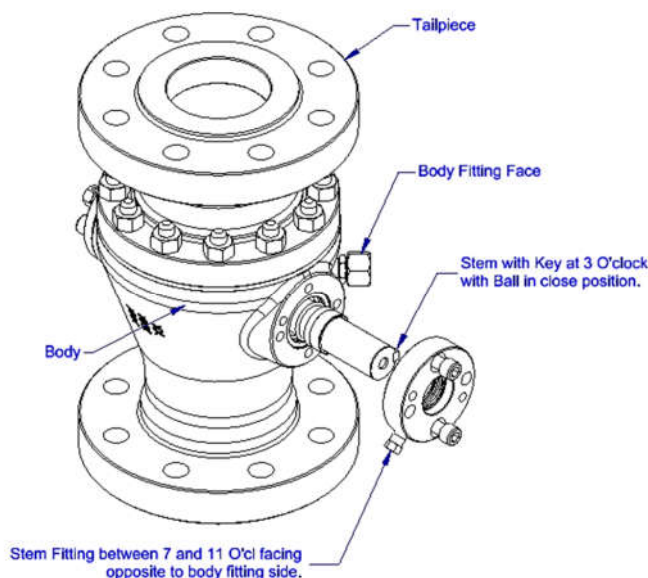
the body. The rest of the body stud nuts can be installed at this time and the trunnion cap screws tightened. Torque all fasteners as shown in the table 4 below.

Installation Torque Values for B7, B7M, L7, L7M Studs and Cap Screws		
BODY NUT AND CAP SCREW SIZE	ASSEMBLY MAKEUP TORQUE DRY/ZINC PLATED THREADS	ASSEMBLY MAKEUP TORQUE CAD/TEFLON COATED THREADS
1/4" – 20 UNC	6 FT-LBS.	4 FT-LBS.
3/8" – 16 UNC	18 FT-LBS.	11 FT-LBS.
1/2" – 13 UNC	45 FT-LBS.	27 FT-LBS.
5/8" – 11 UNC	88 FT-LBS.	52 FT-LBS.
3/4" – 10 UNC	153 FT-LBS.	90 FT-LBS.

**Table 4 : Torque table for Studs**

23. Install the two drive pins into the ball. A little grease may be needed to keep the pins in place.
24. Fit the stem into the body, aligning the drive pin slots in the stem with the drive pins in the ball. The stem needs to be installed with the key slot pointing to the right side of the valve (3:00'o clock).
25. Install the bonnet over the stem; use a soft face hammer if necessary. Rotate the bonnet to obtain alignment of the bolt holes and torque pin holes in the body and bonnet

**Figure 6 – Stem Orientation for Installation**



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For all the valves after 1/4 NPT threaded hole alignment the torque pin holes on bonnet must align with body pin holes. See below Fig. 6 and Fig. 7 for details:

- Insert the bonnet cap screws into their threads on the body and tighten them evenly. The cap screws will need to be torqued, please refer to the **Table 5** for the correct torque. Also tight the lower cover cap screws at this time

