Becker

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Linear Piston Spring Return Actuators

Instruction Manual (Rev. B)

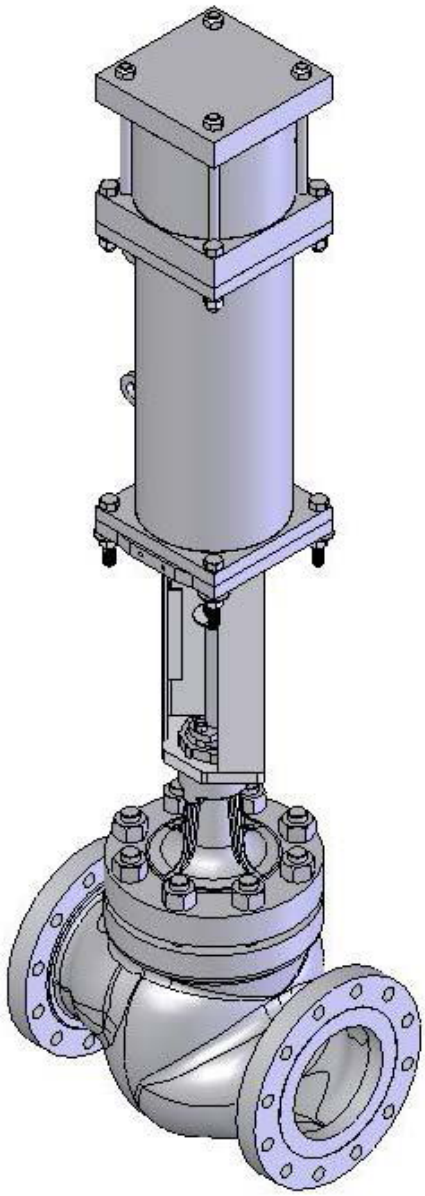

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Table of Contents

Technical Specifications

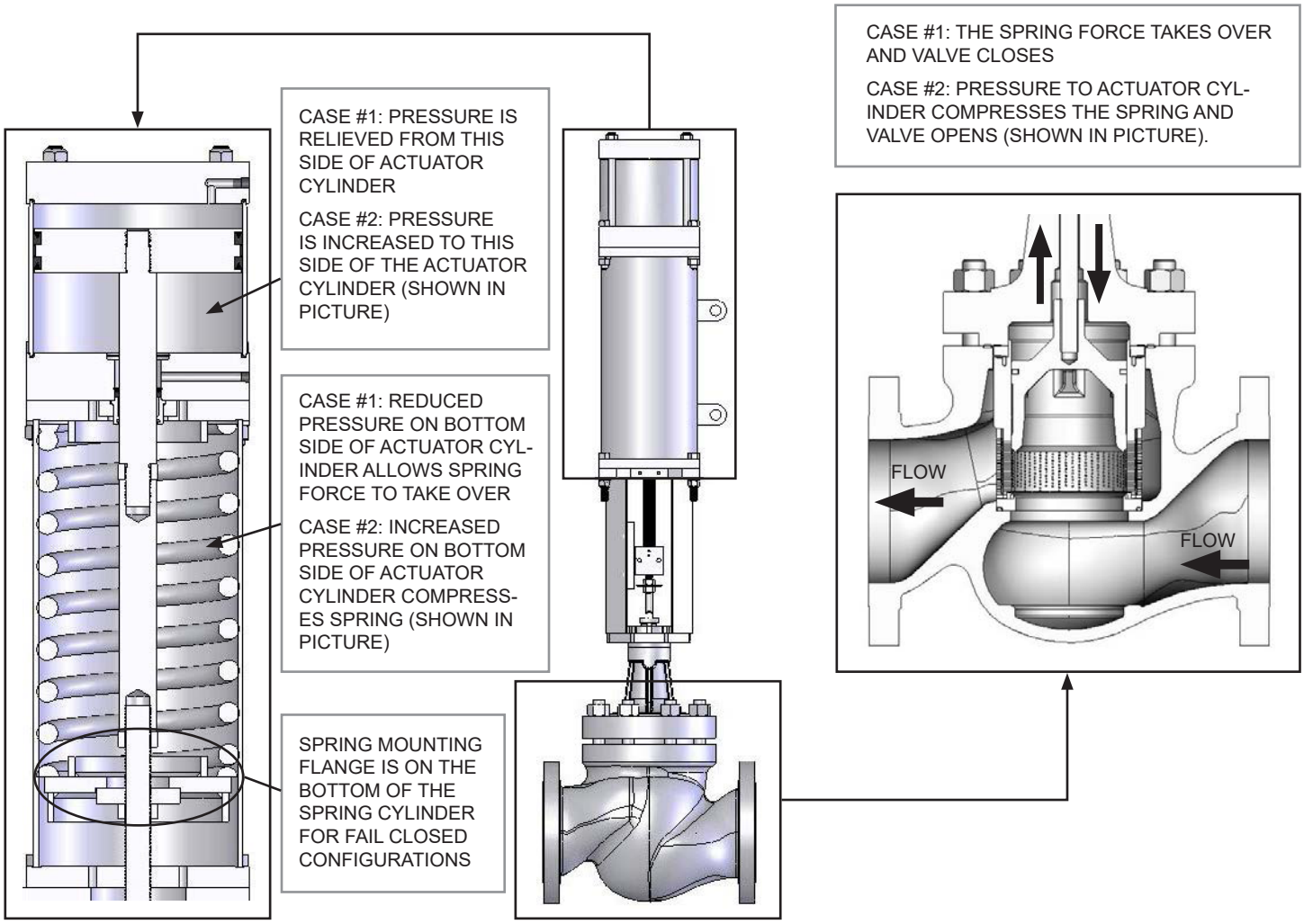
Actuator Type	Linear Piston Spring Return
Installation	• Indoors or outdoors • Vertical or Horizontal • Safe in explosion-proof environments
Thrust Output Ranges	• 1176 lbs - 9681 lbs
Operating Temperature Range	• -20º F (-29º C) to 160º F (71º C) (standard) • Low temperature optional
Power Gas Minimum	• 50 psig minimum
Power Gas Maximum	• 400 psig (actuator models 14” bore and smaller) • 250 psig (actuator models 16-24” bore)
Power Gas Filtration	• 100 Micron nominal • Free of excessive moisture • Free of excessive liquid hydrocarbons
Power Gas Moisture Requirements	< 7 Lb. per 1.0 MMSCF If excessive moisture or hydrocarbon content is present, a Filter Dryer may be necessary. For adequate filtration and elimination of moisture, a Becker Model FD-1500 Filter Dryer should be installed. Refer to Becker FD-1500 literature to determine if a Model FD-1500 Filter Dryer is necessary. For adequate filtration and elimination of liquid hydrocarbons, a Becker Model FACD-1500 Filter- Deodorizer should be installed.

Materials of Construction

Housing/Linkage	Carbon Steel
Spring Cartridge	• Carbon Steel • Welded construction
Spring	• 6150H, 5160H • 316 SS (available for low temp.)
Cylinder Tube[2,3]	Chrome-plated steel, SS available
Pneumatic Cylinder Piston Seals	Buna-N U-Cups, Low Temperature - Buna-N, Viton
Cylinder Piston Rod[3]	Chrome plated hardened steel
Pneumatic Cylinder Piston Rod Bearing	Duralon™ (fiberglass weave with Teflon™ coating) in steel shell
Pneumatic Cylinder Piston Rod Seal	Polyurethane U-Cup
Actuator Paint/Coating	• Standard coating: - single coat PSX® 700 siloxane - epoxy (4-7 mil) - 1.0 lbs/gal VOC • Custom coatings: - Epoxy, Polyester, coal tar and zinc-base coatings may be applied in-plant to customer specifications
Instrumentation Tubing	3/8” Seamless Tubing 316 SS[1]
Instrumentation Tubing Fittings	Double Ferrule design 316 SS (standard)

Notes:
1. Larger actuators and quick stroking actuators typically require 1/2” Seamless Tubing 316 SS.
2. Cylinders are supplied with pneumatic cushions when stroking time is two seconds or less.
3. For PED Cylinder materials see component lists on page 6.

“How it Works” – Fail Closed Actuator



“Fail Closed” actuators utilize Becker “Reverse Acting” controllers as instrumentation. “Reverse Acting” implies that when sensing pressure to the controller increases, output pressure from the controller decreases. In steady-state operation all forces on the actuator are in balance, and the controller (ex. Becker VRP-SB-CH) “senses” that the downstream pressure is equal to the “set pressure” of the controller. At this point the valve is not moving, but at any time two cases can occur:

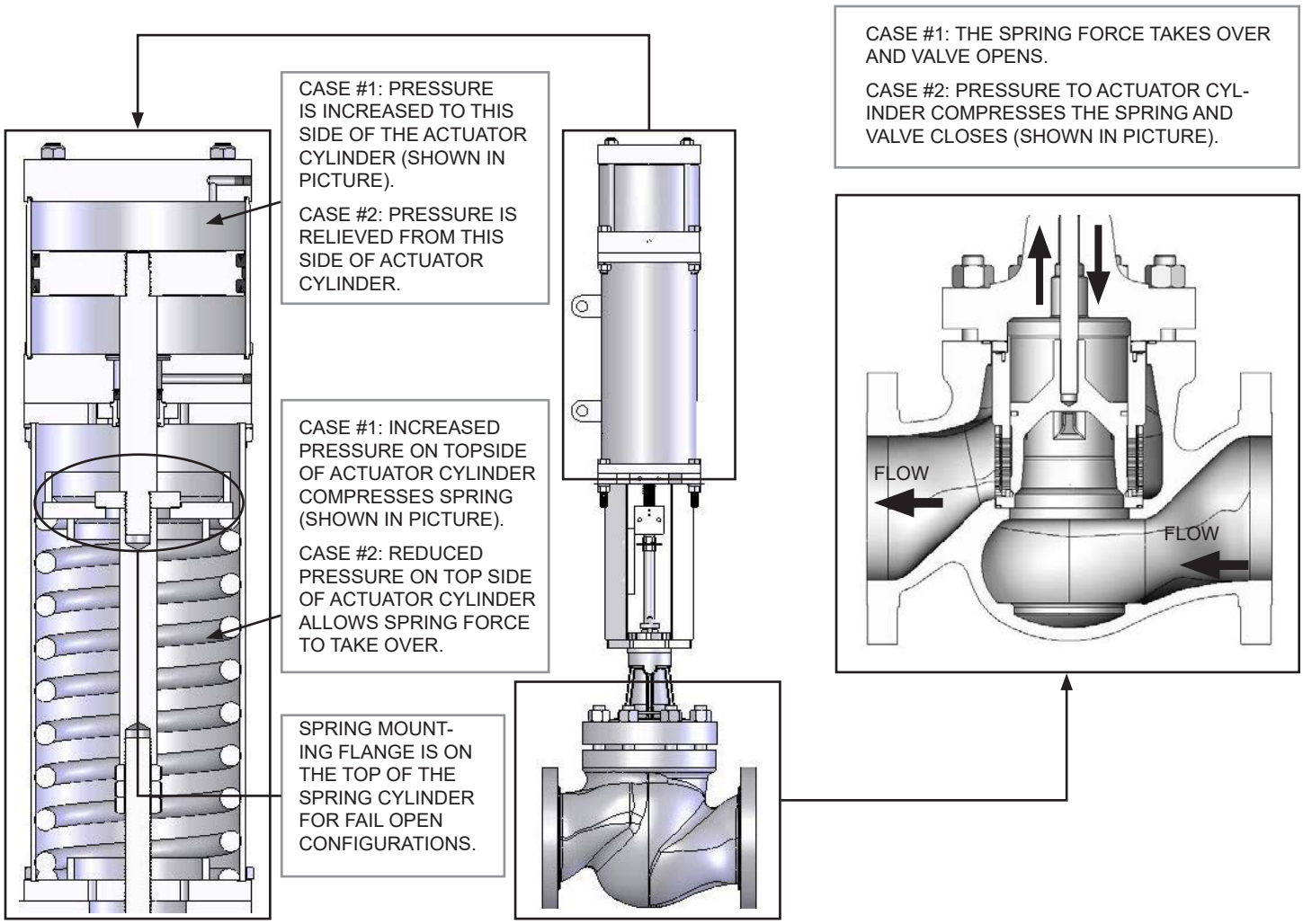
CASE #1 - AN INCREASE IN DOWNSTREAM PRESSURE

1) The controller “senses” pressure downstream that is higher than its “set pressure”.
2) Because the controller is “Reverse Acting”, this increase in sensing pressure creates a decrease in output pressure that relieves pressure from bottom of the actuator cylinder.
3) The actuator spring force takes over and begins to close the valve, therefore reducing the downstream pressure.
4) This continues until the controller “senses” that the “set pressure” is reached again. At this moment the spring and cylinder forces will equally balance, and the valve will remain at its new position.

CASE #2 - A DECREASE IN DOWNSTREAM PRESSURE

1) The controller “senses” pressure downstream that is lower than its “set pressure”.
2) Because the controller is “Reverse Acting”, this decrease in sensing pressure creates an increase in output pressure that increases pressure to the bottom of the actuator cylinder.
3) Increased pressure to the bottom of the actuator cylinder compresses the actuator spring and begins to open the valve, therefore increasing the downstream pressure.
4) This continues until the controller “senses” that the “set pressure” is reached again. At this moment the spring and cylinder forces will equally balance, and the valve will remain at its new position.

“How it Works” – Fail Open Actuator



“Fail Open” actuators utilize Becker “Direct Acting” controllers as instrumentation. “Direct Acting” implies that when sensing pressure to the controller increases, output pressure from the controller increases. In steady-state operation all forces on the actuator are in balance, and the controller (ex. Becker VRP-SB-CH) “senses” that the downstream pressure is equal to the “set pressure” of the controller. At this point the valve is not moving, but at any time two cases can occur:

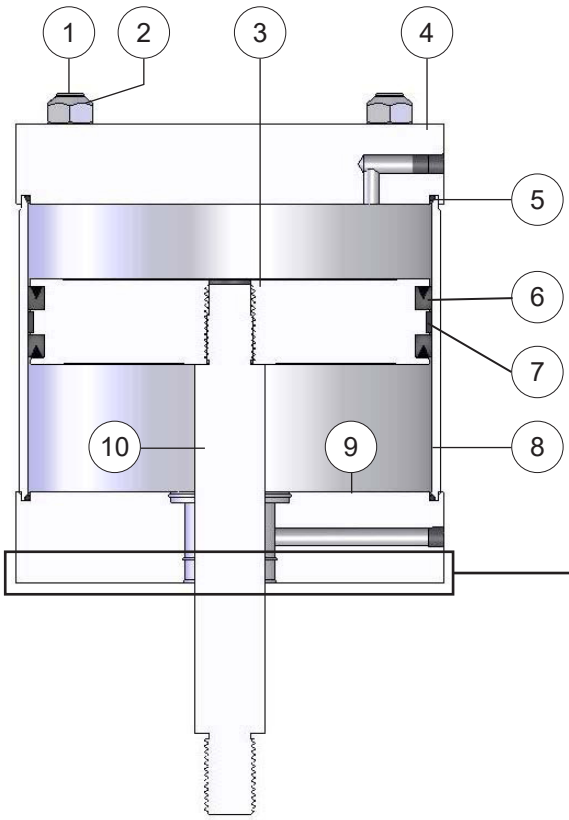
CASE #1 - AN INCREASE IN DOWNSTREAM PRESSURE

1) The controller “senses” pressure downstream that is higher than its “set pressure”.
2) Because the controller is “Direct Acting”, this increase in sensing pressure creates an increase in output pressure that increases pressure to the top of the actuator cylinder.
3) Increased pressure to the top of the actuator cylinder compresses the actuator spring and begins to close the valve, therefore decreasing the downstream pressure.
4) This continues until the controller “senses” that the “set pressure” is reached again. At this moment the spring and cylinder forces will equally balance, and the valve will remain at its new position.

CASE #2 - A DECREASE IN DOWNSTREAM PRESSURE

1) The controller “senses” pressure downstream that is lower than its “set pressure”.
2) Because the controller is “Direct Acting”, this decrease in sensing pressure creates a decrease in output pressure that relieves pressure from top of the actuator cylinder.
3) The actuator spring force takes over and begins to open the valve, therefore increasing the downstream pressure.
4) This continues until the controller “senses” that the “set pressure” is reached again. At this moment the spring and cylinder forces will equally balance, and the valve will remain at its new position.

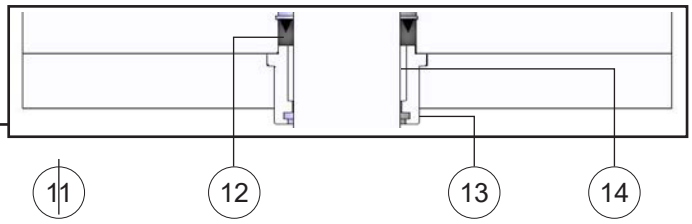
Standard Pneumatic Cylinder Components



Standard Pneumatic cylinders have many common parts, as shown in the table below. However, for certain cylinder bore sizes there are differences around the rod seal area (shown in the rectangular area above).

