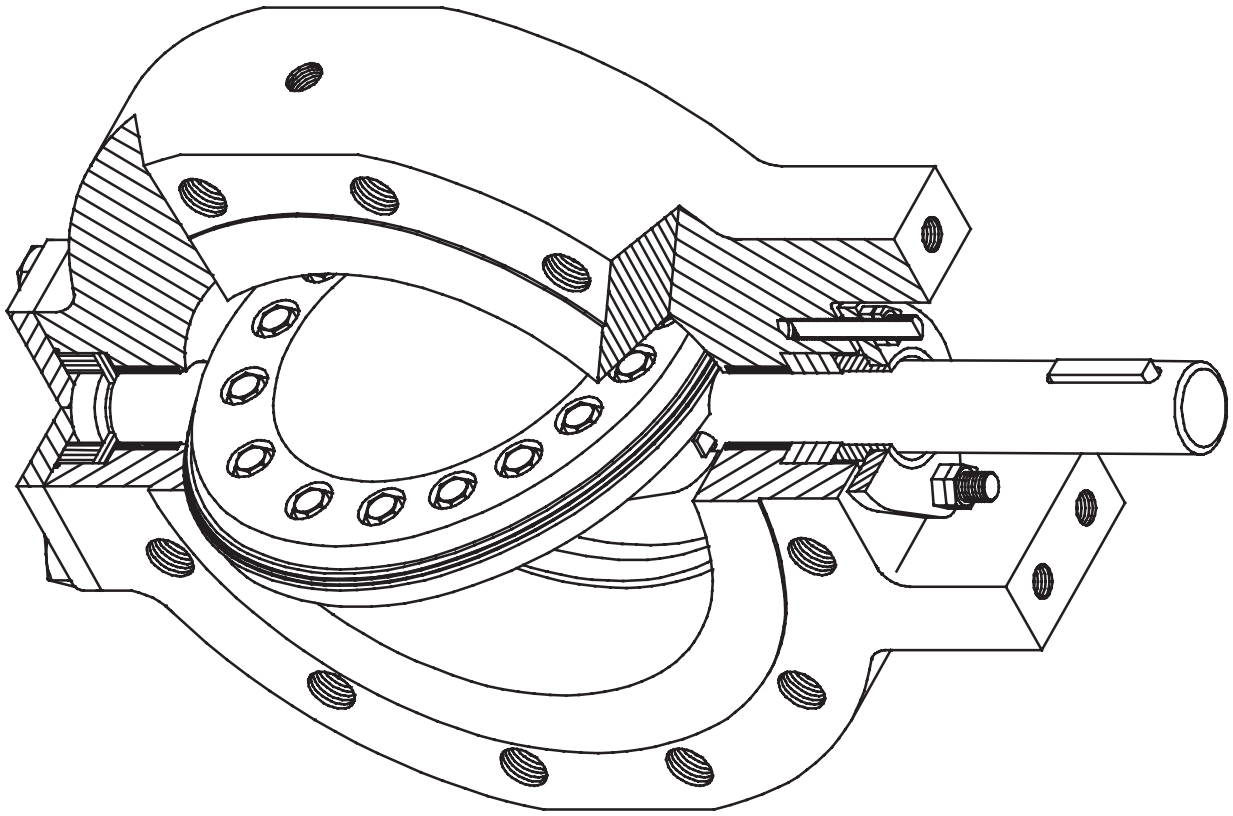
TRICENTRIC®

Service Manual

Installation / Operation / Maintenance



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WEIR
VALVES & CONTROLS

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Note:

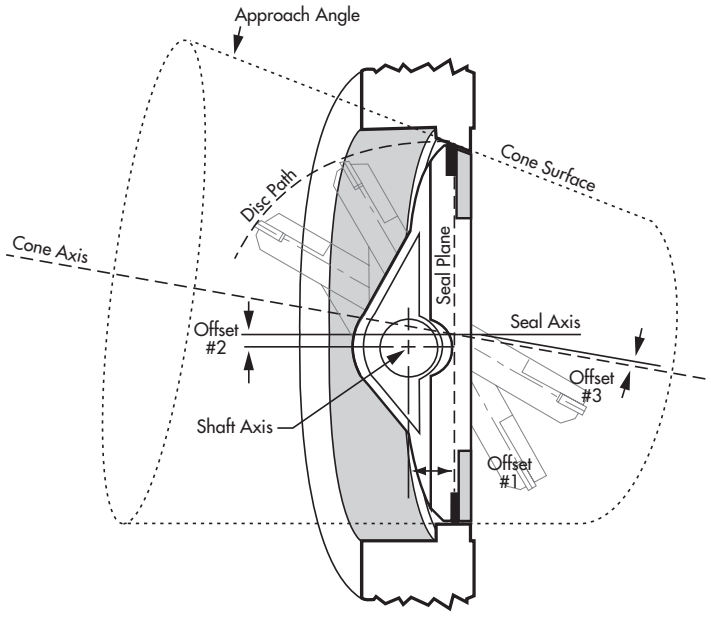
This manual is a general representation of the information required for correct usage of the industrial TRICENTRIC® Valve. More specific information is available, and can be supplied per customer request. Weir Valves & Controls, USA reserves the right to amend this document, with no prior notice.

GENERAL VALVE DESCRIPTION

The TRICENTRIC® VALVE is a metal seated butterfly type which is designed and manufactured in a manner that allows the disc to rotate into and out of the seat with absolutely no interference. This results in a sealing system that, unlike butterfly valves that depend upon interference to achieve a seal, is not effected by the frequency of operating cycles.

The geometry of the sealing system is that of two matching conical zones that must be carefully mated to each other and coupled to the remainder of the working elements in order to achieve the non-interfering characteristics desired.

Due to the unique conical surface of the TRICENTRIC® , the valve is considered to have a "preferred" and "non-preferred" sealing direction. The preferred sealing direction would be toward the shaft side of the disc, and is marked on the body with a directional arrow, and is referred to as the high pressure side of the valve. The system pressure area torque acting on the shaft side of the disc will force the seal deeper into the matching taper of the seat. The opposite occurs when pressure is applied to the other side of the disc. The torque required to maintain a secure seal increases with the pressure rise on the clamp ring side, which is the non-preferred sealing direction.



1.0 STORAGE

When the valve is not put into immediate service, it is required that the valve be stored in a heated building that is fire resistant, weathertight and well ventilated. Storage area shall be situated and constructed so that it will not be subject to flooding. Weir Valves & Controls recommends that all valve actuators be cycled approximately every 60 days. Any spare parts for the valve shall be stored in the original packaging and under the same conditions as the valve will be stored.

2.0 SHELF LIFE

Item #	Description	Material	Shelf Life
4	Seal Stack	316/C4400 or Durabla	15 yrs.
	Gasket	C-4400 or Durabla, or equivalents	15 yrs. *
19 *	Packing Ring	JC287I	5 yrs.
19.1	Packing Ring	Grafoil	*

* Grafoil, and equivalents, are indefinite

3.0 TOOL REQUIREMENTS

There are no special tools required for installation and maintenance that are not commercially available. Any lifting devices used to move the valve into a desired position shall be of sufficient size to support the weight of the valve/actuator assembly. The use of nylon slings (ie: as manufactured by Lift All, type EE2-803), secured around the valve bearing areas, is recommended to reduce the possibility of mechanical damage occurring to the valve body and actuator. The assembly should never be lifted by the actuator lifting lugs or by a sling only around the actuator. These areas are for removal and installation of the actuator to the valve only.