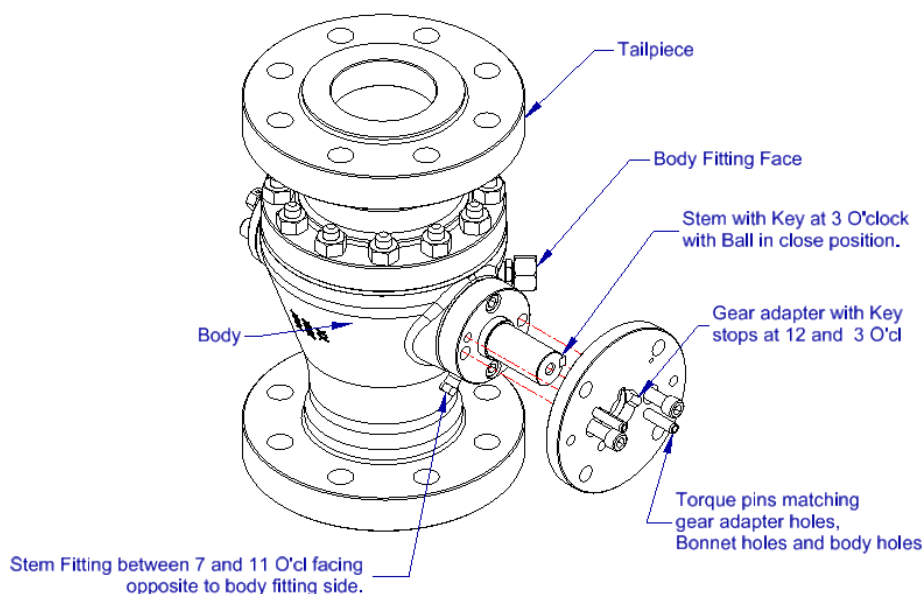
Cap Screw Size (in)	Dry/Zinc Plated / Anti-Size Grease (lbs.Ft)	Cad/Teflon Coated / Grease Lubed (lbs. Ft)
3/8-16UNC	18	11
1/2-13UNC	45	27
5/8-11UNC	88	52

**Table 5: Torque table for Cap screw**

- Install the drain plug in the trunnion, the grease fitting in the body and the bonnet drain fitting. See installation torques noted in **table 6** for fittings.

**Table 6: NPT Fitting Installation Torque**

Fitting Thread Size	Torque Ft-lbs
1/4 NPT	25
3/8 NPT	39
1/2 NPT	75
3/4 NPT	135
1 NPT	288

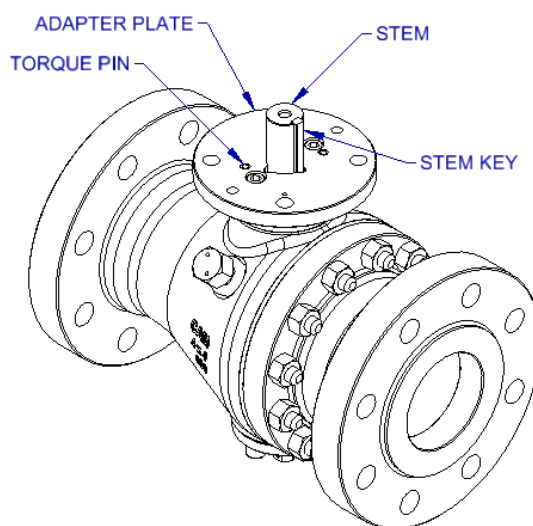


**Figure 7 -Torque pin alignment**

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28. Place the stem fire safe seal over the stem and into its recess of the bonnet.
29. Now fit the gland bushing over the stem until it fits against the fire safe seal.
30. If a bare stem valve, use the following procedure to install the adapter plate (as detailed in Fig. 8):
  - a. Install the stem thrust washer over the stem with the Teflon backing oriented towards the ball
  - b. Install the torque pins and the locating pin into the correctly sized holes.
  - c. Install the gear adapter plate over the stem. The plate should fit over all the pins including the locating pin, with the key grooves oriented towards the valve body markings and the tailpiece.
  - d. Install all the cap screws and torque as required per **Table 5**.
  - e. Install the key. The key should not stick above the stem. See Fig.8