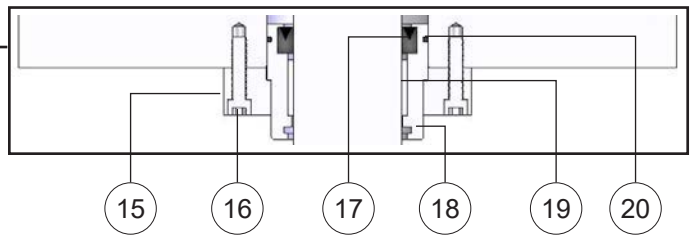
ITEM	QTY.	DESCRIPTION	MATERIAL
1	4	TIE ROD	HIGH STRENGTH STEEL
2	4	HEX NUT	STEEL
3	1	PISTON	NODULAR IRON
4	1	TOP HEAD	STEEL
5	2	TUBE SEAL	BUNA-N O-RING
6	2	PISTON SEAL	BUNA-N U-CUP
7	1	WEAR STRIP	TEFLON
8	1	TUBE	PRECISION HONED STEEL
9	1	BOTTOM HEAD	STEEL
10	1	PISTON ROD	HARD CHROME PLATED STEEL

4” - 6” BORE CYLINDERS



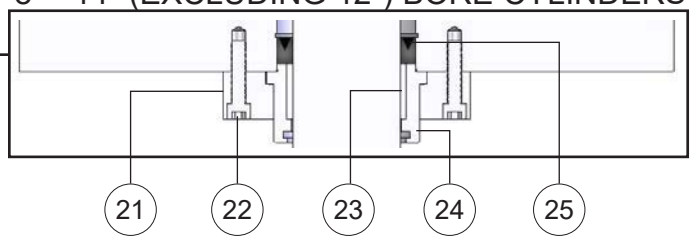
ITEM	QTY.	DESCRIPTION	MATERIAL
11	1	MOUNTING FLANGE	STEEL
12	1	ROD SEAL	POLYURETHANE U-CUP
13	1	BEARING CASING	PLATED STEEL
14	1	BEARING	DURALON

12” BORE CYLINDERS



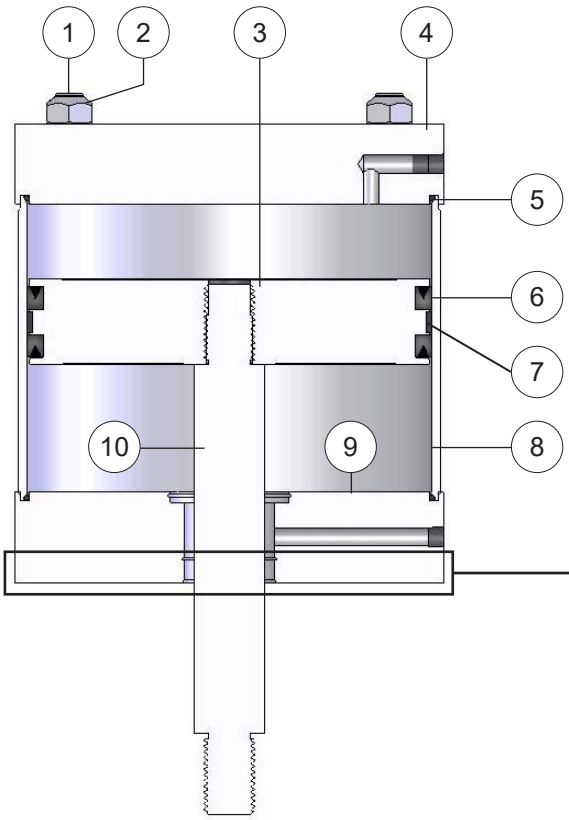
ITEM	QTY.	DESCRIPTION	MATERIAL
15	1	GLAND PLATE	PLATED STEEL
16	4	GLAND SCREWS	ALLOY STEEL
17	1	ROD SEAL	POLYURETHANE U-CUP
18	1	BEARING CASING	PLATED STEEL
19	1	BEARING	DURALON
20	1	BEARING SEAL	BUNA-N O-RING

8” - 14” (EXCLUDING 12”) BORE CYLINDERS

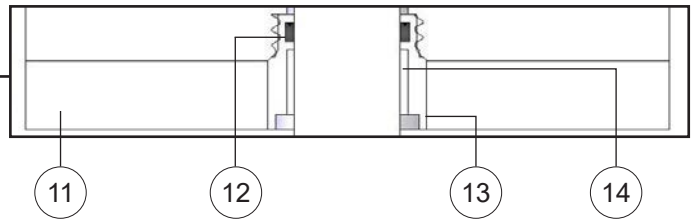


ITEM	QTY.	DESCRIPTION	MATERIAL
21	1	GLAND PLATE	PLATED STEEL
22	4	GLAND SCREWS	ALLOY STEEL
23	1	BEARING	DURALON
24	1	BEARING CASING	PLATED STEEL
25	1	ROD SEAL	POLYURETHANE U-CUP

PED Pneumatic Cylinder Components

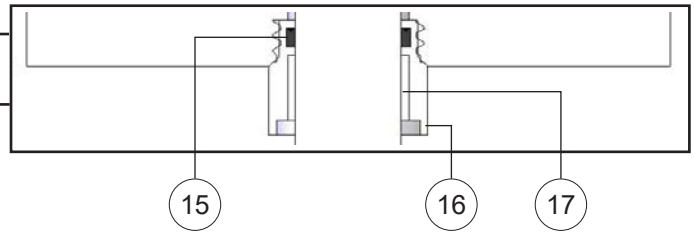


4” - 6” BORE CYLINDERS



ITEM	QTY.	DESCRIPTION	MATERIAL
11	1	MOUNTING FLANGE	STEEL
12	1	ROD SEAL	BUNA-N U-CUP
13	1	BEARING CASING	STAINLESS STEEL
14	1	BEARING	DURALON

8” - 14” BORE CYLINDERS



ITEM	QTY.	DESCRIPTION	MATERIAL
15	1	ROD SEAL	BUNA-N U-CUP
16	1	PISTON BUSHING	STAINLESS STEEL
17	1	BEARING	DURALON

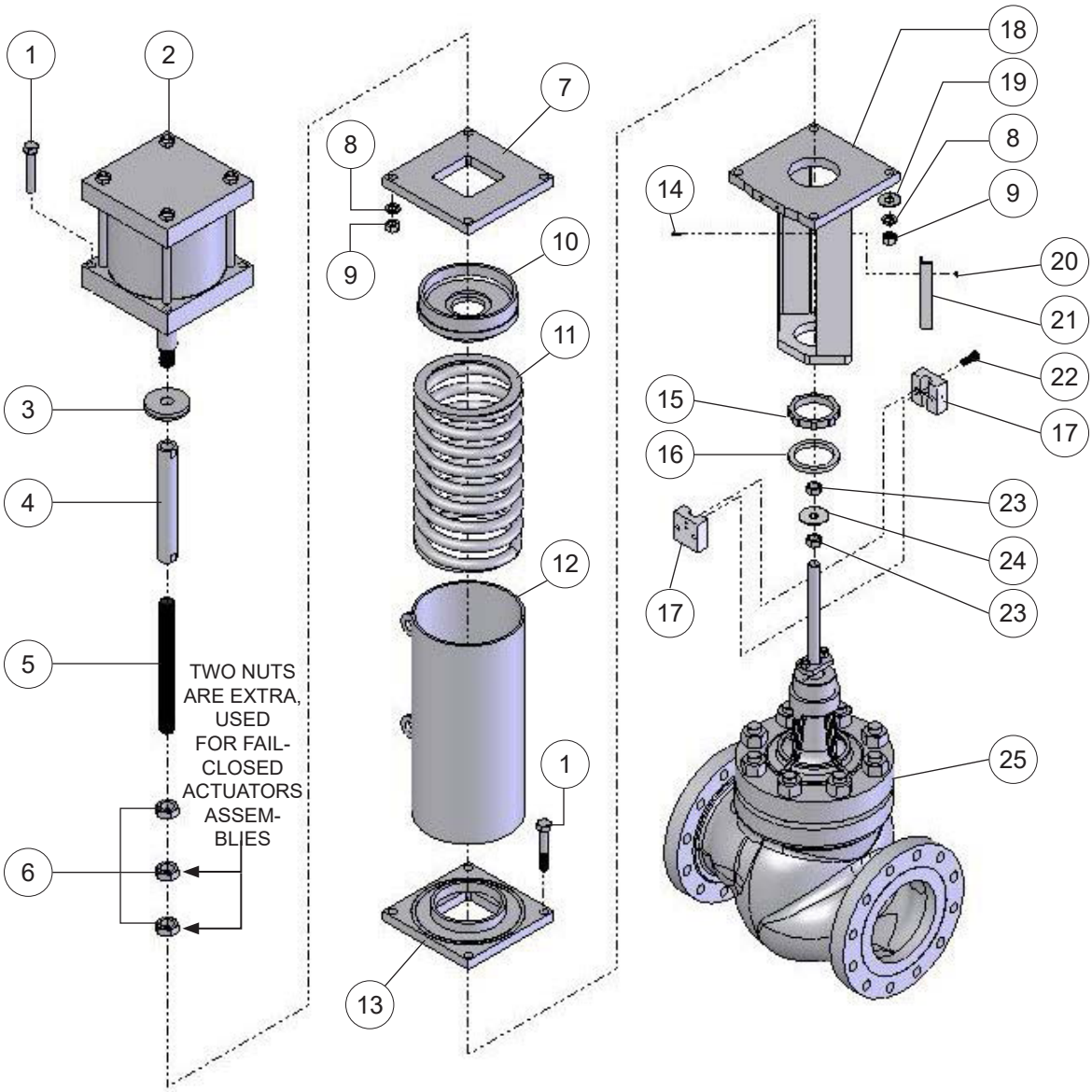
Pressure Equipment Directive (PED) compliant pneumatic cylinders have many common parts, as shown in the table below. However, for certain cylinder bore sizes there are differences in mounting (shown in the rectangular area above).

ITEM	QTY.	DESCRIPTION	MATERIAL
1	4	TIE ROD	STAINLESS STEEL
2	4	HEX NUT	STAINLESS STEEL
3	1	PISTON	CARBON STEEL
4	1	TOP HEAD	A350 LF2
5	2	TUBE SEAL	BUNA-N SQUARE-RING
6	2	PISTON SEAL	BUNA-N U-CUP
7	1	WEAR STRIP	TEFLON
8	1	TUBE	HONED STAINLESS STEEL
9	1	BOTTOM HEAD	A350 LF2
10	1	PISTON ROD	HARD CHROME PLATED CARBON STEEL

About Becker PED Cylinders

In the spirit of the Pressure Equipment Directive, Baker Hughes offers a pneumatic cylinder that conforms to guidelines set forth by the European Community. Along with the Cylinder, all pressure bearing housings and accessories on the actuator are PED certified. A full explanation of the Pressure Equipment Directive can be seen on page 9. PED certification allows Baker Hughes to freely place these products on the European market. As a result of the PED these Cylinders are made from a much harder material, and are also designed to work at lower temperatures. This Cylinder is not only for use in Europe, however. It also provides an alternative to all customers who want more than the Standard Cylinder.

Fail Open Actuator Components

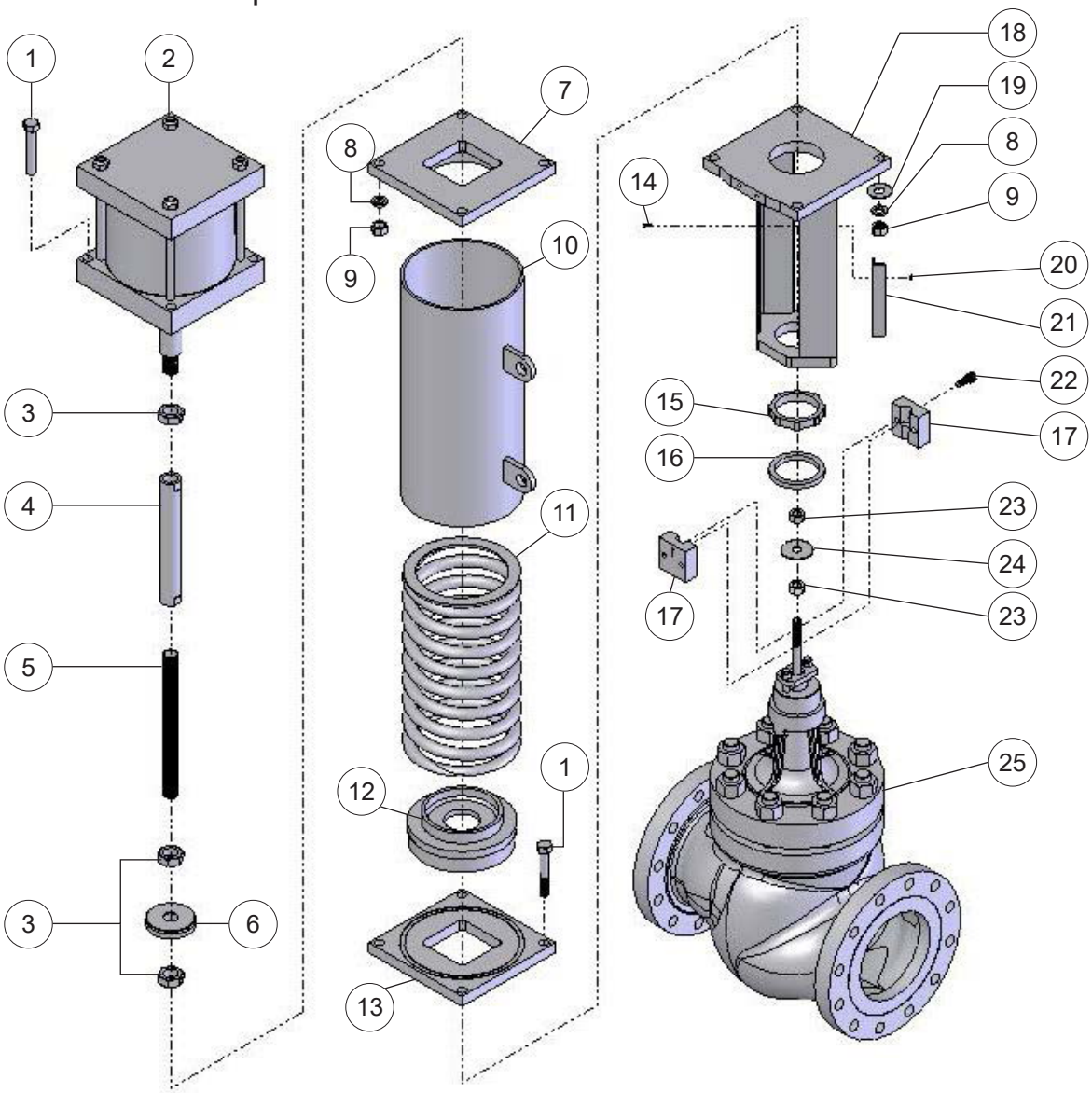


ITEM	QTY.	DESCRIPTION	MATERIAL
1	4	HEX HEAD CAP SCREW	PLATED STEEL
2	1	CYLINDER	*SEE PAGES 5 & 6
3	1	ROD FLANGE	CARBON STEEL
4	1	ROD EXTENSION	ALLOY STEEL
5	1	STUD EXTENSION	ALLOY STEEL
6	3	HEX JAM NUT	PLATED STEEL
7	1	TOP CARTRIDGE FLANGE	CARBON STEEL
8	4	SPRING LOCKWASH-ER	PLATED STEEL
9	4	SPRING HEX NUT	PLATED STEEL
10	1	SPRING FLANGE	SCHEDULE 40 PIPE/ CARBON STEEL
11	1	MAIN SPRING	VARIES DEPENDING ON APPLICATION
12	1	MAIN SPRING TUBE	MECHANICAL TUB-ING

ITEM	QTY.	DESCRIPTION	MATERIAL
13	1	BOTTOM CART. FLANGE	CARBON STEEL
14	2	INDICATOR SCREW	STAINLESS STEEL
15	1	NUT HOLDER	CAST STEEL
16	1	MOUNTING SPACER	PIPE STEEL
17	1	ROD CLEVIS ASSY.	STEEL
18	1	HOUSING ASSEMBLY	CARBON STEEL
19	4	HOUSING FLAT WASH-ER	PLATED STEEL
20	2	INDICATOR JAM NUT	STAINLESS STEEL
21	1	INDICATOR BRACKET	ALUMINUM
22	2	CLEVIS CAP SCREW	ALLOY STEEL
23	2	STEM JAM NUTS	PLATED STEEL
24	1	INDICATOR WASHER	PLATED STEEL
25	1	GLOBE VALVE	CARBON STEEL/ STAINLESS STEEL

Note: items 7, 12, 13 are welded together as a cartridge

Fail Closed Actuator Components



ITEM	QTY.	DESCRIPTION	MATERIAL
1	4	HEX HEAD CAP SCREW	PLATED STEEL
2	1	CYLINDER	*SEE PAGES 6 & 8
3	3	HEX JAM NUT	PLATED STEEL
4	1	ROD EXTENSION	ALLOY STEEL
5	1	STUD EXTENSION	ALLOY STEEL
6	1	ROD FLANGE	CARBON STEEL
7	1	TOP CARTRIDGE FLANGE	CARBON STEEL
8	4	SPRING LOCKWASHER	PLATED STEEL
9	4	SPRING HEX NUT	PLATED STEEL
10	1	MAIN SPRING TUBE	MECHANICAL TUBING
11	1	MAIN SPRING	VARIES DEPENDING ON APPLICATION
12	1	SPRING FLANGE	SCHEDULE 40 PIPE/ CARBON STEEL

ITEM	QTY.	DESCRIPTION	MATERIAL
13	1	BOTTOM CART. FLANGE	CARBON STEEL
14	2	INDICATOR SCREW	STAINLESS STEEL
15	1	NUT HOLDER	CAST STEEL
16	1	MOUNTING SPACER	PIPE STEEL
17	1	ROD CLEVIS ASSY.	STEEL
18	1	HOUSING ASSEMBLY	CARBON STEEL
19	4	HOUSING FLAT WASHER	PLATED STEEL
20	2	INDICATOR JAM NUT	STAINLESS STEEL
21	1	INDICATOR BRACKET	ALUMINUM
22	2	CLEVIS CAP SCREW	ALLOY STEEL
23	2	STEM JAM NUTS	PLATED STEEL
24	1	INDICATOR WASHER	PLATED STEEL
25	1	GLOBE VALVE	CARBON STEEL/ STAINLESS STEEL

Note: items 7, 12, 13 are welded together as a cartridge

The Becker Standard & PED Cylinders

The Becker Standard Cylinder

The Becker Standard Pneumatic Cylinder is constructed of high strength steel to ensure optimum performance over a long lifetime. Standard Cylinders are mounted using N.F.P.A. (National Fluid Power Association) standards. As shown from the Standard Cylinder component list on page 5, 4” - 6” Bore Cylinders utilize N.F.P.A. MF1 mounting standards. This requires an extra mounting flange attached to the bottom of the cylinder. 8” - 14” bore cylinders utilize a ME3 mounting standard, and can be directly mounted onto the actuator.

The Becker PED Cylinder

The main difference between the Becker PED Cylinder and the Standard Becker Cylinder are the materials of construction. The PED directive requires the Cylinder material to be much harder, and to function at a lower temperature than the Standard Pneumatic Cylinder. To accommodate those design requirements the Cylinder Heads are made from A350 LF2 carbon steel, and all other parts, excluding rubber goods, are made from stainless steel. The PED Cylinder also features a Square Ring Tube Seal design instead of an O-Ring design. It is important to recognize these subtle differences to ensure the user refers to the right sections of this manual when performing maintenance on the Cylinder.

PED Background Information

The PED, or Pressure European Directive (97/23/EC), was adopted by the European Parliament and the European Council in May 1997 in order to create better trade relations between its Member States. From July 19,2016, the Pressure Equipment Directive has been updated in 2014/68/EU. The main purpose of the PED is to eliminate the technical barriers that prevent trade within the community. This was accomplished by introducing new harmonized national laws regarding the design, manufacture, and conformity assessment of pressure equipment. According to legislation, on May 29, 2002, the Pressure Equipment Directive became mandatory for all Member States in the European Union. The power of the PED is that it allows a flexible regulatory environment within the E.U. This allows free placement of compliant products onto the market. According to the directive, pressure equipment or assemblies that are above the directive specified pressure/volume threshold must

- be safe
- meet essential safety requirements covering design, manufacture and testing
- satisfy appropriate conformity assessment procedures
- carry the CE marking and other information

Pressure equipment or assemblies below the specified pressure/volume threshold must

- be safe
- be designed and manufactured according to sound engineering practice
- bear specified markings (but not the CE marking)

Small Differences in Maintenance

Although they look virtually identical from the outside, the Becker Standard Cylinder and PED Cylinder have some key differences. It is a good idea to pay attention to these differences when using the following section.