4.0 INSTALLATION

General Considerations Prior to Installations:

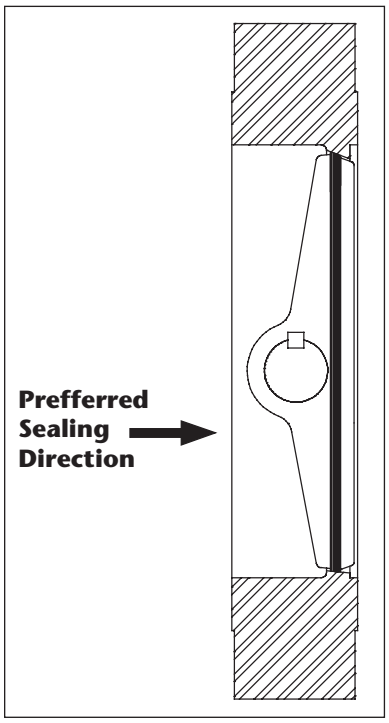
Since the seating torque of a TRICENTRIC® VALVE is normally greater than all other torque considerations, the TRICENTRIC® VALVE is less sensitive than other butterfly valves in regards to the effects of installation upon fluid dynamic torque requirements. The TRICENTRIC® VALVE, however, must still be installed with the eccentric velocity of the fluid in mind, if the flow rates are high. 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, minimizing dynamic torque requirements for the valve. The TRICENTRIC® VALVE, due to the available torque, may not be subject to the same orientation requirement, depending upon the resulting flow characteristics effect on the system.

Before installation of the valve into the piping system, the body seat and disc seal must be checked for dirt accumulation or damage due to transit or storage. For proper operation of the valve, the seat and disc seal must be undamaged and free of foreign material. Any rust preventative should be removed, using a commercial solvent.

The valve should be installed with the shaft in a horizontal plane. This will reduce the axial load on the annular key and prevent debris build-up in the bearing area. However, the valve can be installed in a vertical or angular orientation, if so desired.

The shaft side of the disc is considered the high pressure side of the valve, (as indicated on the drawings by a flow arrow) meaning the best closure performance is obtained on this side of the valve, and a determination as to the best installation configuration should be made, to utilize this feature. <u>This may not necessarily be the normal flow direction of the system.</u>

The valve must be installed so that pipeline stresses are not transmitted to the valve body. Despite it's solid manufacture, such stress may affect valve operation. If pipeline stresses are severe, they should be cushioned by expansion joints or compensators. If supports are necessary for the valve, they should only support the dead weight of the valve and should not serve as base points for the pipeline.



The connecting flanges of the piping system shall be properly orientated, the flange bolts having the correct clearance, and the faces parallel to prevent the introduction of unwanted piping stresses.

DO NOT USE A PARTIALLY INSTALLED VALVE AS A BASE POINT TO ALIGN THE CONNECTING PIPELINE. When one side of the valve is secured to the pipeline, the opposite valve flange may not be used to draw the connecting pipe into alignment, with the exceptions as described later in this section. Any pipe supports that maintain the connecting pipe in place must be evaluated as to the restrictive nature of the support, in regards to correct flange alignment.

Two basic valve body configurations are considered for installation techniques. The lugged style valve is supplied with all flange holes tapped. The wafer style valve is supplied in two variations, one being the flange holes drilled through the body to allow the use of full length studs, the other being a combination of drilled through holes and blind tapped holes which use short bolting. Section 11 contains the torque limitation for all tapped holes on the valve body flange holes. When a valve has drilled through holes, the only limitation of torque will be based on the chosen stud material.

ABSOLUTELY NO LIFTING DEVICES SHALL EVER PASS THROUGH THE VALVE PORT WHEN RIGGING A VALVE FOR INSTALLATION OR REMOVAL, SINCE SEAT AND/OR SEAL DAMAGE MAY RESULT.

Basic Installation Techniques:

Note: The following is intended to assist the end user in developing procedures for installation. A & M recommends that all common safety practices be followed during installation of the valve.

4.1 **The use of impact wrenches to install a TRICENTRIC® VALVE is not permitted. Use of impact wrenches can cause the valve body seat to change shape, increasing the possibility of valve leakage or internal binding.**

4.2 All valves must be in the full closed position during installation or removal. It is not necessary to torque seat the valve, but the disc travel must be restricted to prevent seal damage.

Lugged or Flange Style Valves:

4.3 Connect one side of the valve to a mating pipe flange. It is not important which side of the valve is connected first, providing all of the subsequent directions are followed.

4.4 Assure that each bolt is centered within the bolt holes of the flange. This can be critical, as any bolt touching a flange hole may increase the chance of stress introduction to the valve internals, either causing the valve to bind in rotation or the seat of the body to become distorted.

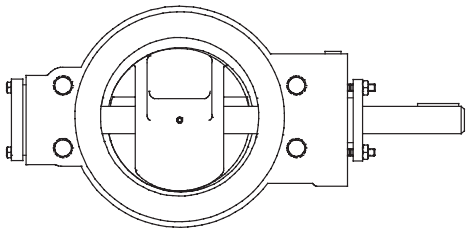
4.5 Torque four equally-spaced bolts in the first flange, to approximately 25% of the final torque value.

Note: The final flange bolt pre-load is entirely dependant upon the type of gasket used, the pipeline media, operating temperature, and the working (or design) pressure of the system. Refer to the table in Section 11 for the maximum allowable torque level for the tapped flange holes in the valve body.

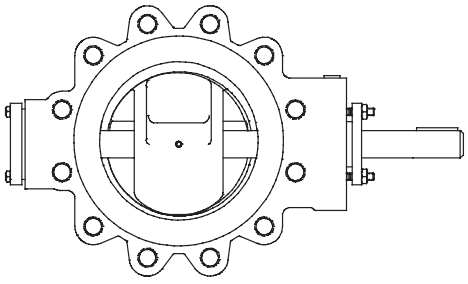
4.6 The pipe support(s) may now be required to be partially disengaged. A determination as to pipe flange alignment and space between the pipe flange and the valve face must be made at this time. The optimum spacing would be such as to only allow the flange gasket to be installed, at the maximum, and the flange bolt holes would be concentric.

4.7 The connecting pipe flange face may not be more than 1/4 inch away from the valve flange face. Alternate methods of alignment, other than using the flange bolts, must be utilized to conform with this requirement.

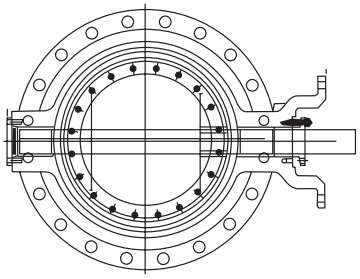
4.8 Install the remaining bolts in both flanges and assure that the correct clearance is maintained around the bolt diameters.



Wafer Style Valve



Lugged Style Valve



Double Flange Style Valve

4.9 Seat the second flange by alternate tightening of four equally-spaced flange bolts no more than 1/4 turn per bolt, until the flange faces seat. During this operation, it is advisable to continually check the relative distance between the flange faces and adjust the tightening method to maintain the parallelism of the flange faces. Torque the bolts to approximately 25% of the final torque value.

4.10 Inspect the remaining bolts and assure correct alignment. Tighten to the same level as the first four bolts.

4.11 Complete the tightening of all flange bolting in a minimum of four increments to the final determined torque value.

Wafer Style Valves: (No Tapped Holes)

4.12 Position and support the valve, contacting one flange.

4.13 The pipe support(s) may now be required to be partially disengaged. A determination as to pipe flange alignment and space between the pipe flange and the valve face must be made at this time. The optimum spacing would be such as to only allow the flange gasket to be installed, at the maximum, and the flange bolt holes would be concentric.

4.14 The opposite connecting pipe flange face may not be more than 1/4 inch away from the valve flange face. Alternate methods of alignment, other than using the flange bolts, must be utilized to conform with this requirement.

4.15 Install all studs, maintaining uniform clearance between the studs and the mating bolt holes. Additionally, the studs spanning the valve assembly should not contact the valve body.

4.16 Step 4.15 can be critical, as any stud touching a flange hole may increase the chance of stress introduction to the valve internals, either causing the valve to bind in rotation or the seat of the body to become distorted.

4.17 Seat the flanges by alternate tightening of four equally spaced flange studs no more than 1/4 turn per bolt, until the flange faces seat. During this operation, it is advisable to continually check the relative distance between the flange faces and adjust the tightening method to maintain the parallelism of the flange faces. Torque the studs to approximately 25% of the final torque value.