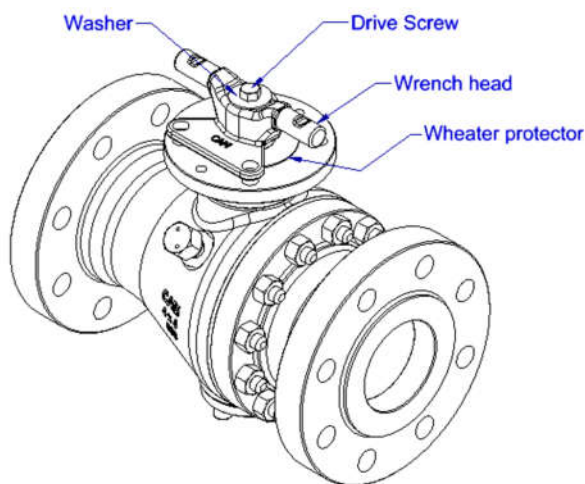


**Fig.8 Bare stem Valve**

31. If a wrench operated valve, use the following procedure to install the wrench (shown in Fig. 9):
  - a. Install the stem thrust washer over the stem with the Teflon backing oriented towards the ball.
  - b. Install the locating pin into the correctly sized hole.
  - c. Install the lever or adapter plate over the stem. The plate should fit over the locating pin with the key grooves oriented as 90deg to the valve body markings and the tailpiece.
  - d. Install all cap screws and torque as required per **Table 5**.
  - e. Install the key. The key should not stick above the stem.
  - f. Install the weather protector. Install the wrench head and secure the washer and screw on top of the stem. Shown in Fig.9

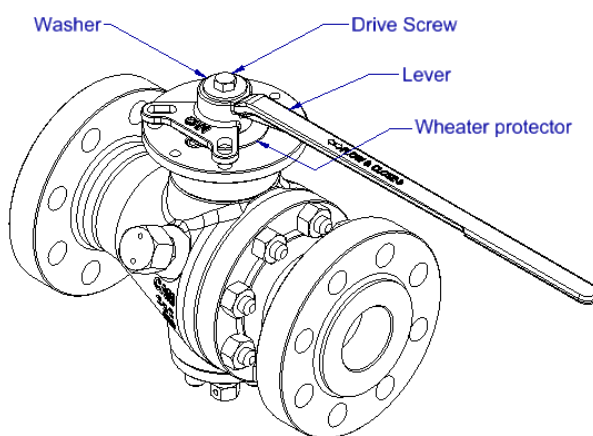
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**Fig.9 Valve with Wrench operator**

32. If lever operated valve, use the following procedure to install the lever (shown in Fig.10)
  - a. Install the stem thrust washer over the stem with the Teflon backing oriented towards the ball.
  - b. Install the locating pin into the correctly sized hole.
  - c. Install the lever or adapter plate over the stem. The plate should fit over the locating pin with the key grooves oriented as 90deg to the valve body markings and the tailpiece.
  - d. Install all cap screws and torque as required per **Table 4**.
  - e. Install the key. The key should not stick above the stem.
  - f. Install the weather protector.
  - g. Install the lever and secure the washer and screw on top of the stem.



**Fig.10 Valve with lever operator**

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33. If the valve is 2FP up to 6RP
  - a. Bare stem places the adapter plate over the stem with the internal stop at the 12 o'clock and 3 o'clock position. Insert the cap screws and torque as shown in Table 5 for the correct torque. Install the torque pins now using a pneumatic pin driver.
  - b. Lever operated, place the locking bearing housing over the stem, secure it with the cap screws, and install the torque pins using a pneumatic pin driver. Install the stop collar and the snap ring. **Note:** the stop collar should be installed so that the valve opens counterclockwise and closes clockwise.
  - c. If gear operated see next section