When using the maintenance section, an outlined box, such as the one shown below, contains slightly modified instructions for PED Cylinders. If no box is shown then the instructions for Standard Cylinders are exactly the same as for PED Cylinders.

Actuator Maintenance & Inspection Background

Maintenance Background

Becker manufactures the highest quality pneumatic cylinders in order to ensure long-life and optimum performance. Over the course of normal operation, however, the actuator cylinder may wear and ultimately develop leakage through the following sealing mechanisms (see figure 1):

1. Tube Seals (O-Rings)
2. Piston Seals (U-Cups)
3. Piston Rod Seals

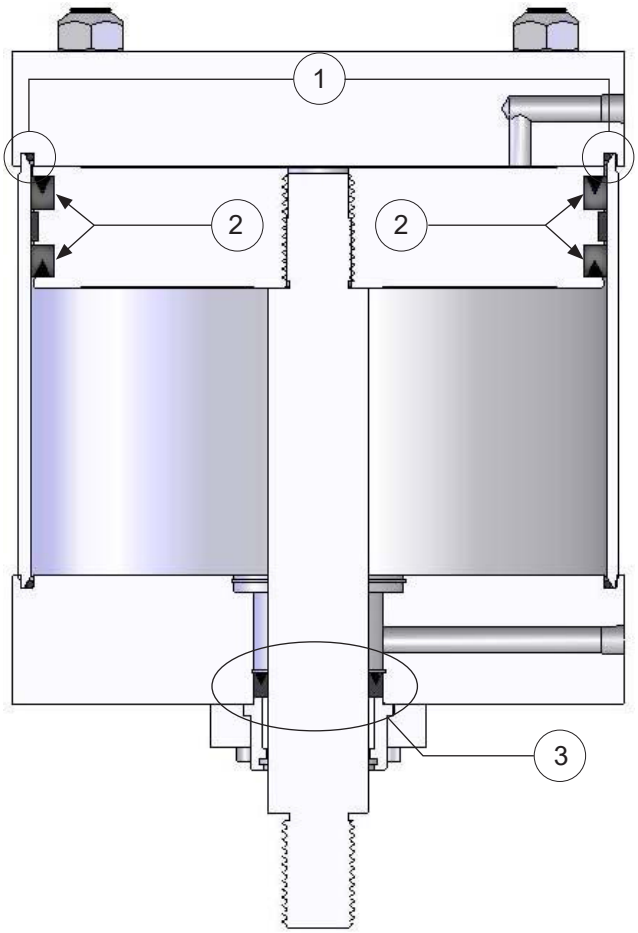


Figure 1. Possible Pneumatic Cylinder leakage points

Causes of Cylinder Leakage

Actuator cylinder seal leakage is typically attributed to wear over a very long period of time. However, actuator cylinder seals can wear prematurely due to excessive cycling (caused by Globe Valve Regulator malfunction or improper adjustment). In addition, seal wear can result from contaminates or debris in the power gas supply. Some older actuator cylinders may contain rusted carbon steel piston rod bearings, which can cause seal leakage. It is important to note that actuator cylinders are sensitive to low temperature effects. Worn actuator cylinders may appear normal, but will exhibit leakage only when ambient temperatures drop to freezing or below. Baker Hughes recommends the inspection of Becker piston rod seals and control instrumentation every year, along with a complete inspection of all cylinder seals. The definition of excessive piston leakage can be seen from table 1. The “ZERO” pressure port is defined as the NPT pressure port on the non-pressurized side of the cylinder.

Table 1: Excessive Piston Leakage Definition	
Ambient Temperature	Excessive Piston Seal Leakage Definition
> 40°F (Warm Conditions)	Soap Bubble across “ZERO” pressure port breaks in five seconds or less
< 40°F (Cold Conditions)	> 10 SCFH measured leakage from “ZERO” pressure port

Actuator Maintenance & Inspection

Procedure 1:

Cylinder Piston Rod Leakage Inspection

1. Fully pressurize “rod” side of actuator cylinder as shown in figure 2.
2. Ensure both block valves are closed.
3. Observe gauge needle opposite from “rod” side of cylinder, if gauge needle moves, then piston seals (u-cups) may need replacement. Follow procedure 5 on page 13 to replace piston seals, then move to step 4.
4. Repeat steps 1 and 2.
5. Observe gauge needle on “rod” side of cylinder. If needle shows a decrease in pressure, piston rod seals must be replaced.

Follow procedure 6 on page 15 to replace piston rod seals.

Procedure 2:

Control Instrumentation Inspection

Refer to the technical manual included with each specific instrumentation application for further instruction.

Procedure 3:

Checking Tube Seals

1. Remove the pneumatic buffer system or desiccant canister.
2. Pressurize the normally pressurized side of the cylinder with at least 100 psig power supply gas.
3. Apply a leak-check solution around the perimeter of the cylinder tubing wall. Any leakage should be easily visible.
4. Follow procedure 5 on page 13 to replace tube seals.

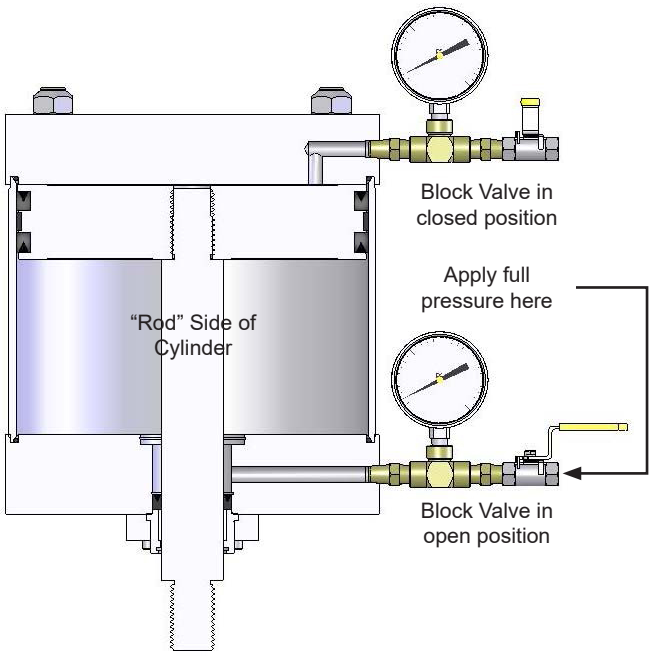


Figure 2. Piston Rod leakage test set-up

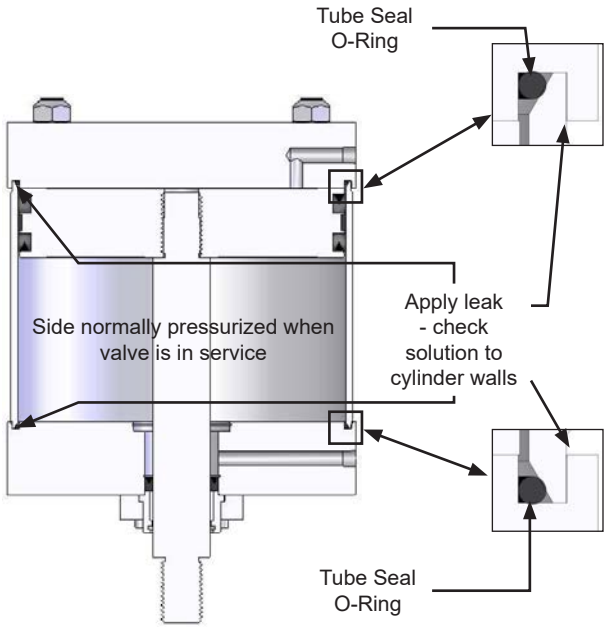


Figure 3. Cylinder Tube Seal leak test setup

Actuator Maintenance & Inspection

FOR PED CYLINDERS:

This procedure is exactly the same only SQUARE RINGS are used as TUBE SEALS and not O-RINGS. The presence of SQUARE RINGS is one way to determine which kind of CYLINDER you are using. If this is the case pay special attention to the “FOR PED CYLINDERS:” boxes throughout this maintenance section.

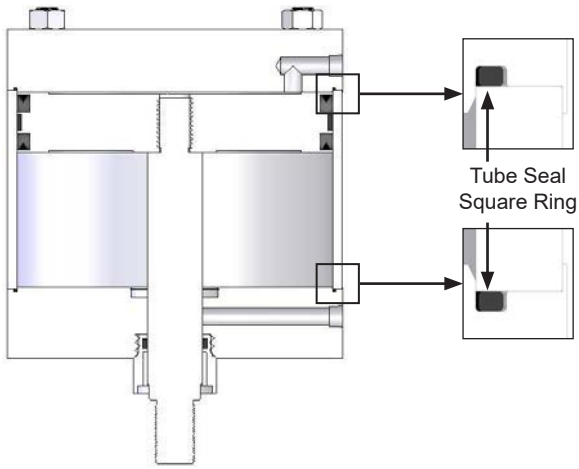


Figure 4. Square Tube Seals for PED Cylinders

Procedure 4:

Checking Piston Seals

1. Apply 100 psig power supply gas to the cylinder top port and ZERO pressure to the cylinder bottom port as show in figure 5.
2. Remove the tubing fitting (and pneumatic buffer or desiccant canister) from the actuator cylinder bottom port.
3. Check for excessive piston seal leakage at the ZERO pressure port (see table 1).
4. Apply 100 psig power gas supply to the cylinder bottom port and ZERO pressure to the cylinder top port.
5. Remove the tubing fitting from the actuator cylinder top port.
6. Check for excessive piston seal leakage at ZERO pressure port (see table 1).

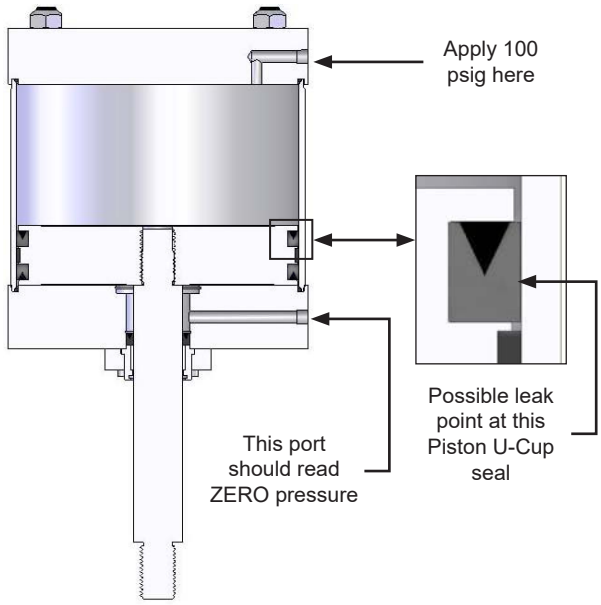


Figure 5. Piston Seal U-Cup leak test N°1

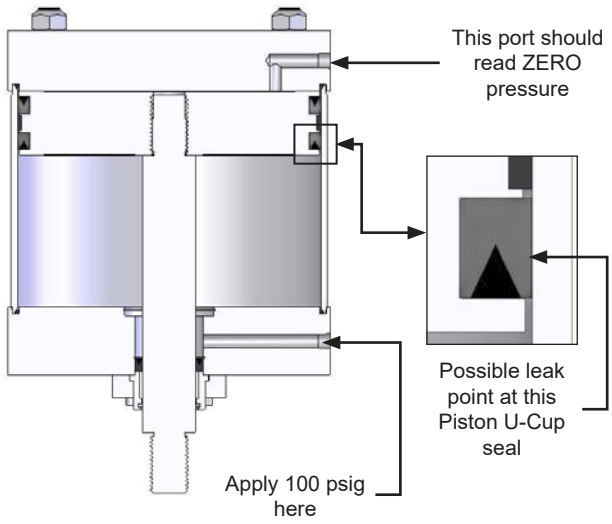


Figure 6. Piston Seal U-Cup leak test N°2

Corrective Action Procedures

When a specific inspection procedure reveals a leak somewhere, corrective action must be taken in order to get things back in working order. This section provides an in-depth explanation of corrective disassembly and assembly procedures needed to accomplish this task.

Actuator Maintenance & Inspection

Procedure 5:

Replacing Tube Seals & Piston Seals

This procedure DOES NOT require removal of the CYLINDER from the ACTUATOR.

1. Remove the power gas to allow the ACTUATOR CYLINDER (A) to stroke to the spring position.
2. Depressurize all instrumentation.
3. Remove instrumentation tubing and instrumentation from the ACTUATOR CYLINDER (A).

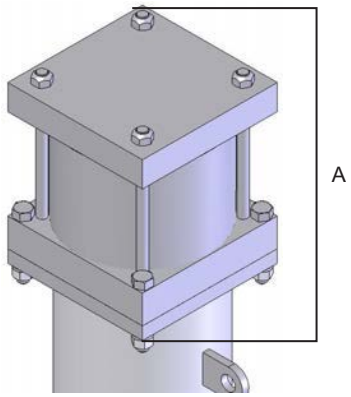


Figure 7. Remove all instrumentation and tubing, but do not remove Cylinder from Actuator Assembly

4. Make a vertical reference mark between BOTTOM MOUNTING FLANGE (B) and CYLINDER TUBE (C) to ensure proper realignment upon reassembly.

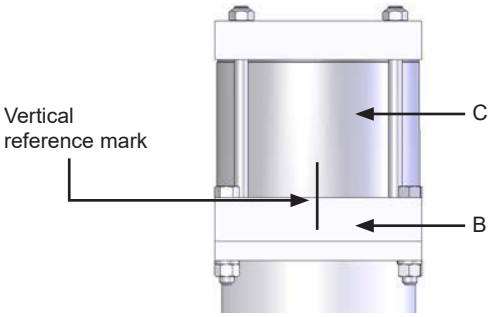


Figure 8. Vertical mark is made for you own reference

CAUTION

Ensure that power gas pressure has been fully vented from the ACTUATOR CYLINDER (A) prior to loosening TIE ROD NUTS (D)!

5. Remove TIE ROD NUTS (D) from TOP FLANGE (E). If TIE ROD NUT (D) seizes and TIE ROD (F) unscrews, remove entire TIE ROD (F).

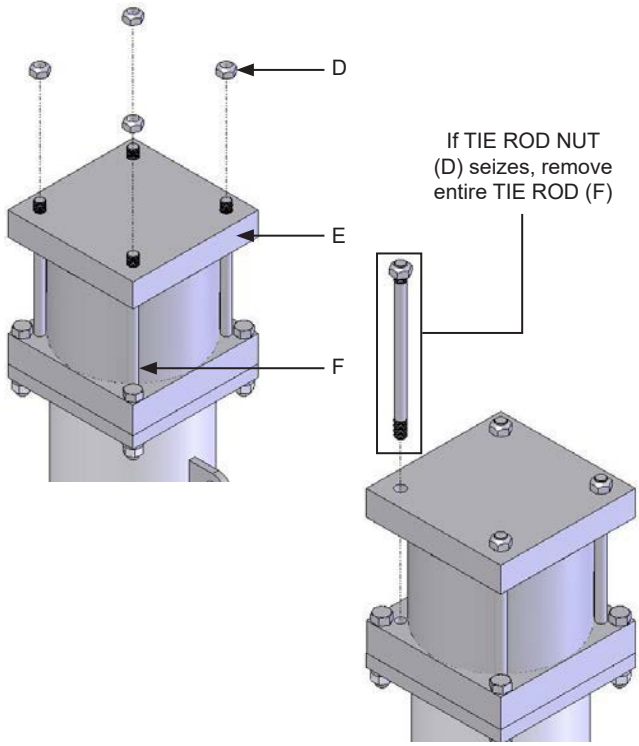


Figure 9. Preparing to remove the Top Flange and Tube

CAUTION

To prevent damage do not strike CYLINDER TUBE (C) wall with any object while removing!

6. Remove TIE RODS (F), then remove TOP FLANGE (E) and TOP SEAL O-RING (G).

FOR PED CYLINDERS:

Follow Procedure 5 exactly, except replace instances of TOP SEAL O-RING (G) and BOTTOM SEAL O-RING (H) with TOP SEAL SQUARE RING (G) and BOTTOM SEAL SQUARE RING (H).

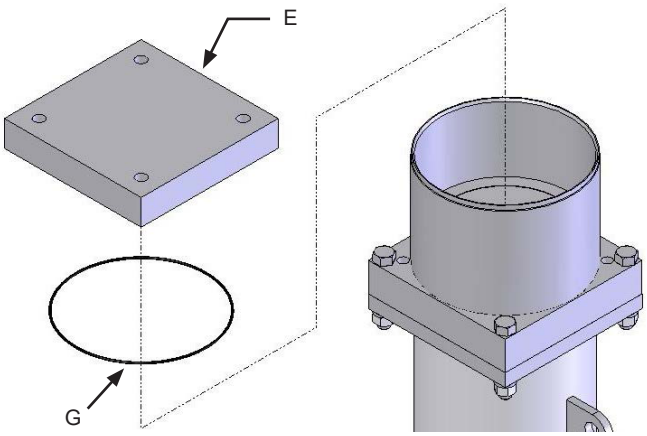


Figure 10. Removing the Top O-Ring Seal and Flange

7. Remove CYLINDER TUBE (C) and BOTTOM SEAL O-RING (H) from BOTTOM MOUNTING FLANGE (B).
8. Remove TOP PISTON U-CUP (I) and BOTTOM PISTON U-CUP (J) from PISTON (K).

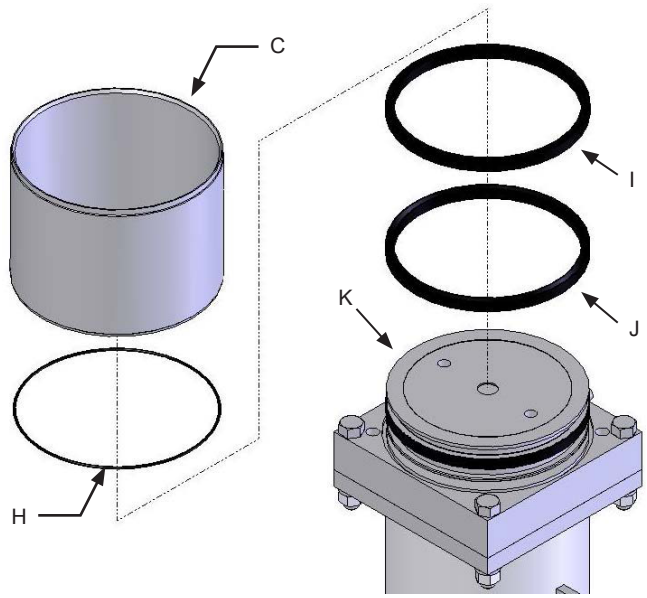


Figure 11. Remove the rest of the Seals from the Cylinder Assembly.