Note: The final flange bolt pre-load is entirely dependant upon the type of gasket used, the pipeline media, operating temperature, and the working (or design) pressure of the system. Refer to the table in Section 11 for the maximum allowable torque level for the tapped flange holes in the valve body.

4.18 Inspect the remaining studs and assure correct alignment. Tighten to the same level as the first four studs.

4.19 Complete the tightening of all flange studs, in a minimum of four increments, to the final determined torque value.

Wafer Style Valves: (Tapped Holes)

4.20 Position and support the valve, contacting one flange, and install the bolts into the tapped flange holes of the valve body.

4.21 The pipe support(s) may now be required to be partially disengaged. A determination as to pipe flange alignment and space between the pipe flange and the valve face must be made at this time. The optimum spacing would be such as to only allow the flange gasket to be installed, at the maximum, and the flange bolt holes would be concentric.

4.22 The opposite connecting pipe flange face may not be more than 1/4 inch away from the valve flange face. Alternate methods of alignment, other than using the flange bolts, must be utilized to conform with this requirement.

4.23 Install the remaining bolts into the valve body tapped flange holes. Install all studs, maintaining uniform clearance between the studs and the mating bolt holes. Additionally, the studs spanning the valve assembly should not contact the valve body.

4.24 This can be critical, as any stud, or bolt, touching a flange hole may increase the chance of stress introduction to the valve internals, either causing the valve to bind in rotation or the seat of the body to become distorted.

4.25 Seat the flanges by alternate tightening of two equally-spaced flange bolts (in the tapped holes of the valve) and two equally spaced and opposite studs, no more than 1/4 turn per bolt and stud, until the flange faces seat. During this operation, it is advisable to continually check the relative distance between the flange faces and adjust the tightening method to maintain the parallelism of the flange faces. Torque the studs to approximately 25% of the final torque value.

Note: The final flange bolt pre-load is entirely dependant upon the type of gasket used, the pipeline media, operating temperature, and the working (or design) pressure of the system. Refer to the table in Section 11 for the maximum allowable torque level for the tapped flange holes in the valve body.

4.26 Inspect the remaining studs and assure correct alignment. Tighten to the same level as the first four studs and bolts.

4.27 Complete the tightening of all flange studs, and bolts, in a minimum of four increments, to the final determined torque value.

5.0 ACTUATOR ASSEMBLY AND ADJUSTMENT

The TRICENTRIC® Valve is a quarter-turn, torque-seated butterfly valve. Any actuator capable of a minimum of 90° of travel that can provide the maximum torque output required for the valve size, may be used on the valve.

The most common types of actuators used on TRICENTRIC® Valves are:

• **Manual gear, with handwheel or chainwheel.** The coupling arrangement may be a fixed, bored and keyed gear, a bored and keyed adaptor bushing, or a bored, keyed and 360° splined adaptor bushing. Open and close mechanical stops may be either a set screw arrangement limiting total gear travel internally, or a sliding nut system contained in a separate assembly. Typically, the gear travel range is between 100 to 110°, with an effective range of 90° from mid-position.

• **Electric motor driven gear, with manual by-pass.** The coupling arrangement may be a fixed, bored and keyed gear, a bored and

keyed adaptor bushing, or a bored, keyed and 360° splined adaptor bushing. The motor is controlled with a combination of limit switches and torque switches, in both the open and closed directions of travel. The manual by-pass normally consists of a de-clutch lever and handwheel. Open and close mechanical stops may be either a set screw arrangement limiting total gear travel internally, or a sliding nut system contained in a separate assembly. Typically, the gear travel range is between 100 to 110°, with an effective range of 90° from mid-position. The electrical components can rotate 360°.

• **Double acting pneumatic cylinder,** typically with a scotch yoke arrangement. The coupling arrangement may be fixed, bored and keyed, or a bored and keyed adaptor bushing, or a bored, keyed and 360° splined adaptor bushing. Typically, the travel range is between 95 to 100°, with an effective range of 90° from mid-position.

• **Spring return pneumatic cylinder,** typically with a scotch yoke arrangement, which can fail open or closed, upon loss of the air supply. The coupling arrangement may be fixed, bored and keyed, or a bored and keyed adaptor bushing, or a bored, keyed and 360° splined adaptor bushing. Typically, the travel range is between 95 to 100°, with an effective range of 90° from mid-position.

ACTUATION PRECAUTIONS

• All TRICENTRIC® VALVES close in the clockwise direction and are torque seated.

• Do not allow the valve to be position seated by the actuator.

Manual Gear and Electric Operated Gears:

• Do not force the handwheel. Do not exceed the rim pull rating.

• The use of an air motor tool to rotate the valve is permitted, provided that the valve is not seated with the tool.

• Assure that the mechanical close stop screw does not restrict the valve from closing. The stop for the close position should be set to allow for valve seat wear.

• Limit switches shall be set to indicate full valve travel. The closed limit switch must not control the motor, and should only be used as a general indication of disc position. The close torque switch must be functional and sized correctly.

Pneumatic Actuators

• Do not exceed the maximum operating pressure indicated on the actuator. If the maximum operating pressure of the cylinder exceeds the calculated maximum in-put pressure for valve torque, provisions must be taken to limit the operating pressure of the cylinder.

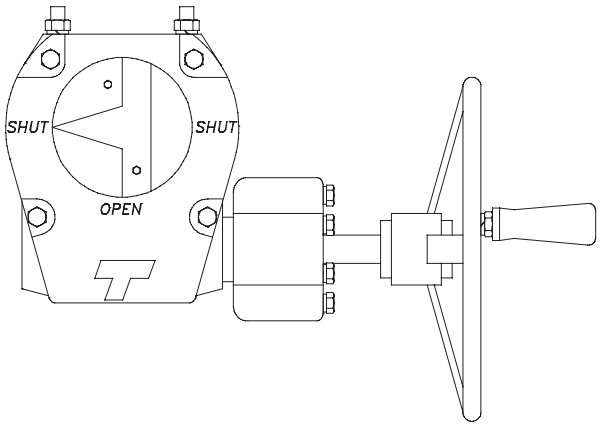
• Spring return units will fail open or closed upon loss of the air supply. Personal injury may result if body extremities are in the path of the disc travel.

• Keyway location(s) in any adaptor bushing must allow for seat wear. Typical maximum travel of these actuators require close attention to the close key location.

Due to the many actuator variations available, all potential actuator/valve combinations can not be detailed in a single manual.

The following procedure is intended for use with a manual gear actuator which utilizes a bored, keyed and 360° splined adaptor bushing. This actuator combination is considered as an example of a typical valve and actuator assembly. The use of the 360° splined adaptor bushing represents the worst case arrangement, due to the possible mis-alignment of the gear to the valve. Improperly actuated valves can cause valve problems.

5.1 The valve must be in the closed position to correctly install the actuator. All valves close in the clockwise direction, as shown in Section A-A on a typical assembly drawing.

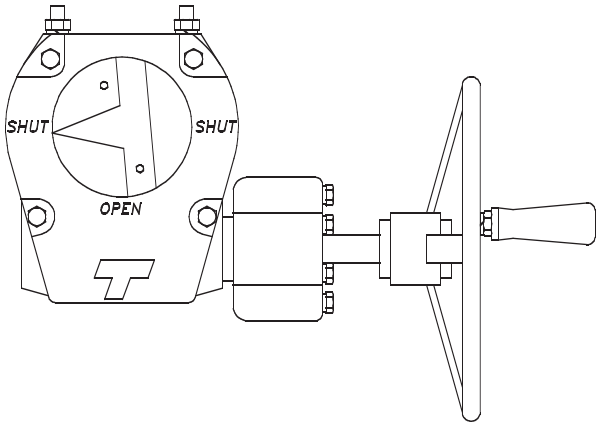


5.2 Install the actuator mounting bracket. Align the actuator bolt pattern to center on the shaft and bolt in place.

5.3 Install the parallel key into the drive shaft.

5.4 Confirm the actuator rotation. When the actuator is at the valve closed position, (actuator's optimum stroke) the pointer cap will align with the actuator center lines, parallel and perpendicular with the worm shaft. Position the actuator aligning the pointer with the actuator center lines or closed indicator.