#### GEAR OPERATOR ASSEMBLY

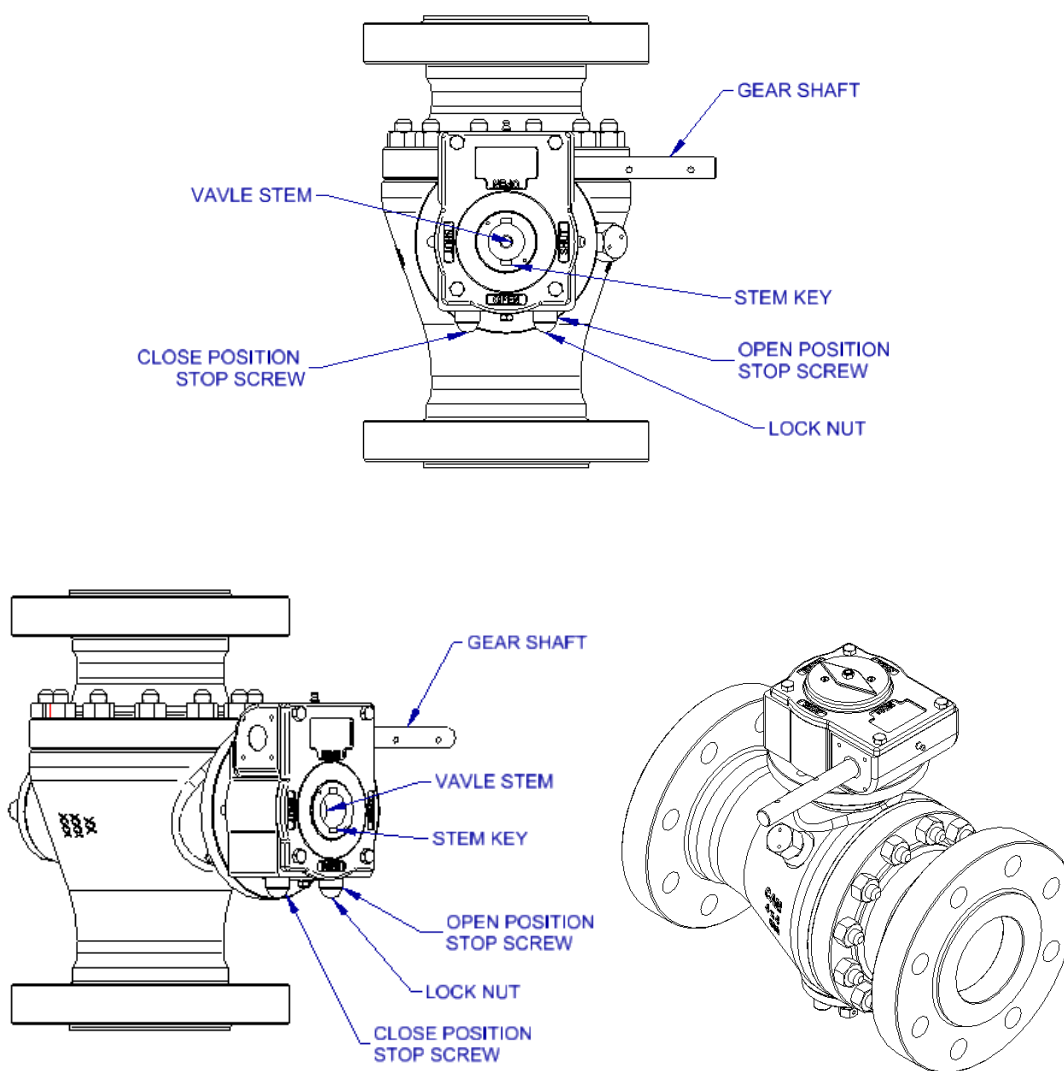
- 1 Refer to the valve BOM to select the proper operator and mounting hardware.
- 2 With the operator positioned with the cover down, install the mounting studs provided with the order. Measure the bonnet and operator nut thickness to gage the proper amount of stud to leave protruding from the gearbox.
- 3 Apply on the face of the adapter plate sealant.
- 4 Orient the gear such the gear shaft is toward front of the valve- the side with markings and fittings. The shaft will always be at 90 degrees from the centerline of the valve and never at an angle. The operator can be rotated around the stem into the proper position, without removing it from the stem.
- 5 After correctly positioning the hand wheel shaft, slide the operator toward the adapter placing the studs through the bonnet flange until approximately 1/4" of the stud is exposed on the back of the flange. Start all nuts onto the studs (flat side down) and tighten them with the proper open-end wrench.
- 6 Remove the indicator plate. Using the hand wheel, turn the hand wheel shaft so that the key slot of the stem and operator are aligned with each other. On small gearboxes it is possible to install the key on the stem prior to sliding the gearbox onto the valve shaft.
- 7 Check the BOM for the proper size and length square key. Tap the key gently into the key slot until it is below the surface of the operator hub. **Do not use excessive force to drive the key.** If the key does not fit properly recheck the alignment of the slots. (Another key or pin punch should be used to drive against the key, to prevent damage to the operator key or key slot.)
- 8 To set the closed stop turn the hand wheel until the key stop on the adapter plate. The marking on the ball (created at pct 3.14) shall be on the center comparing with the adapter flow bore. Check