CAUTION
Do not use abrasive cleaning methods such as brushes or sandpaper!

9. Remove any rust, dirt, or foreign material from CYLINDER TUBE (C) wall and PISTON (K) using solvent if needed.
10. Inspect actuator CYLINDER TUBE (C) wall for scratches or excessive wear spots. If scratches or wear spots are present on the tubing wall, it may need to be replaced.

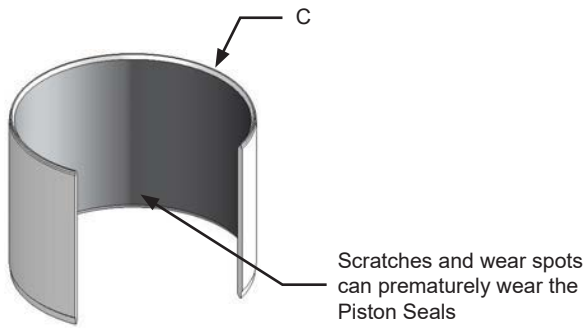


Figure 12. Cut-away view of the Cylinder Tube

CAUTION
Be careful not to damage replacement seals during installation.

11. Replace TOP SEAL O-RING (G), BOTTOM SEAL O-RING (H), TOP PISTON U-CUP (I), and BOTTOM PISTON U-CUP (J) with correct seal kits given in table 2. Orientation of U-CUPS (I,J) are shown in figure 13.

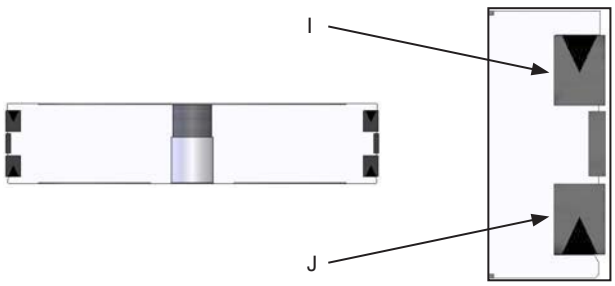


Figure 13. Piston U-Cup orientation

12. Using a clean, lint-free cloth, apply a thin layer of STP® brand lubricant to CYLINDER TUBE (C) wall, and a thin film of o-ring grease to PISTON SEALS (G,H,I,J).
13. Wipe excess STP® brand lubricant from CYLINDER TUBE (C) wall and excess grease from PISTON SEALS (G,H,I,J).

12. Re-assemble ACTUATOR CYLINDER (A). Install TIE RODS (F) and TIE ROD NUTS (D), but do not tighten TIE ROD NUTS (D).
13. Tighten TIE ROD NUTS (D) in a crossing pattern (shown in figure 14), using specified torque ratings (listed in table 2).
14. Reassemble instrumentation and tubing.

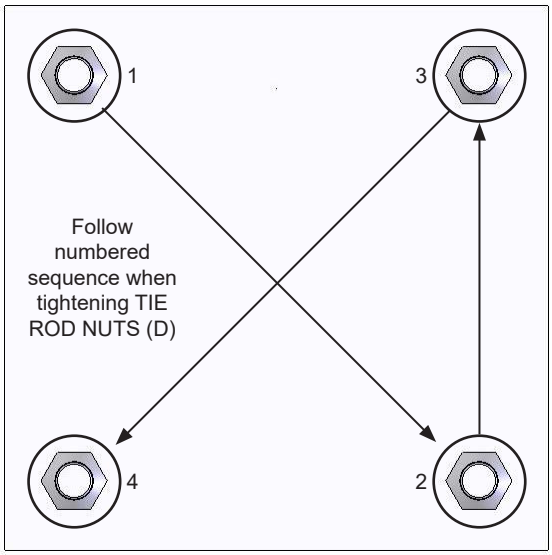


Figure 14. Tighten nuts in crossing pattern

NOTE: In emergency situations, the U-CUP SEAL from the NON-PRESSURIZED side of the CYLINDER can be switched with the leaking U-CUP SEAL to allow the ACUTATOR to be put back into service immediately. New seals can then be installed at a later, planned time.

Procedure 6:

Replacing Piston Rod Seals

This procedure necessitates removal of the CYLINDER from ACTUATOR to access the ROD SEAL CARTRIDGE. Replacement of the ROD SEALS, requires some disassembly of the CYLINDER due to this cartridge design.

1. Remove the power supply gas pressure. Depressurize all instrumentation and the ACTUATOR CYLINDER (A).
2. Remove 2, SOCKET HEAD CAP SCREWS (B) from ROD CLEVIS ASSEMBLY (C). Remove BACK ROD CLEVIS (D) and FRONT ROD CLEVIS (E) from STUD EXTENSION (F) and VALVE STEM (G).

3A. FOR FAIL OPEN ACTUATORS

a) Remove 4 HEX NUTS (H), 4 LOCKWASHERS (I), and 4 HEX HEAD CAP SCREWS (J) that are used to mount CYLINDER (A) to SPRING CARTRIDGE (K).

Table 2: Specified Actuator Cylinder Tie Rod Nut Torque & Seal Kit Information

Cylinder Bore (Inches)	Tie Rod Size	Tie Rod Torque (ft. - lbs)	Standard Piston Rod Seal Kit #	Standard Piston Seal Kit #	P.E.D. Piston Rod & Piston Seal Kit
4	3/8”-24	28	01-6836	01-6819	01-9944
5	1/2”-20	48	01-6836	01-6820	01-9947
6	1/2”-20	48	01-6837	01-6821	01-9950
8	5/8”-18	115	01-6837	01-6822	01-9953
10	3/4”-16	170	01-6838	01-6833	01-9956
12	3/4”-16	170	01-6839	01-6834	01-9959
14[1]	7/8”-14	375	01-6840	01-6835	N/A

Notes:
1. Bore size not available for PED Cylinders

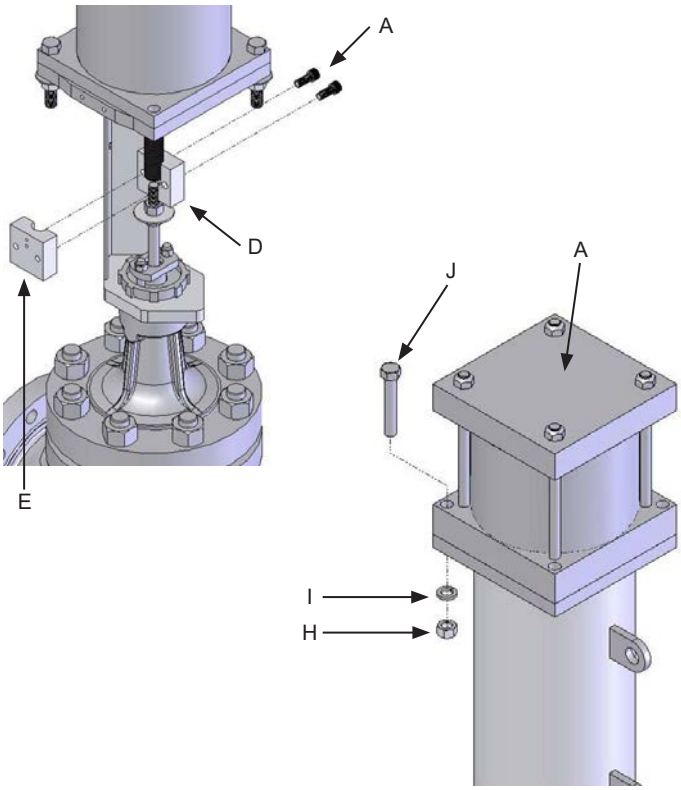


Figure 15. Preparing to remove the Cylinder

b) Remove CYLINDER (A) from SPRING CARTRIDGE (K). A ROD EXTENSION (L), STUD EXTENSION (F), ROD FLANGE (M), and 3 JAM NUTS (N), will be attached to CYLINDER (A).

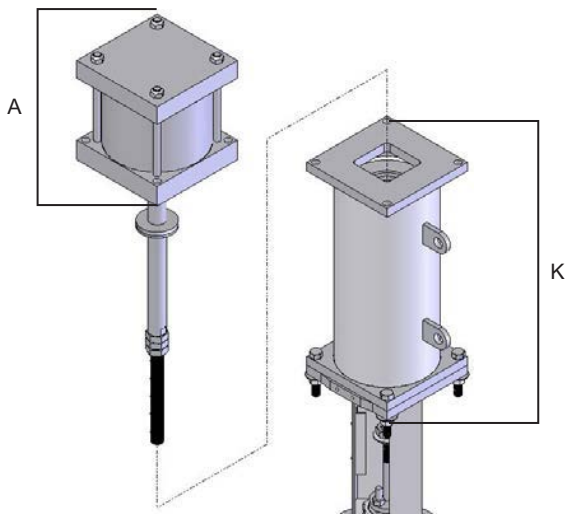


Figure 16. Removing the Cylinder and attached parts

c) Remove ROD EXTENSION (L), STUD EXTENSION (F), ROD FLANGE (M), and 3 JAM NUTS (N), from CYLINDER (A).

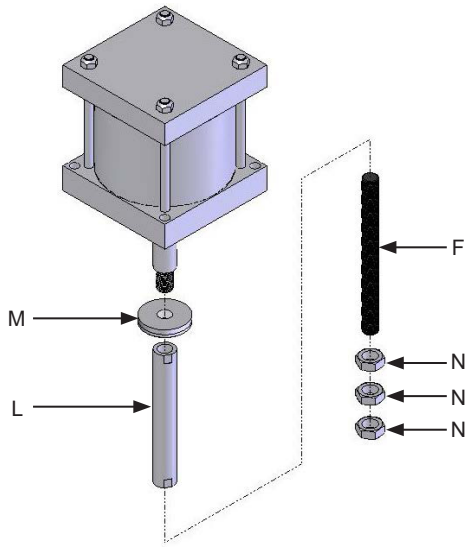


Figure 17. Isolating the Cylinder assembly

3B. FOR FAIL CLOSED ACTUATORS

a) Remove 4 HEX NUTS (H), 4 LOCKWASHERS (I), 4 FLAT WASHERS (J), and 4 HEX HEAD CAP SCREWS (K) that are used to mount SPRING CARTRIDGE (L) to HOUSING ASSEMBLY (M).

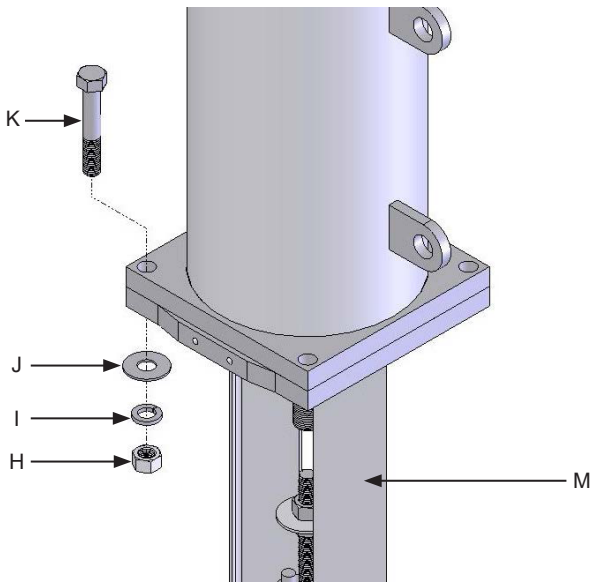


Figure 18. Removing the Spring Cartridge fasteners

b) Remove CYLINDER (A) and SPRING CARTRIDGE (L) from HOUSING ASSEMBLY (M). A ROD EXTENSION (N), STUD EXTENSION (F), ROD FLANGE (O), and 3 JAM NUTS (P), will be attached to CYLINDER (A) ROD.

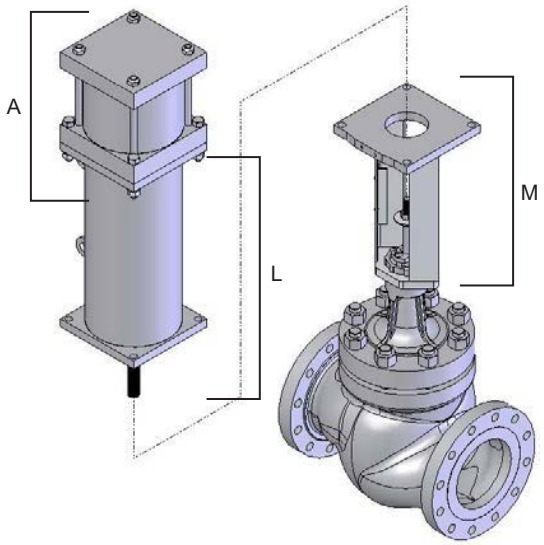


Figure 19. Removing Cylinder and Spring Cartridge

c) Unscrew JAM NUT (P) and ROD FLANGE (O), from STUD EXTENSION (F).

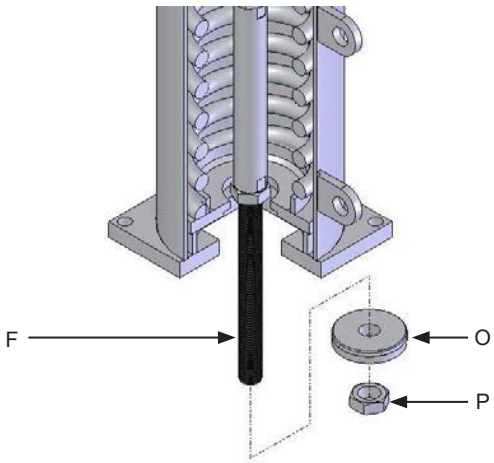


Figure 20. Removing the Rod Flange

d) Remove 4 HEX NUTS (Q), 4 LOCKWASHERS (R), and 4 HEX HEAD CAP SCREWS (S) that are used to mount CYLINDER (A) to SPRING CARTRIDGE (L).

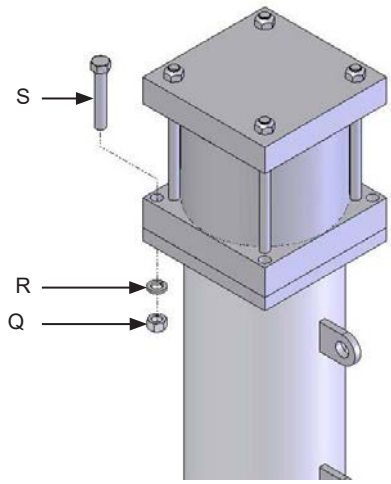


Figure 21. Removing the Cylinder fasteners

e) Remove CYLINDER (A) from SPRING CARTRIDGE (L). A ROD EXTENSION (N), STUD EXTENSION (F), and 2 JAM NUTS (P), will be attached to CYLINDER (A) ROD.

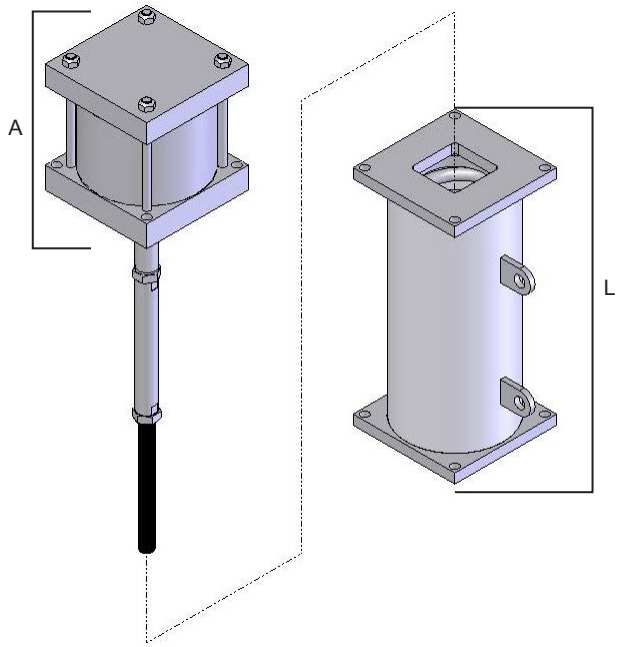


Figure 22. Removing the Cylinder and Attachments

f) Remove JAM NUTS (P), STUD EXTENSION (F), and ROD EXTENSION (N), from CYLINDER (A). The CYLINDER (A) should now be isolated.

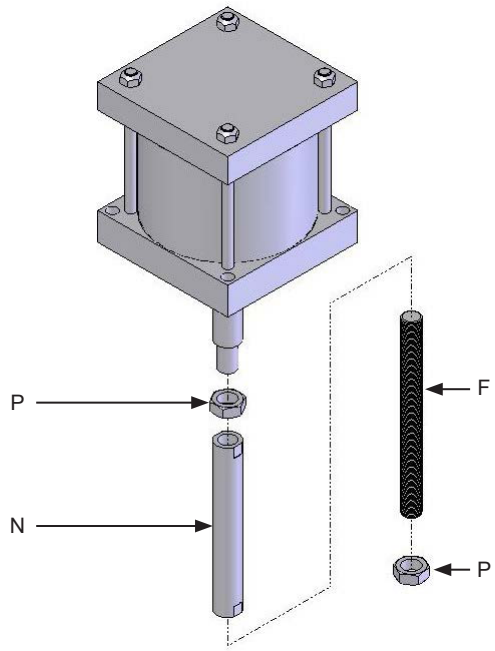


Figure 23. Isolating the Cylinder

4A. FOR 4”, 5”, & 6” BORE CYLINDERS

a) Remove TIE ROD NUTS (T) from TOP FLANGE (U). If TIE ROD NUT (T) seizes and TIE ROD (V) unscrews, remove entire TIE ROD (V) .

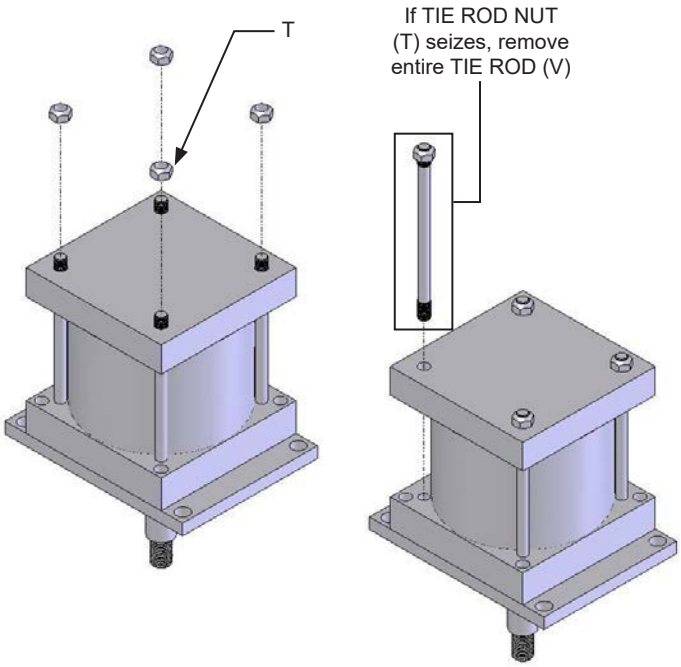


Figure 24. Preparing to remove the Mounting Flange

b) Remove TIE RODS (V). MOUNTING FLANGE (W) and BEARING ASSEMBLY (X) will both come out revealing ROD SEAL (Y). Remove ROD SEAL (Y).