5.5 Rotate the actuator toward the open position approximately 2 to 5 degrees. Match-mark this position, from the pointer cap bolt pattern on the face of the actuator housing. This is now the range of travel the actuator is allowed for valve closure.



5.6 Rotate the actuator to a position midway between the two closed marked positions.

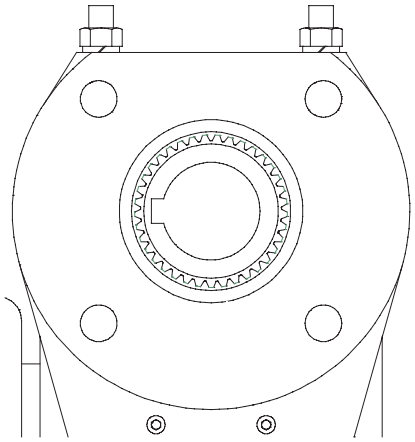
5.7 Apply a coating of anti-seize compound to the spline teeth of the adaptor bushing.

5.8 Install the splined adaptor bushing on the drive shaft.

5.9 CAUTION: The spline adaptor teeth may not be located in the

center of the spline adaptor. The correct position should be visually verified by comparing the splined adaptor bushing to the actuator spline location inside the actuator.

5.10 Slide the actuator assembly onto the splined adaptor bushing in the desired orientation. Check the hole alignment for the mounting bolts.



5.11 It will be acceptable if there is no more than 1/2 hole mis-alignment of the mating holes when the actuator assembly is flush with mounting bracket.

5.12 When the alignment is in this range, turn the actuator handwheel, rotating the actuator on the splined adaptor bushing, until all the bolt holes are aligned. CAUTION: The disc must not be allowed to move when adjusting the actuator position.

5.13 When the initial bolt hole alignment exceeds the maximum allowed mis-alignment, remove the actuator from the valve. Do not remove the splined adaptor bushing. Rotate the actuator gear in the desired direction to correctly align the bolts. Re-install the actuator.

5.14 Insert the bolts and tighten, in a standard criss-cross pattern. Close the valve and confirm that the mechanical stop is not restricting actuator travel.

5.15 Confirm that the disc is fully closed. Check the close match-mark positions on the actuator face. The position of the actuator should be at the full-stroke position (maximum travel), between the marks, or at the 2 to 5 degree position, maximum.

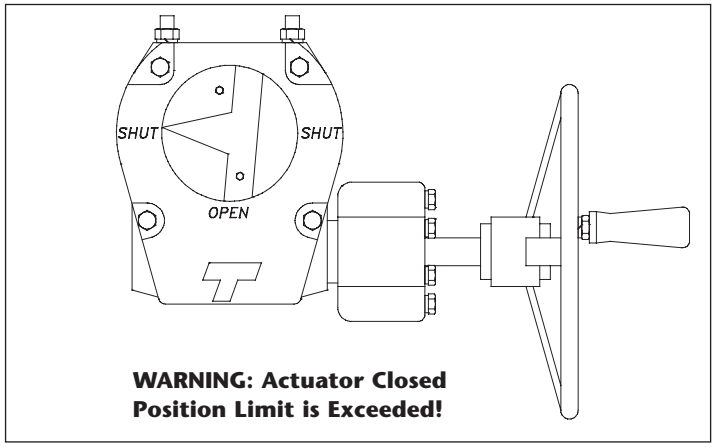
5.16 If the actuator is not in the range described, repeat the above steps until the alignment is correct.

Adjustment for the actuator stops are as follows:

5.17 Actuators with stop screws: With the disc in the full closed position, rotate the close stop screw in until it touches the internal gear segment. Then rotate the screw out 1/2 to 2 turns and secure the screw with the locking nut.

5.18 Rotate the disc to the full open position, approximately 90 degrees from the valve body face. Rotate the open stop screw in until it touches the internal gear segment. Secure the screw in this position with the locking nut.

5.19 Actuators with sliding nut assemblies: With the disc in the full closed position, remove the limit stop housing cap and rotate the close hex stop nut in until it touches the inside of the limit stop housing. Rotate the nut out 1/2 to 2 turns and verify that a gap of 1/8th to 1/4 inch is present between the face of the nut and the limit stop housing, keeping a flat of the nut parallel with the limit stop housing cap. This will properly align the nut to the cover, which in turn, will keep the nut from rotating during normal usage. Replace the limit stop housing cover.

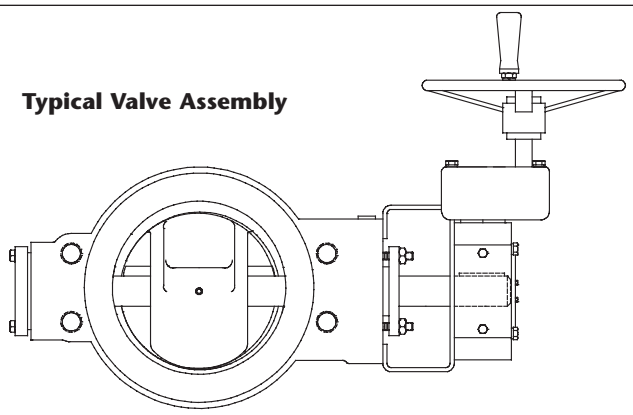


WARNING: Actuator Closed Position Limit is Exceeded!

5.20 Rotate the disc to the full open position, approximately 90 degrees from the valve body face. Remove the limit stop housing cover. Rotate the open hex stop nut in until it touches the inside of the housing, or a point close to the housing, keeping a flat of the nut parallel with the limit stop housing cap. This will properly align the nut to the cover, which in turn, will keep the nut from rotating during normal usage. Replace the limit stop housing cover.

5.21 **CAUTION: Failure to replace the limit stop housing cap during rotation toward the open position could cause the gear segment to disengage. The disc in a TRICENTRIC® VALVE can travel toward the open position far beyond the limits of the actuator.**

Typical Valve Assembly



6.0 OPERATION

• Historically, the torque requirements for seating a TRICENTRIC® VALVE are considerably greater than the required torque to overcome bearing friction, fluid dynamic and hydrostatic torques. These frictions and torques will normally be of little concern with the exception of the onset of chocked flow conditions with compressible fluids.

• Use of a TRICENTRIC® VALVE as a control valve with the disc position less than 20 percent open can possibly cause serious cavitation to occur, depending upon the media, temperature and flow velocities. Knowledge of the valve's inherent flow characteristics must be matched to the desired response goals of the system as a whole. Use of a butterfly valve for throttling will develop a region of lower pressure just downstream of the valve disc. The size of this region will be dependent upon the relative position of the disc, flow velocities and pressure. When the pressure drops to the vapor pressure of the liquid, cavitation bubbles develop. The pressure increase downstream of the valve causes these vapor bubbles to collapse, producing fluid shock waves. Continued operation in this condition can cause erosion of downstream piping components and particularly erosion of the immediate downstream side of the disc. If the flow is toward the shaft side of the disc, the potential for damage to the valve is considerably increased as all the disc bolting is present in this area of erosion.

• Do not force the hand wheel to close the valve. Do not exceed the rim pull rating on the actuator handwheel.

• The preferred sealing (high pressure side) direction is indicated by the arrow on the body.

• If the arrow is missing, the preferred direction can be determined by observing the direction of rotation of the shaft, from the actuator side of the valve. The TRICENTRIC® VALVE rotates clockwise to close.

• No normal valve maintenance schedule is required, with the exception of packing changes, due to service conditions. Refer to the applicable actuator manuals for periodic maintenance requirements of the actuators.