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with a scissor type tool for the ball marking to be on center. Loosen the jam nut on the stop farthest from the hand wheel shaft. Fig.8. Then turn the stop bolt clockwise until it stops. Retighten the jam nut. It may be necessary to turn the stop screw counterclockwise in order to get additional travel and move the operator further closed. **The hand wheel should always be turned in the closed direction to set the closed stop, so that all slack will be taken out of the gearing. This ensures a more accurate stop setting.**



**FIG. 8. Valve with Gear assembly**

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- 9 After setting the closed stop a quick check should be made to ensure that it has been correctly set. This is accomplished by turning the hand wheel shaft several turns towards the open position, and then returning it until the closed stop is contacted. Check with a scissor type tool for the ball marking to be on center, make sure the ball did not close differently when operate.
- 10 To set the open stop turn the hand wheel shaft counterclockwise, moving the valve to the open position until the key stop on adapter plate. Look into the bore of the valve, the ball bore shall be aligned with the flow bore of the seat holders. There should not be more than 1/16" of the ball radius exposed into the flow bore once the final setting has been made. Small adjustments can be made turning back the handwheel if necessary.
- 11 Once the alignment is accomplished loosen the jam nut on the open stop bolt – Fig. .8 - and turn the stop bolt clockwise until it stops. Retighten the jam nut. It may be necessary to turn the stop screw counterclockwise in order to get additional travel and move the operator further open, in order to align the ball flow, bore with the flow bore of the seat holder. **The hand wheel should always be turned in the open direction to set the open stop, so that all slack will be taken out of the gearing. This ensures a more accurate stop setting.**
- 12 After setting the open stop a quick check should be made to ensure that it has been set correctly. This is accomplished by turning the hand wheel shaft several turns towards closed then returning it until it hits the open stop. There should be no more than 1/16" of the ball radius exposed into the flow bore after the stop is properly set. If further alignment is necessary screw the open stop screw in or out to readjust the ball travel.
- 13 The person installing and setting the gearbox should then stamp their operator number onto the housing near the hand wheel shaft.
- 14 Reinstall the indicator and tighten the fasteners; install the stop screws covers.

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**TROUBLESHOOTING**

Table 7 - Troubleshooting

Trouble	Probable cause	Remedy
Will not open or close	Iced up due restricted flow or low temperature	Inject antifreeze solution into valve body. Ensure antifreeze solution is compatible with the type of seal(s) to not damage the seals. Drain periodically to eliminate water accumulation
	Improper setting of gear or actuator stops	Reset gear or actuator stops
Hard to operate	Accumulation of material in the body	Drain the valve – see drain procedure
	Infrequent operation, lack of lubrication	Grease the valve- see grease procedure
	Gear hard to operate or stuck	Check gear, lubricate or replace
	Operator not installed properly	Check operator
Leak pass the seat	Foreign material between seat and ball	Grease the valve- Operate several times to wipe clean
	Valve not fully closed	Check the stop plate or gear for fully closed position
	Worn or damaged seats inserts and or ball	Disassemble the valve and replace worn parts
	Operator stops not properly set	Adjust stops to proper setting
	Worn or damaged O-ring seal	Disassemble the valve and replace Seat O-ring. Check O-ring material for application*
Leak around stem	Worn or damaged stem O-ring seal	Disassemble the valve and replace Stem O-ring. Check O-ring material for application*
Leak between body and adapter	Worn or damaged adapter O-ring seal	Disassemble the valve and replace Adapter O-ring. Check O-ring material for application*
	Adapter studs and nuts not tightened properly	Tighten nuts to specified torque
Grease fitting leaking	Trash into the fitting	Inject small amount of cleaner to dislodge trash
	Damaged fitting	Tighten safety cap or replace fitting <b>WARNING: never remove the entire fitting with the valve under pressure</b>

\*Contact representative for proper trim selection for the required application

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