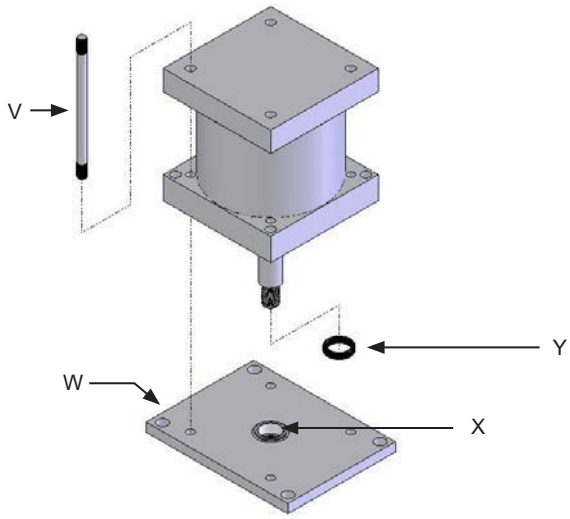


Figure 25. Remove all 4 Tie-Rods to remove Flange

FOR PED CYLINDERS:

Follow STEP 4A, b) exactly, only BUSHING ASSEMBLY (X) will be in the place of BEARING ASSEMBLY (X) as shown in figure 26.

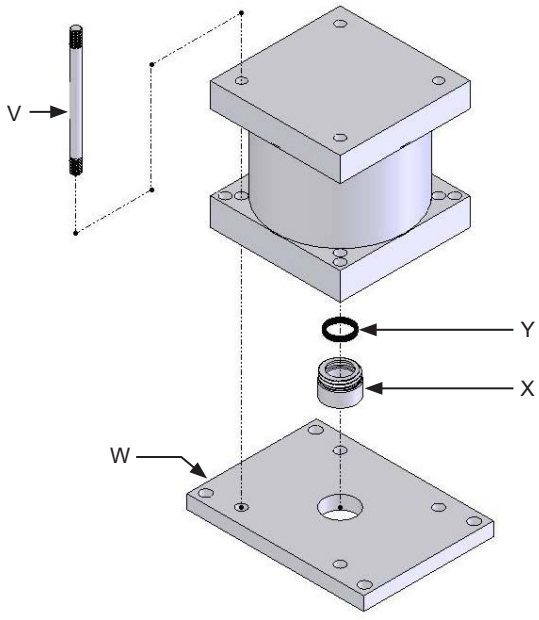


Figure 26. Remove all 4 Tie-Rods to remove Flange

c) Using a clean, lint-free cloth, apply a thin layer of STP® lubricant to BEARING ASSEMBLY (X), and o-ring grease to ROD SEAL (Y).

d) Ensure orientation of seal is correct as pictured in figure 27. Reassemble ROD SEAL (Y), MOUNTING FLANGE (W), BEARING ASSEMBLY (X), TIE RODS (V), and TIE ROD NUTS (T). Utilize figure 14, and table 2 to finish the assembly.

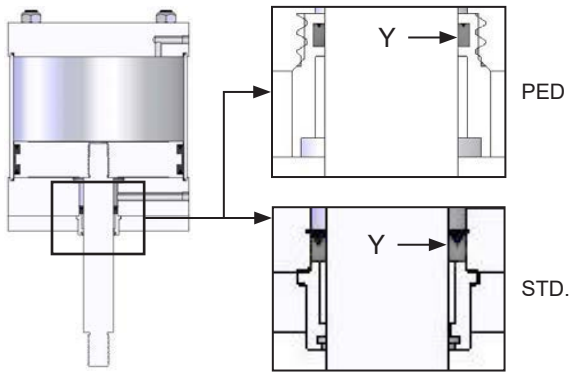


Figure 27. Reassemble the Rod Seals and Flange

4B. FOR 8”, 10”, & 14” BORE CYLINDERS

a) Remove GLAND SCREWS (T). GLAND PLATE (U) and BEARING ASSEMBLY (V) will both come out revealing ROD SEAL (W). Remove ROD SEAL (W).

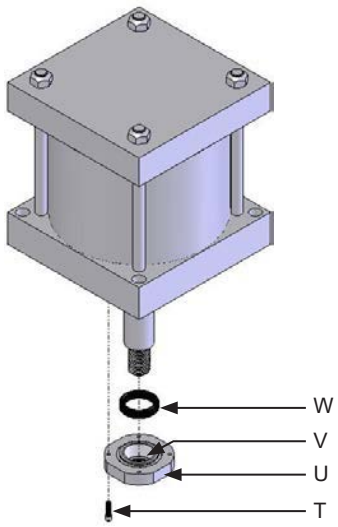


Figure 28. Removing the Gland Plate

FOR PED CYLINDERS:

PED Cylinders DO NOT come in the 14” size. However, for 8” and 10” bore cylinders follow STEP 4B, a) exactly, only BUSHING ASSEMBLY (V) will be in the place of GLAND PLATE (U) and GLAND SCREWS (T) as shown in figure 29.

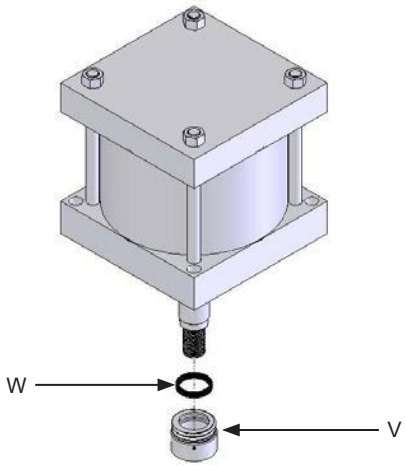


Figure 29. Removing the Bushing Assembly and Seal

b) Using a clean, lint-free cloth, apply a thin layer of STP® brand lubricant to BEARING ASSEMBLY (V), and o-ring grease to ROD SEAL (W).

c) Ensure orientation of seal is correct as pictured in figure 30. Reassemble ROD SEAL (W), BEARING ASSEMBLY (V), GLAND PLATE (U), and GLAND SCREWS (T).

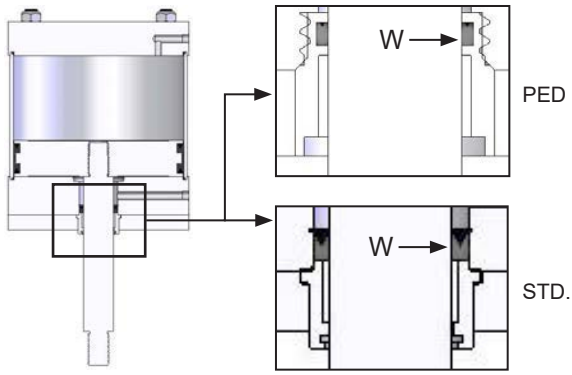


Figure 30. Reassemble the Rod Seals and Flange

4C. FOR 12” BORE CYLINDERS

a) Remove GLAND SCREWS (T). GLAND PLATE (U) and BEARING ASSEMBLY (V) will both come out revealing U-CUP ROD SEAL (W). Remove U-CUP ROD SEAL (W).

b) BEARING ASSEMBLY (V) should now be visible, and will reveal an O-RING ROD SEAL (X). Remove O-RING ROD SEAL (X).

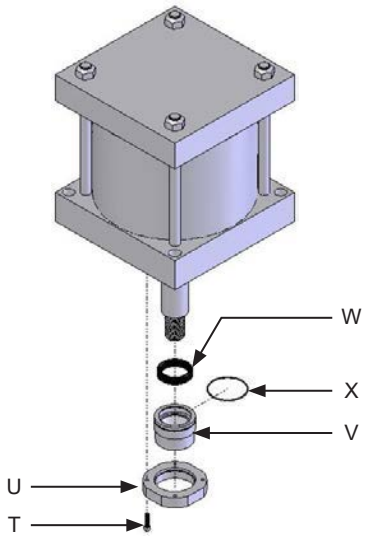


Figure 31. 12” Bore Cylinders have two Seals

FOR PED CYLINDERS:

Follow STEP 4C, a) exactly, only BUSHING ASSEMBLY (V) will be in the place of GLAND PLATE (U), GLAND SCREWS (T), and O-RING (X), as shown in figure 32.

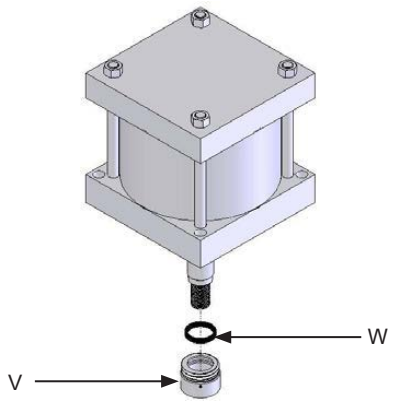


Figure 32. Removing the Bushing Assembly and Seal

b) Using a clean, lint-free cloth, apply a thin layer of STP® brand lubricant to BEARING ASSEMBLY (V), and o-ring grease to U-CUP ROD SEAL (W) and O-RING ROD SEAL (X).

c) Ensure orientation of seals are correct as pictured in figure 33. Reassemble U-CUP ROD SEAL (W), O-RING ROD SEAL (X), BEARING ASSEMBLY (V), GLAND PLATE (U), and GLAND SCREWS (T).

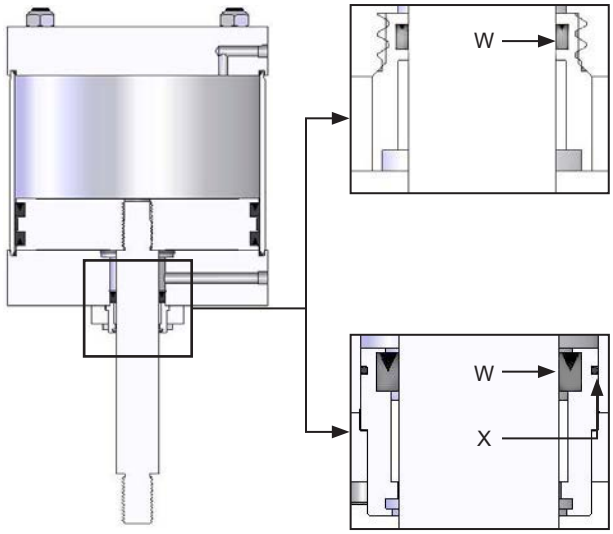


Figure 33. Close-up view with all Seals in place

Buffer™ & Vent Breather System

The pneumatic buffer system consists of a check valve installed on the non-pressurized side of the cylinder. When equipped with the check valve, the instrumentation’s exhaust is run into the non-pressurized cylinder port and out through the check valve. The check valve “traps” 1/3 psig of gas pressure in the cylinder to insure that it remains clean, dry, and free of contaminates from the surrounding air (see figure 34). The vent breather insures that when the cylinder strokes, moisture from the surrounding atmosphere is not pulled into the non pressurized side of the cylinder (see drawing #22-2542).

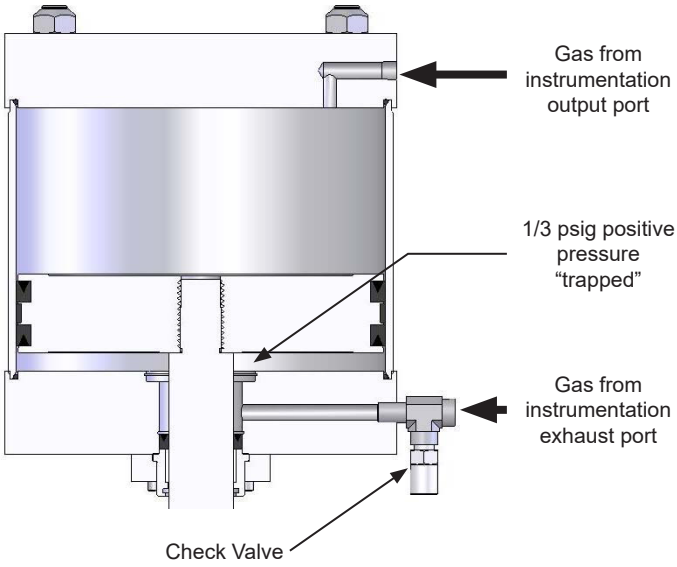


Figure 34. Check Valve Set-up

Procedure 7:

Checking Buffer System or Vent Breather

1. For pneumatic buffer system, check for leaks around the check valve and up to the cylinder port to insure the system is working.
2. For Vent Breather[1], replace the unit at the first signs of moisture inside the canister. For a working regulator, it is recommended to replace the cartridge annually. The replacement part # is 22-2542.

Note 1:

a) Check valve maintains a 1/3 psig positive pressure inside of the cylinder during steady state. This protects cylinder against moisture.

b) During startups, pressure increases in the cylinder up to 3 psig. This generates a boost, and greatly reduces the unloading time.

c) When additional accessories are used (MCV, Versa Valves, etc.) all parts MUST be connected through the check valve.

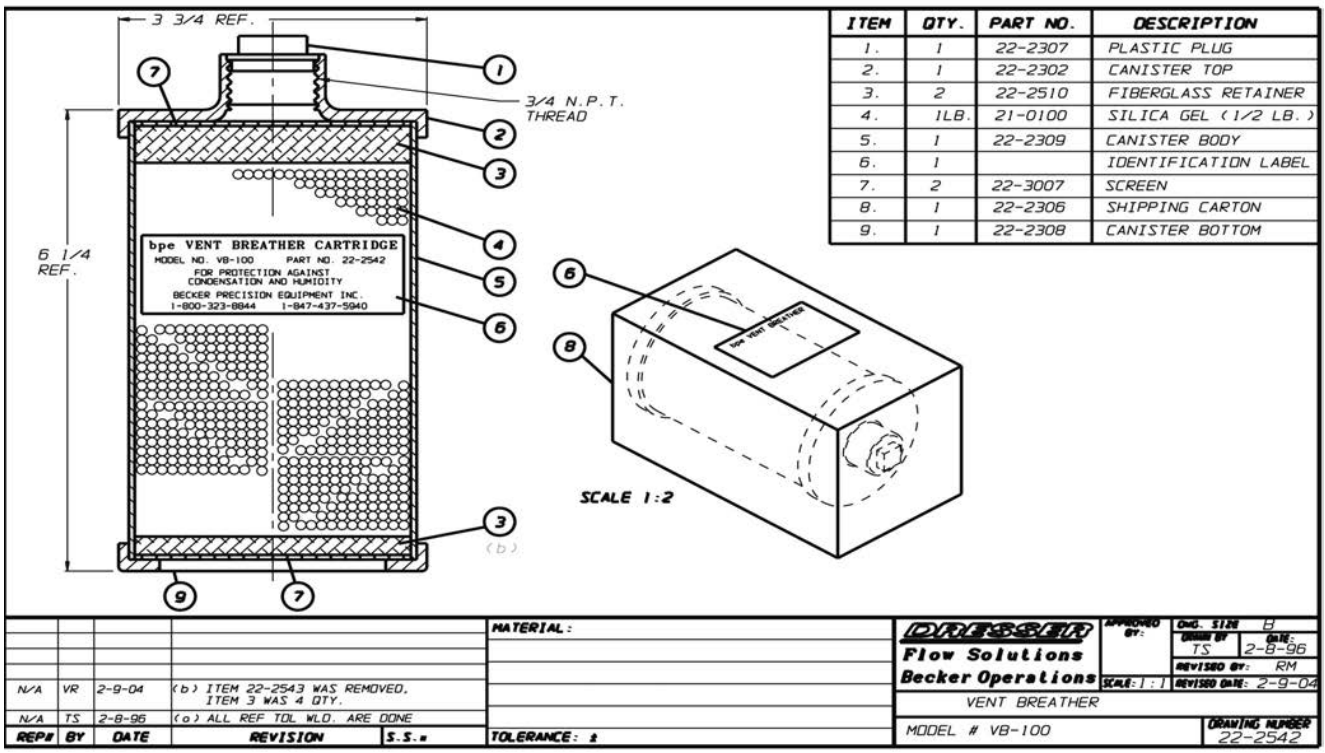


Figure 35. Internal view of Vent Breather (Part # 22-2542)

Fail Open Actuator Assembly on Globe Valve

Actuator & Globe Valve Assembly Instructions

Assembly of a Linear Spring Return Actuator onto a Globe Valve requires special attention. Although on the outside the differences are hard to spot, there are significant differences in the assembly procedure depending if you need a FAIL OPEN or FAIL CLOSED configuration.

When using the assembly procedures given in the following pages, there are some very important points to take note of to ensure proper operation of the valve. Although these issues become more clear as the reader of this manual actually begins the assembly procedure, it is helpful to keep these things in mind:

- The MAIN SPRING and SPRING FLANGE may shift during their assembly. They MUST be properly centered before completing the assembly.
- The VALVE STEM dimension can fluctuate by as much as ±1/2” according to the manufacturer. This means that the STUD EXTENSION can either be too short or too long. The MOUNTING SPACER was made to correct just this condition. It must be used either below or above the HOUSING ASSEMBLY in order correct this condition.

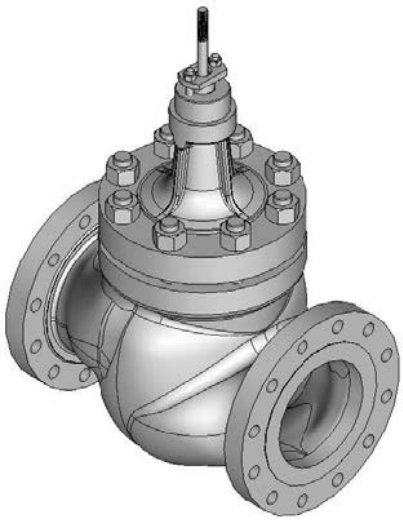


Figure 36. Globe Valve without Actuator Assembly

1. Make sure valve is fully open. If actuator is already installed on valve, remove actuator.
2. Thread ROD FLANGE (A) onto CYLINDER ROD (B) as far as it will go, but do not tighten. Make sure to follow orientation shown in figure 37.
3. Thread ROD EXTENSION (C) onto CYLINDER ROD (B) as far as it will go, but do not tighten.