• Since wear to the seal will change the closed position of the disc, a periodic check of the actuator close stop nut may be required.

7.0 MAINTENANCE

7.1 TRICENTRIC® Valves are generally designed to require no maintenance, however, areas are covered in this manual for disc seal replacement.

7.2 Valve shaft orientation other than horizontal will require a preventive maintenance program to be developed, taking into account the media contents (solids), cycle frequency, and any other site-specific information that may have a detrimental effect on the valve assembly.

7.3 Normally, seat damage is very rare. Typical failure mode is wear or corrosion which results in performance degradation over time. Refer to Section 8 for information regarding acceptance criteria for the seat surface.

7.4 The seal stack requires replacement only when leakage exceeds the required levels. Failure modes are crushing or deformation in local areas or wear over time. These modes would degrade leak tightness, but not result in catastrophic failure. Complete failure is not possible as long as the clamp ring remains intact.

7.5 The annular key is a very low stressed part with a failure mode of bearing wear on the flat faces over time. Normal usage is indefinite.

7.6 The bearings used in the TRICENTRIC® VALVE are a non-lubricated design and require no periodic preventative maintenance. Normally, the bearings will have a minimal amount of wear for the life of the valve. However, the system media should be evaluated as to the content of solids that may eventually become lodged between the bearings, drive shaft and the annular key. A program of inspection should be implemented to clean the valve internal components if debris build-up is a concern.

7.7 The packing usage is indefinite, dependent upon operating conditions.

Packing change instructions are as follows:

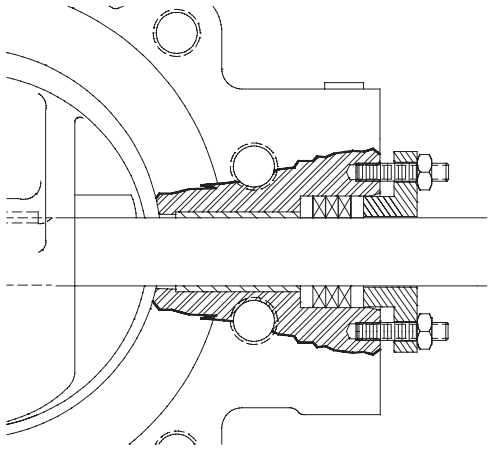
Note: The changing of the packing can be made without removing the actuator if split rings are used. However, if the rings are not split, the actuator will have to be removed from the valve.

7.8 De-pressurize the valve.

7.9 Remove all the nuts from the studs and pull back the gland follower to the adaptor plate.

7.10 Remove the packing with a flexible screw hook packing puller. Remove the packing from the bore one layer at a time.

7.11 Caution: Care should be taken to assure that the packing bore and the drive shaft are not damaged during packing removal.



7.12 Install the new packing one ring at a time in the same order as removed

7.13 Split packing should be installed at 90 degree intervals to minimize any potential leak path.

7.14 Use the packing gland follower to push each layer of packing evenly into the bore.

7.15 It is important that the packing gland follower is symmetrically mounted around the shaft. This will prevent galling on the shaft or binding during operations.

7.16 Once the packing has been installed, the gland can be tightened down with the nuts. The stuffing box studs are to be tightened opposite successively and proportionately, until no leakage can be detected. The gland follower should be checked to determine if is centered around the shaft diameter during packing consolidation. It is not allowed to contact the shaft at any time.

SPARE PARTS:

- To order, Weir Valves & Controls needs the following information:
  Serial Number
  Assembly drawing number
  Item number and description
  Quantity of each part being ordered

- Note: If at all possible, include all the information shown on the I.D. name plate mounted on the valve body.

- The recommended spare parts are indicated on the valve assembly drawing.

8.0 DISC SEAL REPLACEMENT

- When the sealing system in the TRICENTRIC® VALVE is suspected of unacceptable leakage, the following simple visual checks can be made to determine if the disc seal must be replaced:

- Check for nicks or gouges in the metal laminations.

- Check for damaged, torn or broken fiber laminations.

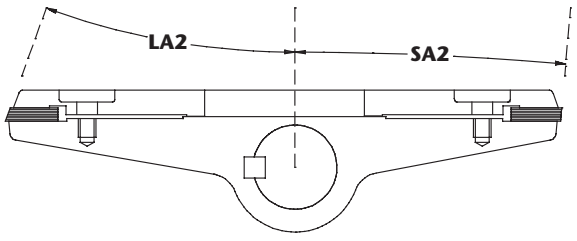
- Check the seal gasket for damage.

- Check to determine if the seal stack is bent or dented.

• IF ANY OF THE THESE CONDITIONS EXIST, IT IS RECOMMENDED THAT THE SEAL AND GASKET BE REPLACED.

The following procedure is intended to represent a typical TRICENTRIC® seal replacement.

NOTE: Before starting the seal stack removal operation, observe the clamp ring and seal stack orientation with respect to the disc. The long axis of the elliptical disc seal has one end that is angled slightly greater than the end located 180 degrees away. This orientation is intended to be located perpendicular to the shaft axis. The valve disc has the same elliptical machined edge as the seal stack, and is assembled in the valve to match the valve seat configuration. This is important to understand, as the seal could be installed upside-down and rotated in the wrong orientation.



The following definitions are applicable to all TRICENTRIC® Valves:

A2: The center line of the valve, perpendicular to the shaft axis.

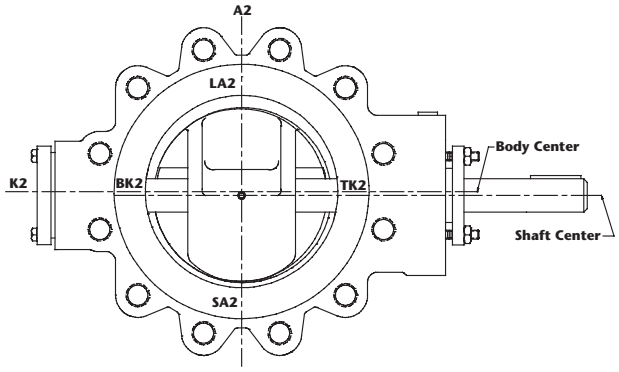
K2: The center line of the valve, parallel to the shaft axis.

SA2: The point on the A2 line that is closest to the K2. This position is the shallowest seal angle.

LA2: The point on the A2 line that is farthest from the K2. This position is the greatest seal angle.

TK2: The point on the K2 line that is closest to the driven side of the body.

BK2: The point on the K2 line that is on the non-driven side of the body.



Both the TK2 and BK2 seal angles are the same.

Prior to seal replacement, the valve should be removed from the pipe line, cleaned and inspected. The actuator will need to be removed, in most cases.

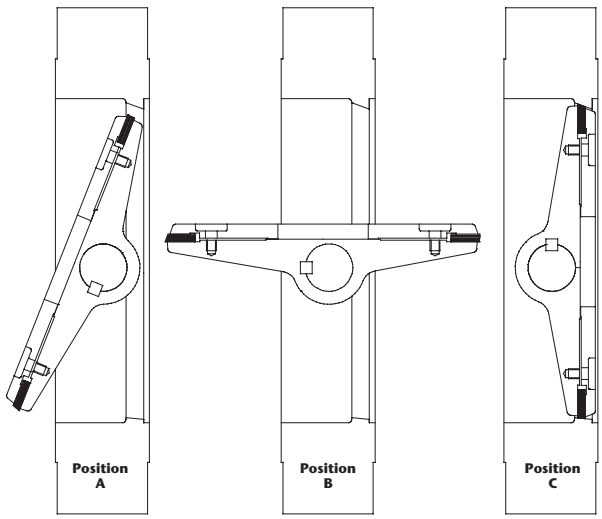
Disc Position for seal replacement is as follows:

- Position A is the disc assembly rotated as far from closed as the valve body will allow.

- Position B is the normal full open position of the valve.

- Position C is the valve in the full closed position.

- Normal orientation of the disc will be in Position B for removal of the clamp ring and seal stack.



- Various sizes of valves require the disc to be in Position A for seal removal, due to insufficient clearance between the seat and clamp ring.

- A quick visual check of the disc in Position B will indicate if the disc should be rotated to Position A.

Note: Any actuator will have to be removed prior to moving the disc to Position A, as this travel path will exceed the limits of the actuator.

8.1 With the disc in the closed position, remove all of the disc bolts with the exception of two bolts located on the disc A2 line (perpendicular to the shaft). These bolts should be located 180 degrees apart on this center line.

8.2 To remove the clamp ring, the valve disc will need to be in Position A or Position B.

8.3 When the disc is in position, remove the remaining bolts from the clamp ring.

8.4 Lift the clamp ring off the seal stack. A flat tool wedged between the clamp ring and seal may be required.

8.5 Remove the clamp ring from the drive shaft side of the body.

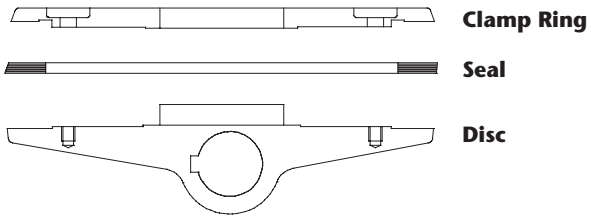
8.6 **DO NOT ATTEMPT TO REMOVE THE CLAMP RING THROUGH THE SEAT SIDE OF THE BODY. CAUTION MUST BE TAKEN TO ASSURE THAT THE VALVE BODY SEAT IS NOT DAMAGED.**

8.7 Remove the seal stack by lifting it away from the steps on the disc and remove the seal stack in the same manner as the clamp ring.

8.8 The seal stack may be stuck to the gasket located between the seal stack and disc. A flat scraper may be used to assist in removal. In all cases, this gasket will need to be replaced. For future reference, note the thickness and location of any gasket found in the disc assembly.

8.9 Remove any gasket material remaining on the disc before a new seal stack is used.

8.10 CAUTION: Exercise extreme care in handling and installing the new seal stack, as damage to the seal stack will result in valve leakage.



8.11 It is recommended to position the valve assembly with the body flange faces vertical, with the drive shaft center below the valve center line. Rotate the disc to Position A or Position B. Install the supplied gasket on the disc face.

8.12 Center the gasket around the hub. Mark the overhang on the gasket and trim the gasket to fit flush with the disc O.D. Any gasket that remains exposed after the seal is installed could interfere with proper seal function.

8.13 Install the new seal stack in the correct orientation on the disc, centering the seal stack SA2 mark (notch or center punch marks) on the disc SA2.

8.14 Carefully close the disc manually. Maintain the disc in the closed position.

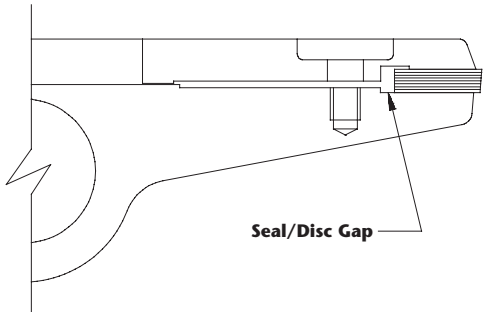
8.15 Check the clearance between the seal I.D. and the associated disc hub. There should be clearance completely around the seal stack I.D. This will allow the seal to float into place with no mechanical interference from the disc.

8.16 If diametral clearance on the seal I.D. is 1/16 inch (or less) from the disc hub, remove the seal from the valve and grind an appropriate amount of material from the seal I.D, as stated in paragraph 8.17. Repeat the process until the gap is greater than 1/16 inch, but no more than 3/32 inch, completely around the seal I.D. Normally, this step is not required with new seal stacks.

8.17 Determine what the new diameter will be and mark a line around the seal I.D. Place the seal in a vise and protect the sealing edge of the disc from damage. With the use of a hand grinder, lightly remove the excess material from the seal I.D., taking care not to overheat the seal stack.

8.18 CAUTION: Exercise extreme care in removing material from the seal I.D. Do not allow the seal to overheat. Do not damage the sealing surface of the seal. Thoroughly de-burr all worked areas.

8.19 When the seal I.D. is correctly sized, re-install the gasket and seal.



8.20 Open and close the valve three or four times, making sure that the valve closes fully each time.

8.21 On the last closing, hold the disc assembly in the full closed position.

8.22 Perform a light check (with the light source on the shaft side of the disc) for any gaps between the sealing surfaces.

8.23 When there is light indications present, open the disc and rotate (float) the seal stack slightly and repeat. Some experimentation will be required to determine the best direction to move the seal stack for centering.

8.24 When there is no light indications, match-mark the exact location of the seal stack position relative to the disc, on the A2 center line of the disc.

8.25 Install the clamp ring.

8.26 Inspect the clamp ring for full contact with the seal stack.

8.27 The clamp ring I.D. step must not be allowed to contact the disc hub before the clamp ring O.D. contacts the seal stack face, after compression. (Due to the material thickness variations of replacement seal stacks, the seal may not be thick enough to allow clamping to occur.)

8.28 When there is a gap between the seal and clamp ring, a gasket will need to be added between the seal stack and clamp ring. Do not add the gasket between the disc and seal stack.

8.29 Any additional gasket(s) used in construction shall be the same material grade as the gasket between the seal stack and the disc, and be trimmed to fit.

8.30 Lubricate the bearing surfaces and install the bolting and the lock washers. Wrench tighten all bolts in a standard criss-cross pattern.

8.31 Manually close the valve to Position C. Install the actuator as indicated in Section 5.

8.32 Apply approximately 1/4 of the rated torque to the valve.

8.33 Visually confirm that the assembled valve is in the correct configuration, is not binding, that all gaskets are trimmed flush, and that the valve seal stack is light tight.

8.34 Partially open the valve and torque the disc bolts to the levels indicated in the torque tables using four successive increments of 25%, 75%, 100% and 100%.

8.35 Close the disc to Position C and apply full rated torque to the valve shaft.

8.36 Open the valve approximately 5 degrees. Re-torque the bolts to the value listed in the torque tables.

8.37 Operate the valve from full close to full open several times, applying full rated torque at each close cycle.

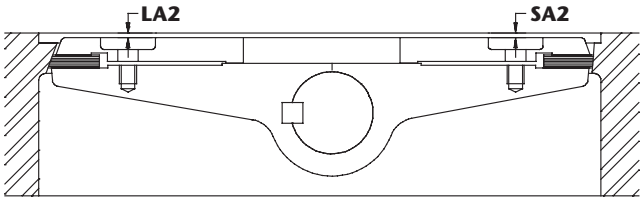
8.38 With the valve fully open, inspect the sealing surfaces for any signs of damage.

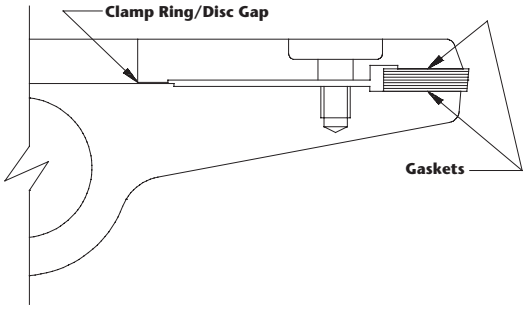
8.39 Close the valve until the sealing members contact only, and place a flat ground bar across the A2 center line on the valve face closest to the clamp ring.

8.40 On the bolt circle at the points LA2 and SA2, measure from the bar to the clamp ring face.

8.41 Acceptance is as follows:
1) LA2 and SA2 measurement are the same.
2) SA2 from 1/16 inch less than LA2 to 1/16 inch greater than LA2

8.42 When the difference in measurements are not within the above range, perform the following:





8.43 SA2 exceeds 1/16 inch greater than LA2: Remove the seal stack disc gasket. Replace with the next largest nominal gasket thickness. Repeat all applicable steps. (Any clamp ring gasket previously installed may now have to be removed and discarded.)