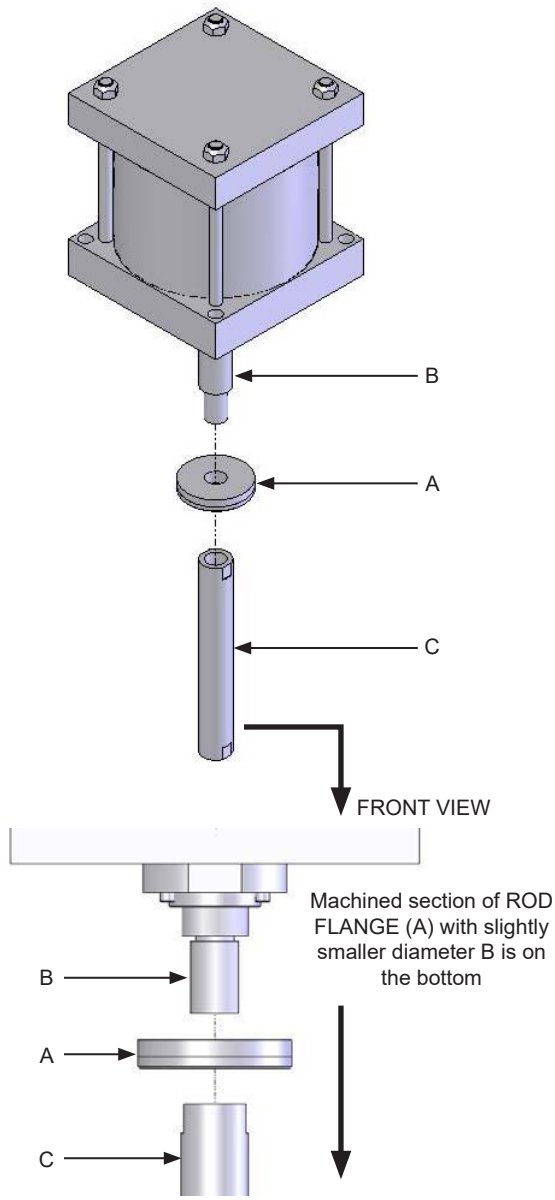


Figure 37. Initial Rod Flange Assembly

Fail Open Actuator Assembly on Globe Valve

4. Hold machined flats of ROD EXTENSION (C) in vise. Tighten faces of ROD EXTENSION (C) and ROD FLANGE (A) against each other by applying torque to ROD FLANGE (A) clockwise. After tightening there will be a small gap between the CYLINDER ROD (B) face and ROD FLANGE (A) as shown in Figure 38.

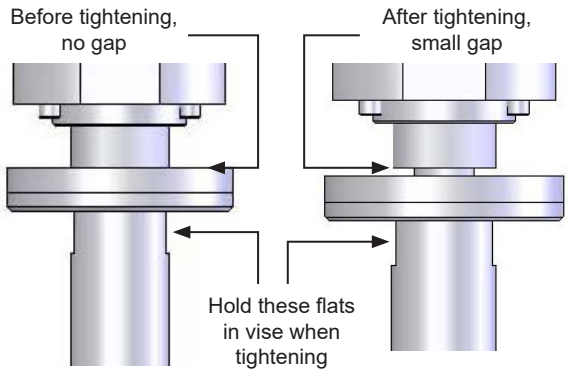


Figure 38. Appearance of components after tightening

5. Measure major diameter of STUD EXTENSION (D). Thread STUD EXTENSION (D) into ROD EXTENSION (C), but only as deep as the length of the major diameter of STUD EXTENSION (D). See figure 39, for further clarification. Thread 1STJAM NUT (E1) onto STUD EXTENSION (D). Hold flats of ROD EXTENSION (C) in vise, and tighten 1ST JAM NUT (E1).

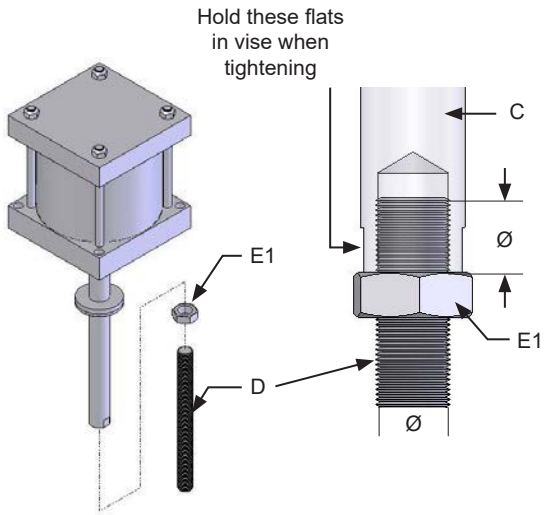


Figure 39. Engagement depth of Stud Extension (Rod Extension shown transparent for clarity)

6. Thread 2ND JAM NUT (E2), and then 3RD JAM NUT (E3) onto ROD EXTENSION (D).

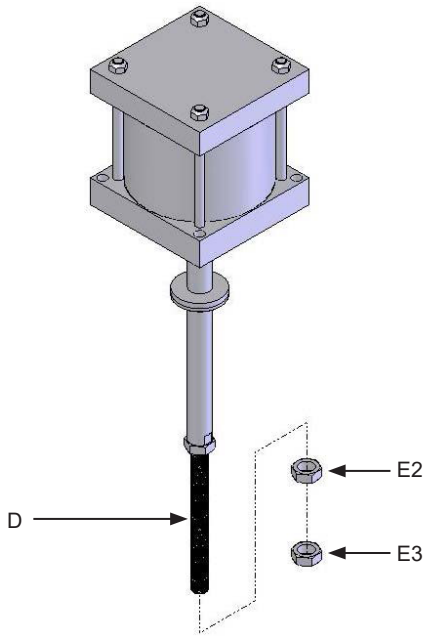


Figure 40. These two Jam Nuts are extras, and are only included in case conversion to a Fail Open Actuator is needed

7. Thread 1ST INDICATOR JAM NUT (F1) onto VALVE STEM (G). Place INDICATOR WASHER (H) onto INDICATOR JAM NUT (F). Thread 2ND INDICATOR JAM NUT (F2) onto INDICATOR WASHER (H).

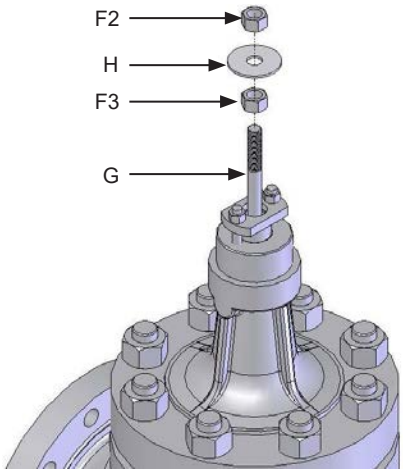


Figure 41. Thread Indicator Washers and Nuts onto Valve Stem

Fail Open Actuator Assembly on Globe Valve

8. Slide MOUNTING SPACER (I) onto body of valve. Orient HOUSING ASSEMBLY (J) such that two holes on CYLINDER MOUNTING FLANGE (K) face “forward”. Place HOUSING ASSEMBLY (J) onto MOUNTING SPACER (I). Fasten HOUSING ASSEMBLY (J) onto valve by threading on NUT HOLDER (L).

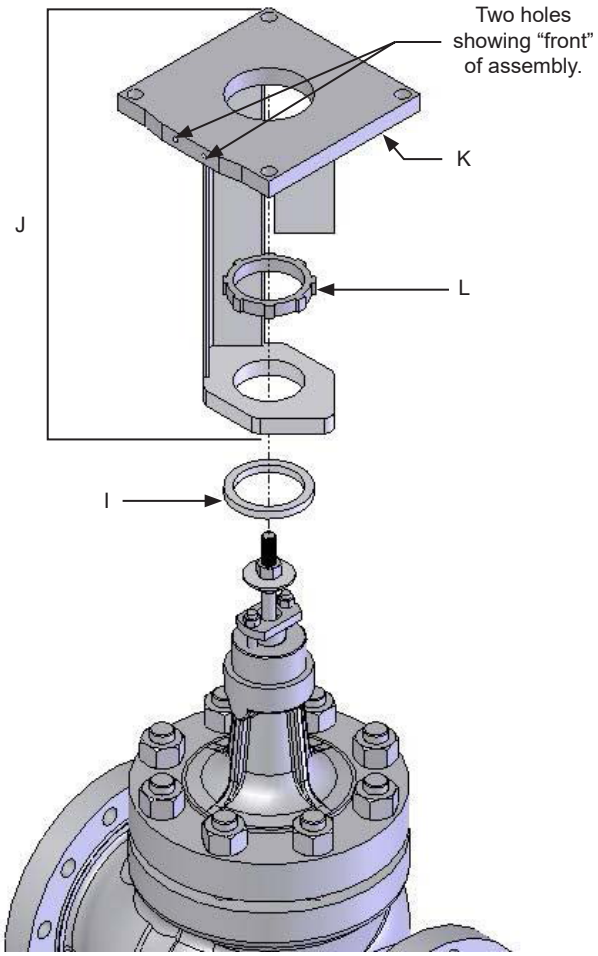


Figure 42. Placing Housing Assembly onto Valve

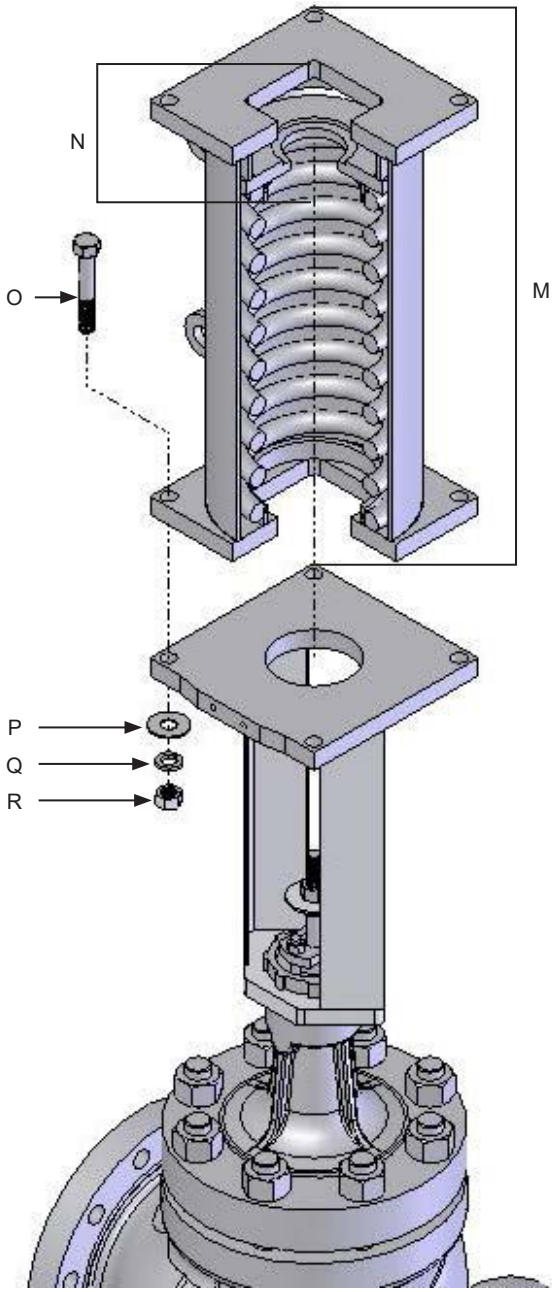


Figure 43. Mounting the Spring Cartridge Assembly

9. Orient SPRING CARTRIDGE ASSEMBLY (M) such that SPRING FLANGE (N) is on top. Mount SPRING CARTRIDGE ASSEMBLY (M) onto HOUSING ASSEMBLY (J).
10. Fasten SPRING CARTRIDGE ASSEMBLY (M) to HOUSING ASSEMBLY (J) using 4 HEX HEAD CAP SCREWS (O), 4 FLAT WASHERS (P), 4 LOCK WASHERS (Q), and 4 HEX JAM NUTS (R).
11. Orient the CYLINDER (S) such that NPT holes are in back. Mount CYLINDER (S) onto SPRING CARTRIDGE ASSEMBLY (M). Ensure ROD FLANGE (A) is fully engaged into SPRING FLANGE (N) grooves as shown in figure 45.

Fail Open Actuator Assembly on Globe Valve

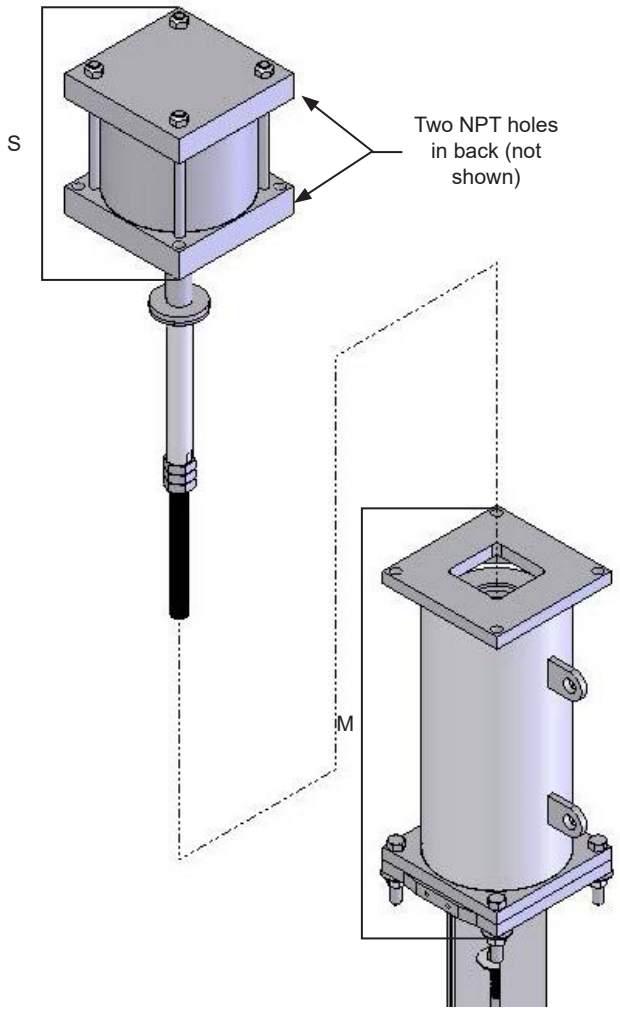


Figure 44. Mounting the Cylinder

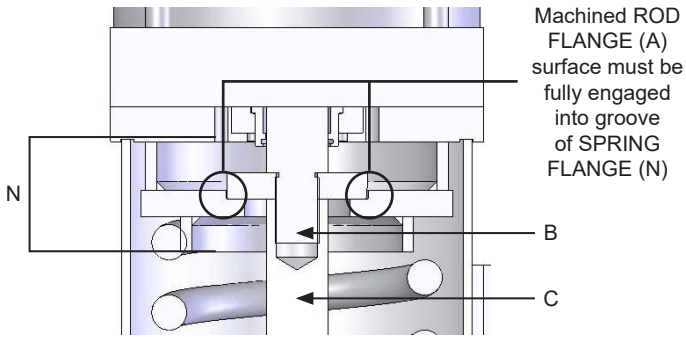


Figure 45. Ensure the Rod Flange and Spring Flange are fully engaged (Spring Cartridge cut-away for clarity)

IMPORTANT CHECKPOINT #1

After ROD FLANGE (A) is tightened down, MAIN SPRING (T) and SPRING FLANGE (N) will have shifted off the centerline. This misalignment will prohibit the entire assembly from working properly.

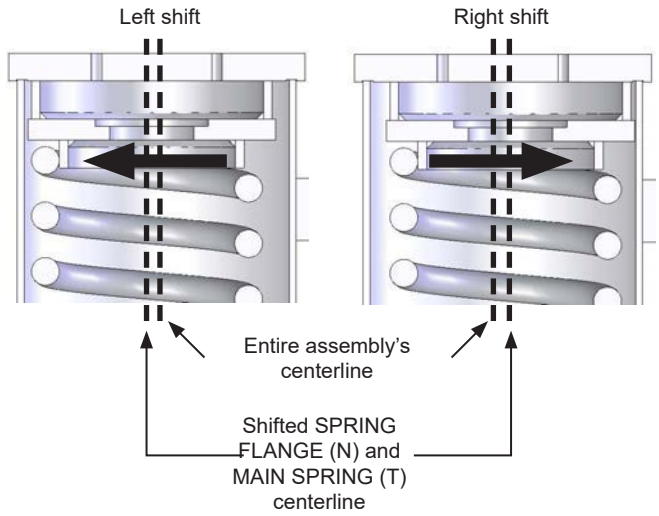


Figure 46. Cross-sectional views showing examples of Main Spring & Spring Flange shifting (certain components hidden for clarity)

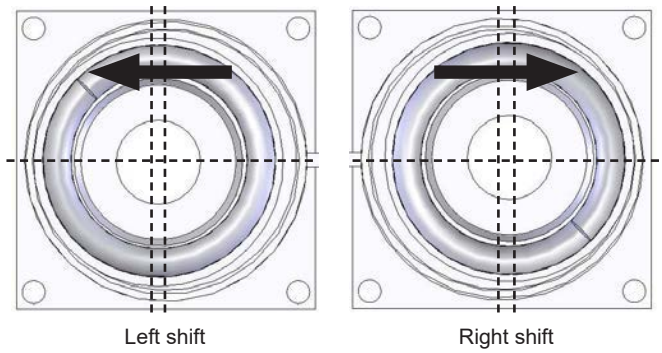


Figure 47. Top View of Main Spring & Spring Flange showing examples of Main Spring & Spring Flange shifting; in addition to right and left, springs may also shift up or down (certain components hidden for clarity)

Fail Open Actuator Assembly on Globe Valve

Before moving on to CHECK POINT #2 use available means to GENTLY re-center the MAIN SPRING (T) and SPRING FLANGE (N), FROM ALL SIDES.

IMPORTANT CHECKPOINT #2

The manufacturer of the valve stem has stated that length of VALVE STEM (G) can fluctuate as much as ± 1/2”. This indicates that, when mounted, distance between STUD EXTENSION (D) and VALVE STEM (G) may be too far apart to continue assembly.

The next step in this assembly would be to attach BACK ROD CLEVIS (U) to both VALVE STEM (G) and STUD EXTENSION (D). However if the distance between STUD EXTENSION (D) and VALVE STEM (G) is too great, BACK ROD CLEVIS (U) will not attach to both components (see figure 48).

Take BACK ROD CLEVIS (U) and compare components. If STUD EXTENSION (D) is too short, and BACK ROD CLEVIS (U) does not fit, follow procedure A - E before moving to step 12.

PROCEDURE A - E

WARNING

Only use this procedure if STUD EXTENSION (D) is too short. If STUD EXTENSION (D) is right size, move immediately to step 12 on page 27.

STEP A) Remove CYLINDER (S), SPRING CARTRIDGE (M), NUT HOLDER (L), HOUSING ASSEMBLY (J), and SPACER (I) so that essentially you are back at the beginning of step 8 on page 24.

STEP B) Slide HOUSING ASSEMBLY (J) onto valve.

STEP C) Slide SPACER (I) onto HOUSING ASSEMBLY (J), and fasten it all together using NUT HOLDER (L).