8.44 SA2 exceeds 1/16 inch less than LA2:
Remove the seal stack disc gasket. Replace with the next smallest nominal gasket thickness. Repeat all applicable steps. (Additional clamp ring gaskets may now be required.)

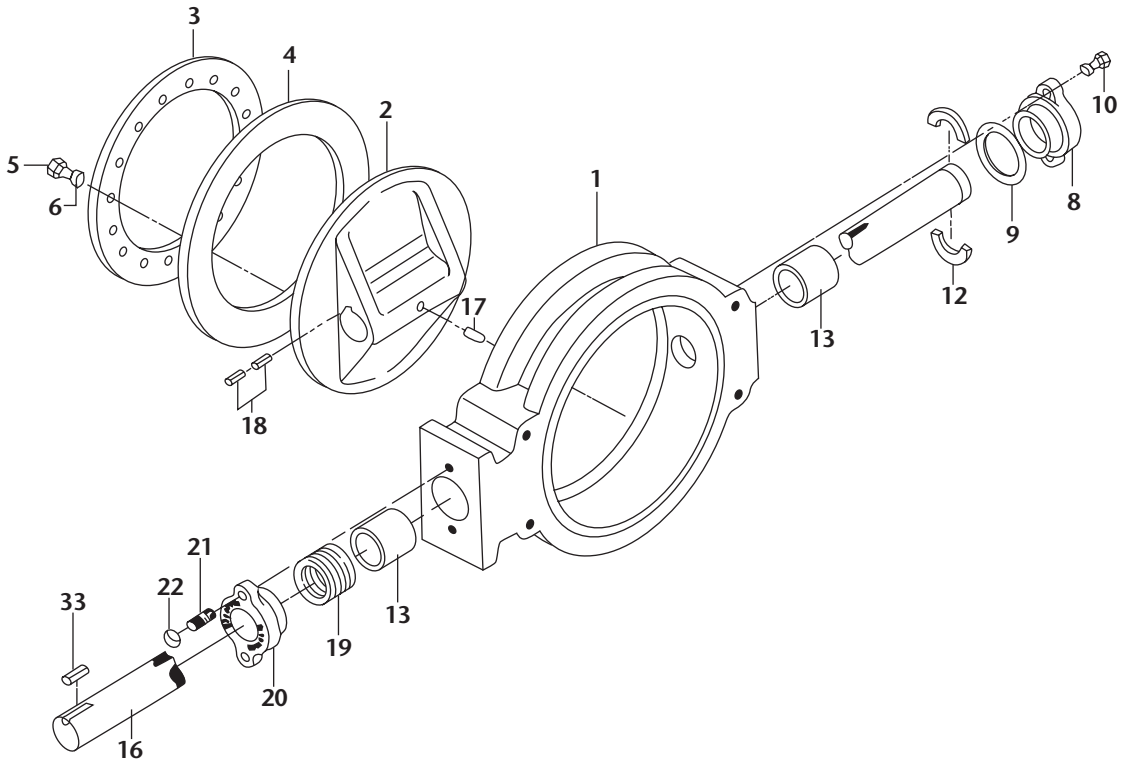
8.45 Perform a bluing check of the sealing surface by applying a thin coat of Prussian Bluing to the seat surface, closing the valve at full torque, and inspecting the resulting pattern.

8.46 No bluing indication left by the seal stack on the area of the seat that is located by the shaft bores means that the gasket used between the seal stack and the disc is not thick enough to allow the seal stack and seat machined cones to meet when the valve is closed. This is due to variations in the material thickness of the seal stack.

8.47 If this condition exists, replace the gasket with the next available thickness and repeat all of the previous steps.

8.48 Acceptance criteria for the bluing pattern is a 75% complete pattern. No interruptions of a single laminate is allowed. Additionally, some damage to the valve seat would be acceptable, provided the damaged areas do not cross the seal pattern.

8.49 Bench testing of the valve, after disc seal replacement, is recommended.



ITEM NO.	DESCRIPTION	QTY PER VALVE
1	Body	1
2	Disc	1
3	Clamp Ring	1
**4	Laminated Seal	1
5	Hex Head Cap Screw	as reqd.
6	Lock Washer	as reqd.
8	Cover Plate	1
**9	O-Ring	1
10	Hex Head Cap Screw	2
**12	Annular Key	1
**13	Bearing	2
16	Shaft	1
17	Spiral Pin	1
18	Disc Key	2
**19	Packing	5
20	Gland	1
21	Stud	2
22	Hex Nut	2
33	Actuator Key	1

** Recommended Spare Parts

9.0 VALVE DISASSEMBLY

9.1 Place the valve on a bench or other suitable working surface with the drive shaft side of the valve up. Remove the dowel pin from the disc.

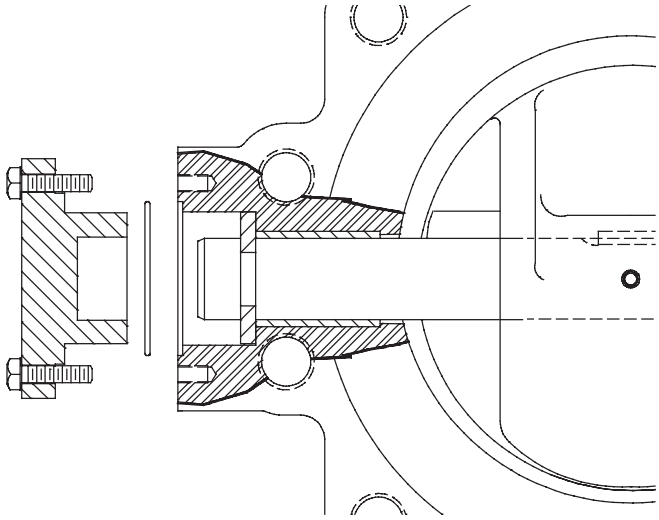
9.2 Restrain the disc assembly from opening by clamping or bolting, a suitably sized square bar across the flange face directly above the edge of the disc that is furthest away from the center of the drive shaft. This bar should be perpendicular to the drive shaft.

9.3 Choose a correct length for a jack screw or hydraulic jack to place between the disc and bar. Place the jack screw in position and apply enough force to mechanically maintain the disc in place. It is not necessary to apply excessive force to maintain position. Remove the actuator from the drive shaft.

9.4 On the non-driven end of the shaft, remove the cover plate bolts, cover plate, and the O-Ring from the valve body.

9.5 On the driven end of the valve shaft, remove the hex nuts and the gland follower. Remove the packing rings. Place an appropriate sized block between each side of the disc ear and the valve I.D. to prevent lateral movement.

9.6 With a soft rod or hammer, move the shaft towards the non driven end of the valve body until the annular key is free. The annular key is a split ring installed in a groove machined on the end of the shaft. Because it is split, the annular key can fall away from the drive shaft easily. Caution should be taken so that the annular key does not become lost.



9.7 Remove the disc ear drive keys as the shaft moves.

9.8 Most valves will contain more than one drive key. Do not attempt to force the drive shaft out too fast as the clearance for drive key removal is small.

9.9 When all of the keys are removed, the shaft may now be withdrawn from either side of the valve body.

9.10 Remove any devices that were used to maintain the disc assembly in position during shaft removal.

9.11 Locate the SA2 edge of the disc. Carefully push down on the disc assembly at this point until the seal stack partially disengages from the seat. This will be moving the disc assembly in the open direction. Carefully lift the disc assembly and guide the disc assembly so that no damage can occur to the disc seal stack.

9.12 The disc assembly should be lifted at a greater angle than the closed position of the disc. A strap thru the ear bores to lift the disc assembly from the body may be utilized.

CAUTION: This will cause the disc assembly to move in a manner that tends to close the disc. Great care should be taken to prevent this movement. It is suggested that a crew of two be used when a disc is removed from the valve.

9.13 Unless there is evidence that the bearing I.D. is damaged, it is suggested that the bearings remain in the valve. If the bearings are to be removed from the valve body, use a soft rod and hammer from the body center out.

10.0 VALVE ASSEMBLY

10.1 Clean all valve components.

10.2 Inspect all components for damage before starting to assemble. Look especially for damage to the seal stack and valve body seating surface, and wear in the bearing areas of the body (or the bearing I.D. if not removed from the valve) and drive shaft.

10.3 Place the valve body on a suitable working surface with the seat side down.

10.4 With a soft rod or hammer, install the bearings toward the inside of the body until they seat fully against the bore shoulder. Note: Some valves have bearings of unequal lengths. Depth of bearing bores in the valve body should match the bearing lengths.

10.5 Carefully place the disc assembly into the valve body. It is recommended to install the disc assembly in a partially open orientation until the seal stack contacts the seat somewhere in the area of the shaft bores.

10.6 Insert the annular key end of the drive shaft thru the driven body bearing and disc bores into the non-driven side of the valve.

10.7 Assure that the disc assembly is closed. Place appropriate sized blocks between the disc ear and the body I.D.

10.8 Place the annular key in the shaft groove. Reverse the direction of shaft travel. Install the disc ear keys as the shaft moves and seat both the annular key and shaft keys at the same time.

10.9 When the annular key is fully seated, check the alignment of the dowel pin hole in the disc with the corresponding hole in the shaft. Adjustments to the disc position may be required.

10.10 Adjustments to the disc position can be accomplished by loosening the disc bolts, floating the seal stack, and re-positioning the disc at the same time.

10.11 On the non-driven side of the body, install the O-Ring, the cover plate, the bolts and lock washers. Lubricate the bearing areas of the bolts and lock washers prior to assembly.

10.12 Torque the bolts to the level indicated in the torque tables in a standard criss-cross pattern.

10.13 Install the new packing, one ring at a time, rotating the splices at 90 degree intervals to avoid setting up a leak path.

10.14 Use the gland follower to push the packing evenly into the bore.

10.15 Once the packing has been completely installed, run the gland follower studs into the tapped holes, if removed during disassembly, and tighten by lightly locking two of the correct size nuts together at the outside end of the stud. Use these nuts to tighten the stud until they slip on the studs. Install the follower.

10.16 Tighten the gland follower down with the nuts, in a cross bolt method, until snug.

10.17 It is important that the packing gland be symmetrically mounted around the shaft. This will prevent the shaft or gland from binding or galling when the valve is operated.

10.18 The final packing adjustment can only be accomplished when the valve is pressurized.

11.0 BOLT TORQUE TABLES

Maximum Flange Bolt Torque Table

VALVE SIZE	BOLT DIA.	FT-LBS.
3" - 4"	5/8"	110
6" - 8"	3/4"	200
10" - 12"	7/8"	320
14" -16"	1"	480
18" - 20"	1 1/8"	300
24"	1 1/4"	840

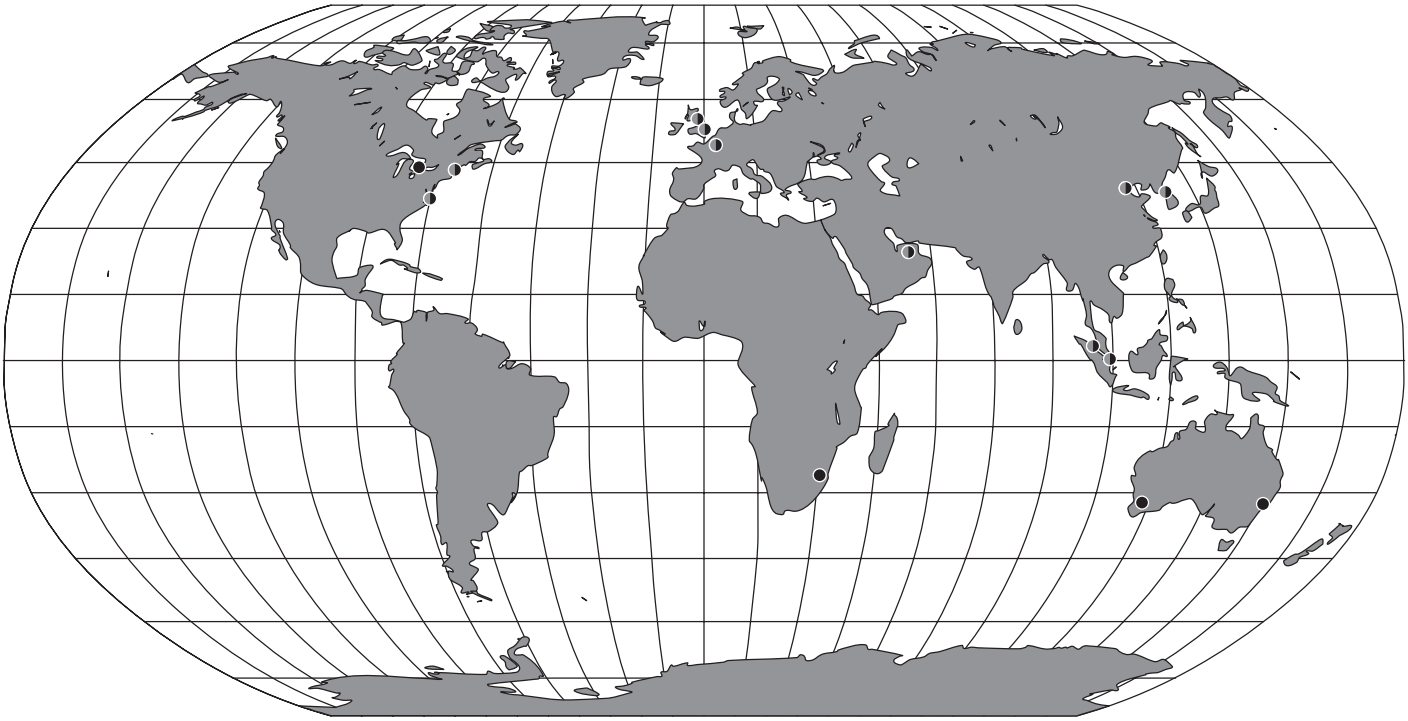
Maximum Disc Bolt Torque Table

1/4 - 20	80 in./lb
5/16 - 18	140 in./lb
3/8 - 16	250 in./lb
7/16 - 14	400 in./lb
1/2 - 13	550 in./lb
5/8 - 11	100 ft./lb
3/4 - 10	130 ft./lb

NOTE: These values are for fasteners of 316 stainless steel material and shall be used for higher strength materials of bolting.

General Fastener Torque Table

Size	316 SST	A193 GR B7	SAE GR 5	A193 GR B8M
1/4 - 20	70 in. lb.	90 in. lb.	70 in. lb.	
5/16 - 18	138 in. lb.	17 ft. lb.	13 ft. lb.	
3/8 - 16	18 ft. lb.	30 ft. lb.	20 in. lb.	86 in. lb.
1/2 - 13	40 ft. lb.	76 ft. lb.	55 ft. lb.	19 ft. lb.
5/8 - 11	87 ft. lb.	150 ft. lb.	95 ft. lb.	37 ft. lb.
3/4 - 10	115 ft. lb.	265 ft. lb.	130 ft. lb.	64 ft. lb.
7/8 - 9	180 ft. lb.	420 ft. lb.	285 ft. lb.	103 ft. lb.
1 - 8	270 ft. lb.	630 ft. lb.	432 ft. lb.	154 ft. lb.
1 1/8 - 8	389 ft. lb.	820 ft. lb.	560 ft. lb.	199 ft. lb.
1 1/4 - 8	429 ft. lb.	1,300 ft. lb.	756 ft. lb.	316 ft. lb.
1 1/2 - 8	837 ft. lb.	2,317 ft. lb.	1,745 ft. lb.	565 ft. lb.



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