STEP D) Continue assembly by following steps 9, 10, 11, and CHECKPOINT #1.

STEP E) Ensure distance between BACK ROD CLEVIS (U) and STUD EXTENSION (D) is satisfactory then move to step 12.

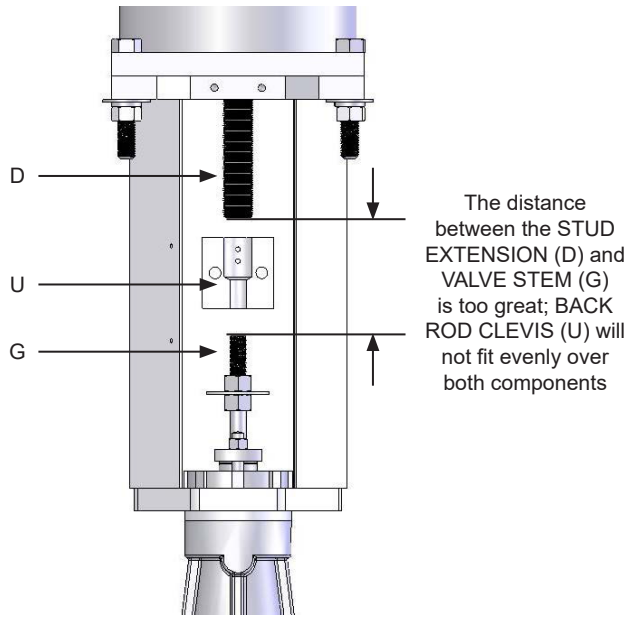


Figure 48. Example of how Valve Stem fluctuation can prevent further continuation of complete assembly (Rod Clevis cut-away to show inside hole depths)

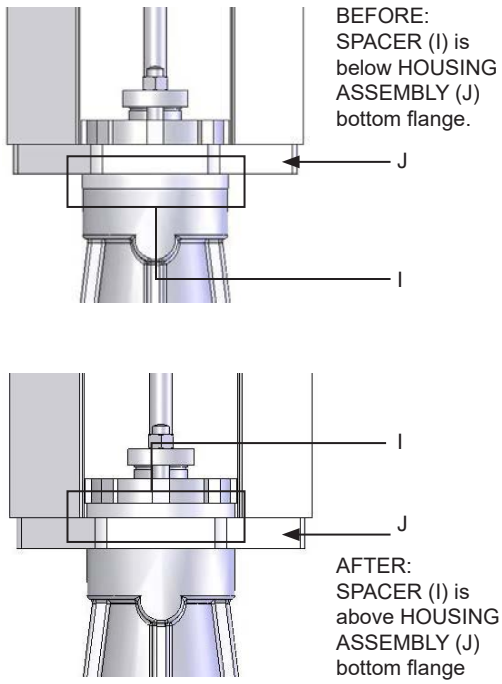


Figure 49. Repositioning Spacer to accommodate Stud Extension length.

Fail Open Actuator Assembly on Globe Valve

12. Fasten CYLINDER (S) to SPRING CARTRIDGE ASSEMBLY (M) using, 4 HEX HEAD CAP SCREWS (V), 4 LOCK WASHERS (W), and 4 HEX JAM NUTS (X).

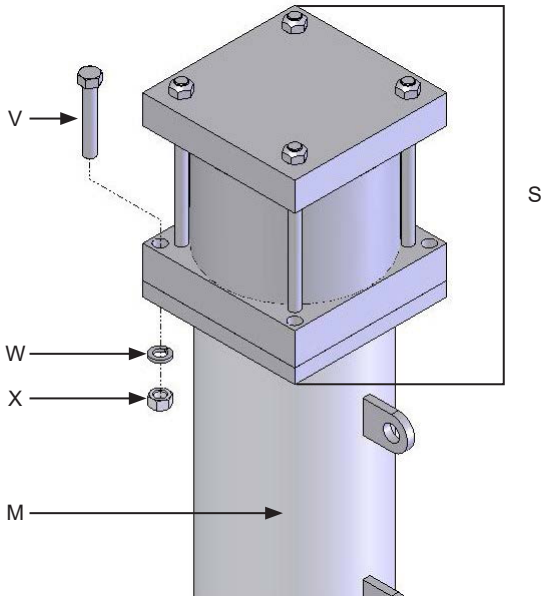


Figure 50. Fasten Cylinder to Assembly only after checking Stud Extension length

13. Insert WOOD BLOCK (Y) in between STUD EXTENSION (D), and VALVE STEM (X).

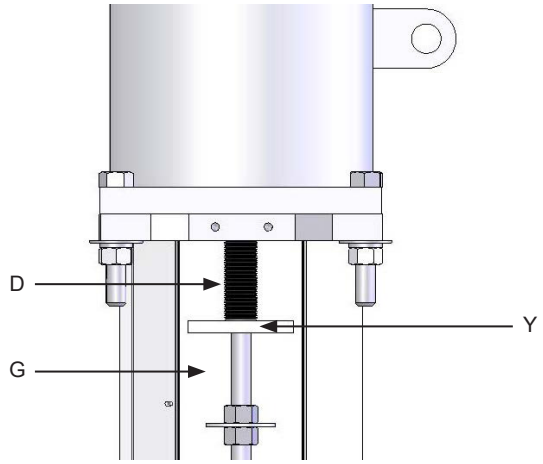


Figure 51. Insert Wooden Block in space before stroking the Valve

14. Apply full pressure to top of CYLINDER (S) to fully close valve.

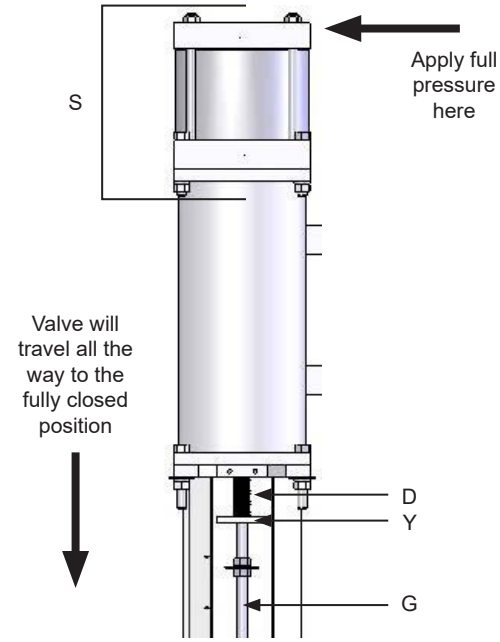


Figure 52. Pressurizing top of Cylinder to close Valve

15. Remove WOOD BLOCK (Y). Orient BACK ROD CLEVIS (U) such that it is approximately centered vertically with the gap as shown in figure 53.

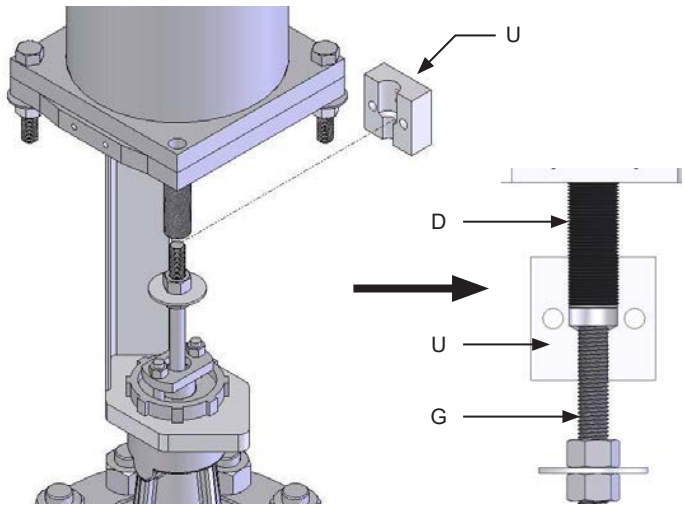


Figure 53. Center of Rod Clevis holes are approximately centered with gap between Stud Extension and Valve Stem (Section of Housing Assembly hidden for clarity)

16. Orient FRONT ROD CLEVIS (Z) such that all holes are lined up. Fasten FRONT ROD CLEVIS (Z) to BACK ROD CLEVIS (U) using 2, SOCKET HEAD CAP SCREWS (AA).

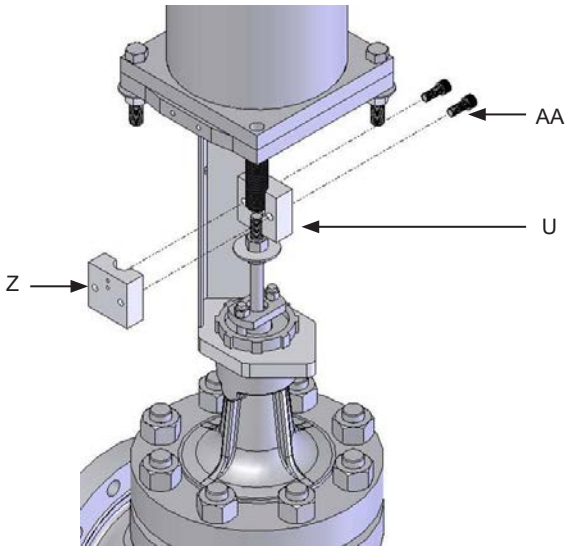


Figure 54. Finish the Rod Clevis Assembly with two Socket Head Cap Screws.

17. Relieve pressure in CYLINDER (S) so that valve fully opens.

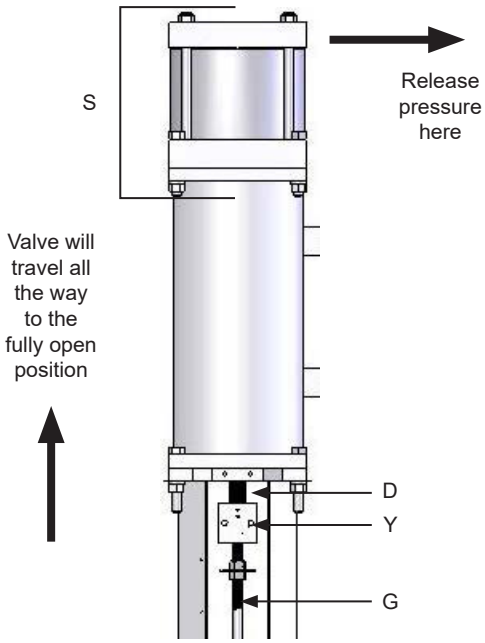


Figure 55. Releasing Cylinder pressure to open Valve

18. Loosen SOCKET HEAD CAP SCREWS (AA) from step 16. Rotate VALVE STEM (G) 1/2 to 1 full turn in clockwise direction. Re-tighten SOCKET HEAD CAP SCREWS (AA).

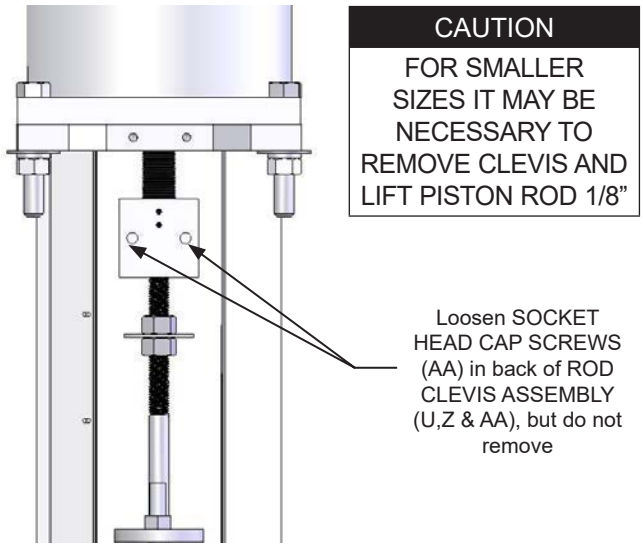


Figure 56. Rotate Valve Stem clockwise 1/2 to 1 full turn to ensure a positive pressure on Valve Seat

19. Fasten INDICATOR BAR (BB) to HOUSING ASSEMBLY (J), using 2, ROUND HEAD MACHINE SCREWS (CC), and 2, HEX HEAD JAM NUTS (DD), but tighten the NUTS (DD) hand-tight only. Finished assembly should resemble the top view of figure 57.

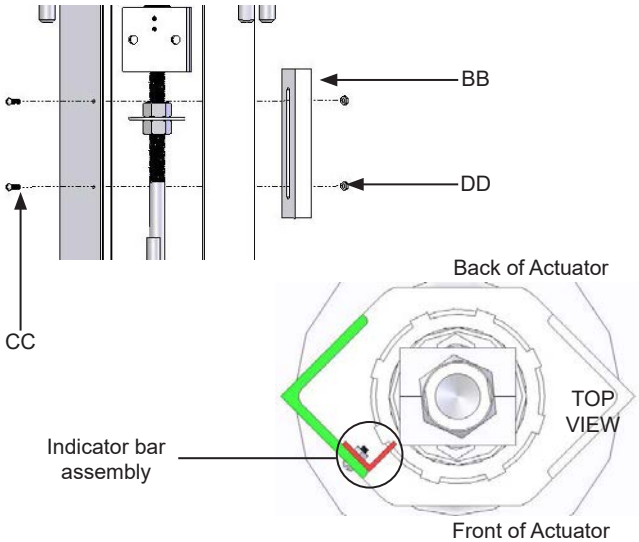


Figure 57. Indicator Bar Assembly (Cylinder and Spring Cartridge hidden for clarity)

20. Check INDICATOR (BB) and INDICATOR WASHER (H). INDICATOR WASHER (H) should be matched with a “fully open” reading on INDICATOR (BB). If readings do not match, loosen INDICATOR JAM NUTS (DD) and slide INDICATOR (BB) up or down until the correct reading is given. Secure INDICATOR (BB) in place by fully tightening INDICATOR JAM NUTS (DD) after all adjustments have been made.

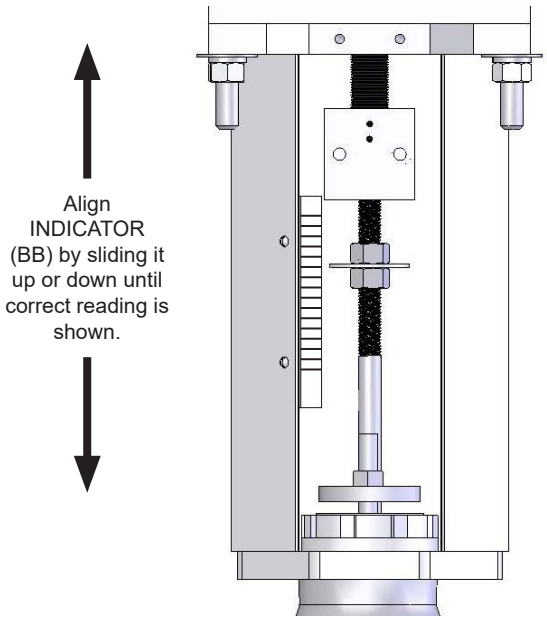


Figure 58. After adjustment, fully tighten Indicator Jam Nuts to ensure subsequent accurate readings

Fail Closed Actuator Assembly on Globe Valve

1. Make sure valve is fully closed. If actuator is installed on valve, remove actuator.
2. Thread 1ST JAM NUT (A1) onto CYLINDER ROD (B) as far as it will go, but do not tighten. Thread ROD EXTENSION (C) onto CYLINDER ROD (B) as far as it will go, but do not tighten.

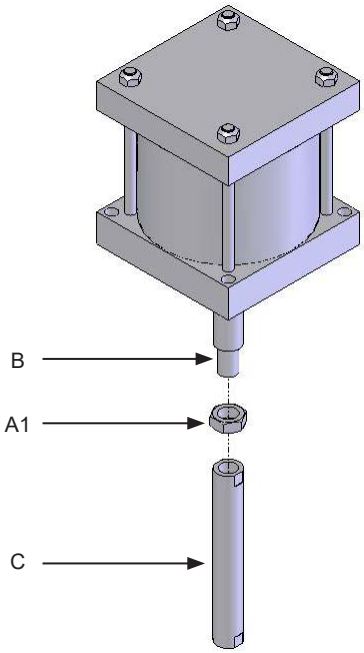


Figure 59. Fastening the Rod Extension

3. Hold ROD EXTENSION (C) in vise using machined flats. Fully tighten 1ST JAM NUT (A1) bottom face against top face of ROD EXTENSION (C). A very small gap will appear between two components when assembly is fully tight.

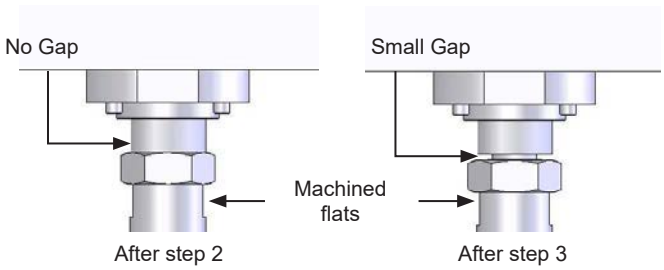


Figure 60. Close-up Front View of Nut and Extension

4. Thread STUD EXTENSION (D) into ROD EXTENSION (C). The engagement depth of STUD EXTENSION (D) into ROD EXTENSION (C) should be exactly same dimension as major diameter of STUD EXTENSION (D).
5. Thread 2ND JAM NUT (A2) onto STUD EXTENSION (D) all the way, but do not tighten.

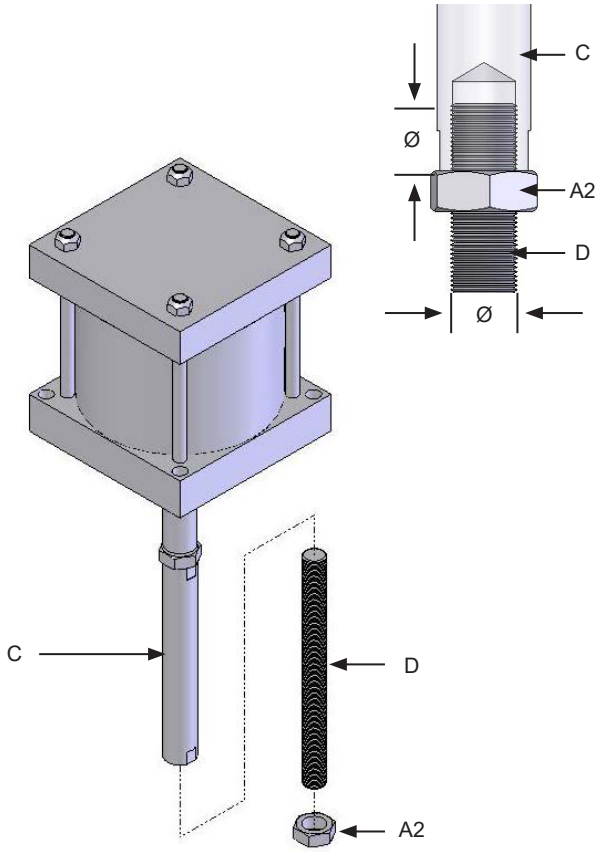


Figure 61. Section view showing depth of engagement of Stud Extension into Rod Extension

6. Hold bottom machined flats on ROD EXTENSION (C) in vise. Fully tighten 2ND JAM NUT (A2).
7. Ensure SPRING CARTRIDGE ASSEMBLY (E) is oriented such that SPRING FLANGE (F) is on bottom. Place CYLINDER (G) above SPRING CARTRIDGE ASSEMBLY (E). Fasten CYLINDER (G) to SPRING CARTRIDGE ASSEMBLY (E) using 4, HEX HEAD CAP SCREWS (H), 4 LOCKWASHERS (I) , and 4 HEX NUTS (J).

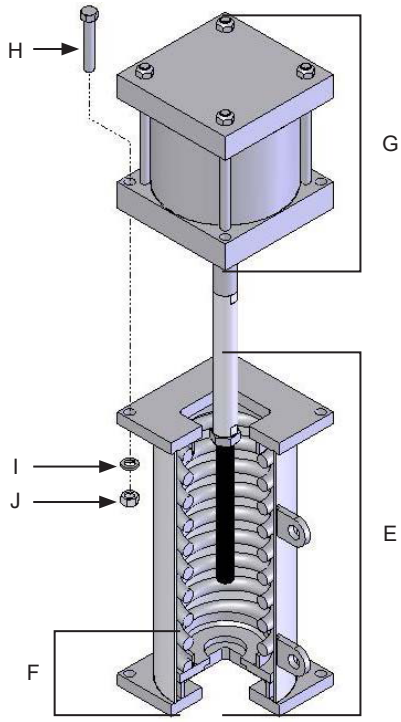


Figure 62. Fastening the Cylinder to the Spring Cartridge

8. Orient ROD FLANGE (K) such that machined side is facing upward. Thread ROD FLANGE (K) onto STUD EXTENSION (D) all the way until ROD FLANGE (K) is completely engaged into SPRING FLANGE (F).

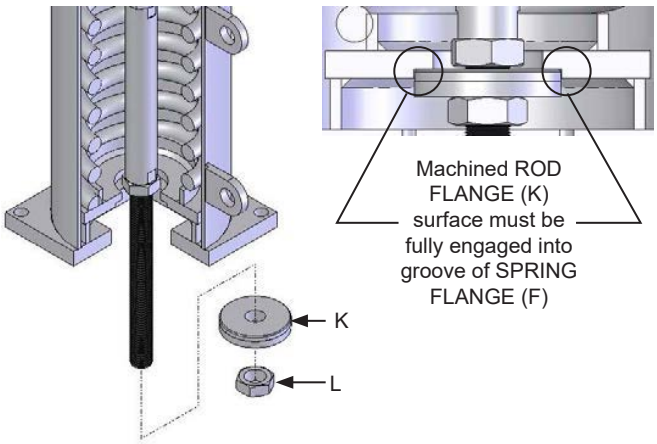


Figure 63. Threading the Rod Flange onto the Stud Extension

9. Lock ROD FLANGE (K) down by threading 3RD JAM NUT (L) onto STUD EXTENSION (D). Fully tighten 3RD JAM NUT (L) top face against bottom face of ROD FLANGE (K).

IMPORTANT CHECKPOINT #1

After ROD FLANGE (K) is tightened down, MAIN SPRING (M) and SPRING FLANGE (F) will have shifted off the centerline. This misalignment will prohibit the entire assembly from working properly.

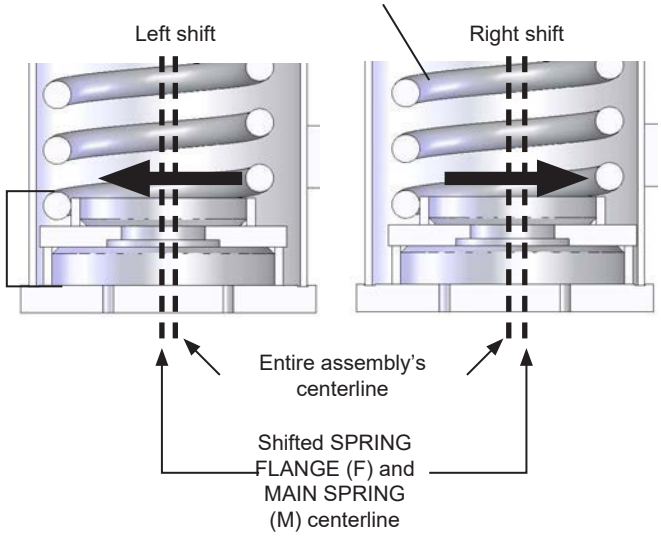


Figure 64. Cross-sectional views showing examples of Main Spring & Spring Flange shifting (certain components hidden for clarity)

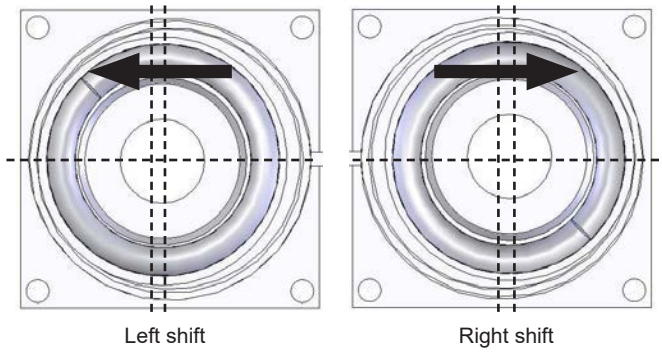


Figure 65. Top View of Main Spring & Spring Flange showing examples of Main Spring & Spring Flange shifting (certain components hidden for clarity)

Fail Closed Actuator Assembly on Globe Valve

Before moving on to STEP 10 use available means to GENTLY re-center the MAIN SPRING (M) and SPRING FLANGE (F), FROM ALL SIDES.

10. Thread 1ST INDICATOR JAM NUT (N1) onto VALVE STEM (O). Place INDICATOR WASHER (P) onto INDICATOR JAM NUT (N1). Thread 2ND INDICATOR JAM NUT (N2) onto INDICATOR WASHER (P).

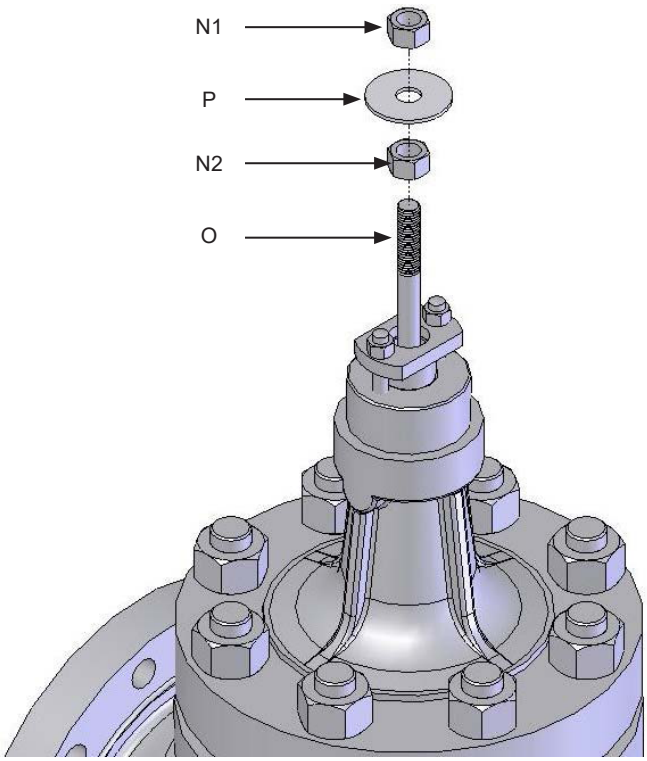


Figure 66. Thread Indicator Washers and Nuts onto Valve Stem

11. Slide MOUNTING SPACER (Q) onto body of valve. Orient HOUSING ASSEMBLY (R) such that two holes on CYLINDER MOUTNING FLANGE (S) face “forward”. Place HOUSING ASSEMBLY (R) onto MOUNTING SPACER (Q). Fasten HOUSING ASSEMBLY (R) onto valve by threading on NUT HOLDER (T).

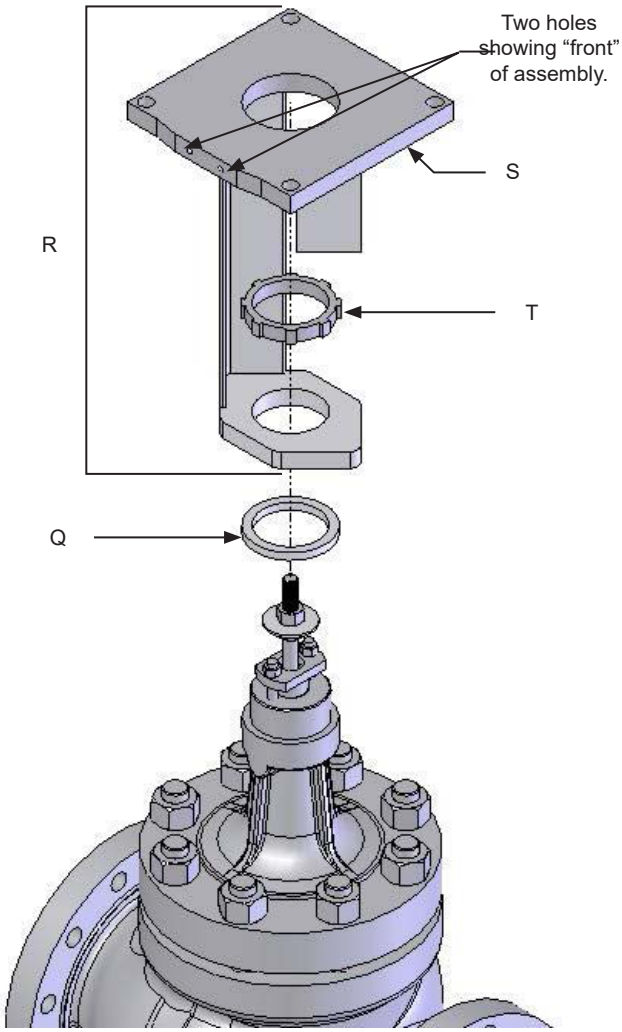


Figure 67. Placing Mounting Assembly onto Valve (Mounting Assembly cut-away to show Nut Holder)

IMPORTANT CHECK POINT #2

The manufacturer of the Valve Stem has stated that length of VALVE STEM (O) can fluctuate as much as ±1/2”. This indicates that, when mounted, distance between STUD EXTENSION (D) and VALVE STEM (O) may be too far apart to continue assembly. The next step in this assembly would be to attach BACK ROD CLEVIS (U) to both VALVE STEM (O) and STUD EXTENSION (D). However, if the distance between STUD EXTENSION (D) and VALVE STEM (O) is too great, BACK ROD CLEVIS (U) will not attach to both components (see figure 68).

Place CYLINDER (G) / SPRING CARTRIDGE ASSEMBLY (E) onto HOUSING ASSEMBLY (R). Secure entire assembly firmly but do not fasten SPRING CARTRIDGE ASSEMBLY (E) to HOUSING ASSEMBLY (R) yet.

Try to attach BACK ROD CLEVIS (U) to both STUD EXTENSION (D) and VALVE STEM (O). If BACK ROD CLEVIS (U) does not fit over both components relatively evenly, follow procedure A - D before moving to step 12.

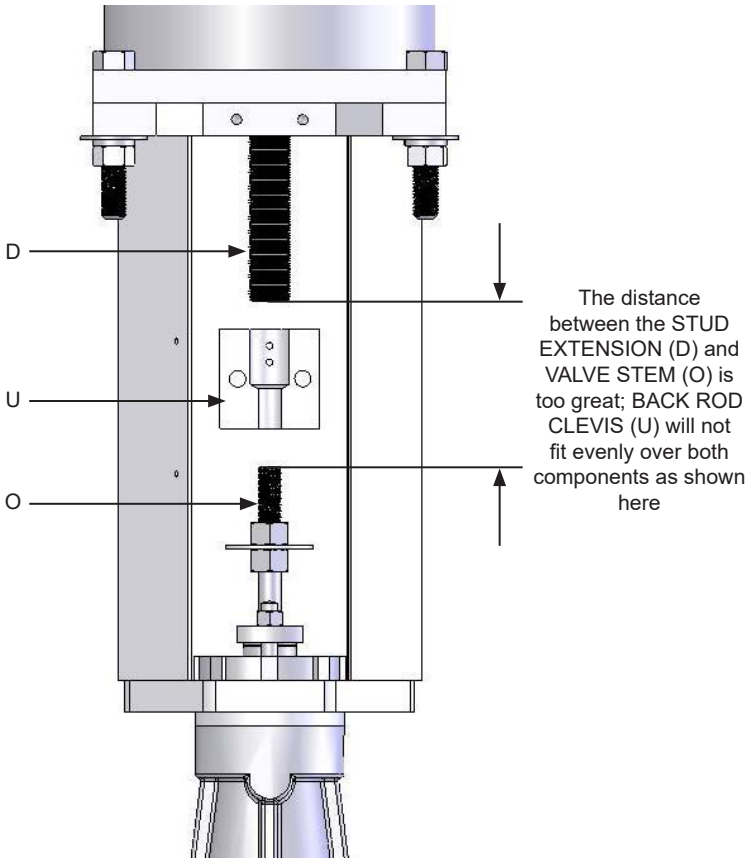


Figure 68. Example of how Valve Stem fluctuation can prevent further continuation of complete assembly (Rod Clevis cut-away to show inside hole depths)

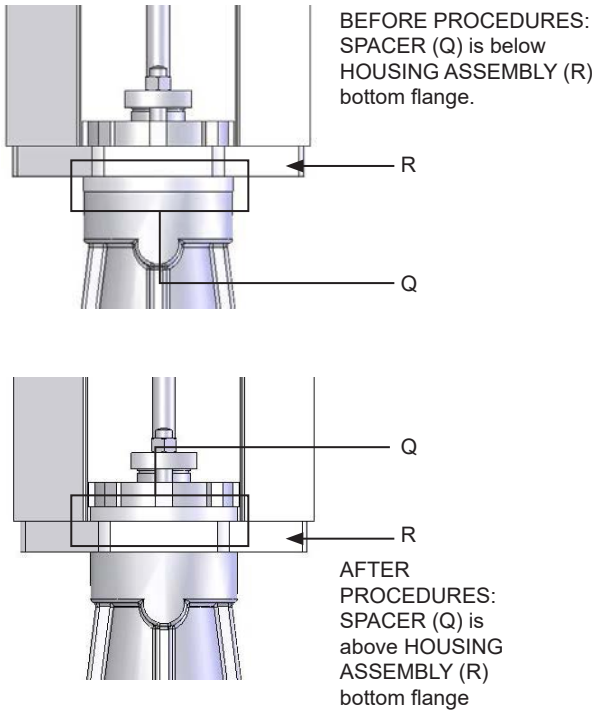


Figure 69. Repositioning Spacer to accommodate Stud Extension length.

PROCEDURE A - D

WARNING: Only use this procedure if STUD EXTENSION (D) and VALVE STEM (O) distance is too great. If components are spaced such that BACK ROD CLEVIS (U) fits relatively evenly over both components, move immediately to step 12 on page 34.

STEP A) Remove CYLINDER (G) / SPRING CARTRIDGE ASSEMBLY (E) , NUT HOLDER (T), HOUSING ASSEMBLY (R), and SPACER (Q) so that essentially you are back at the beginning of step 11 on page 32.

STEP B) Slide HOUSING ASSEMBLY (R) back onto valve.

STEP C) Slide SPACER (Q) onto HOUSING ASSEMBLY (R), and fasten it all together using NUT HOLDER (T).

STEP D) Re-mount CYLINDER (G) / SPRING CARTRIDGE ASSEMBLY (E) and ensure distance between BACK ROD CLEVIS (U) and STUD EXTENSION (D) is satisfactory. Move to step 12.

12. Fasten SPRING CARTRIDGE ASSEMBLY (E) to HOUSING ASSEMBLY (R) using 4 HEX HEAD CAP SCREWS (V), 4 FLAT WASHERS (W), 4 LOCK WASHERS (X), and 4 HEX JAM NUTS (Y).

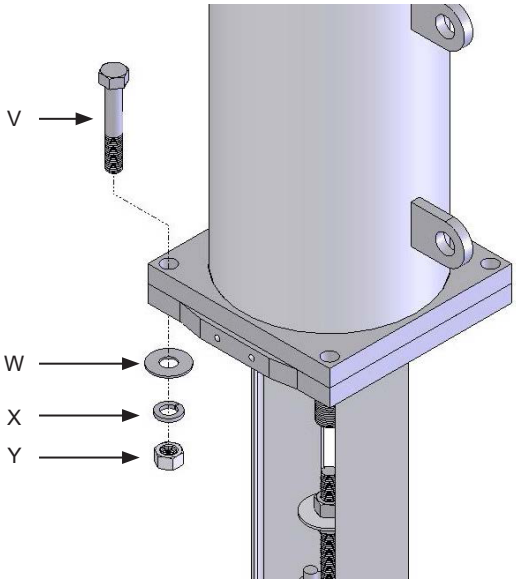


Figure 70. Fastening Spring Cartridge Assembly to Housing Assembly

13. Orient BACK ROD CLEVIS (U) such that holes are approximately centered horizontally with gap as shown in figure 71.

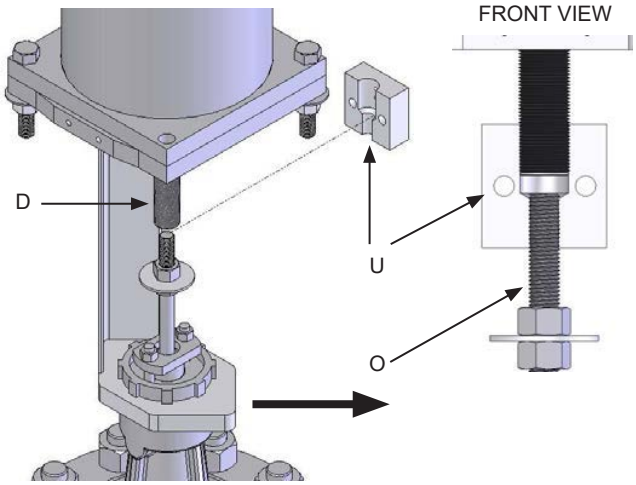


Figure 71. Center of Rod Clevis holes are approximately centered with gap between Stud Extension and Valve Stem (Section of Housing Assembly hidden for clarity)

14. Orient FRONT ROD CLEVIS (Z) such that all holes are lined up. Fasten FRONT ROD CLEVIS (Z) to BACK ROD CLEVIS (U) using 2, SOCKET HEAD CAP SCREWS (AA).

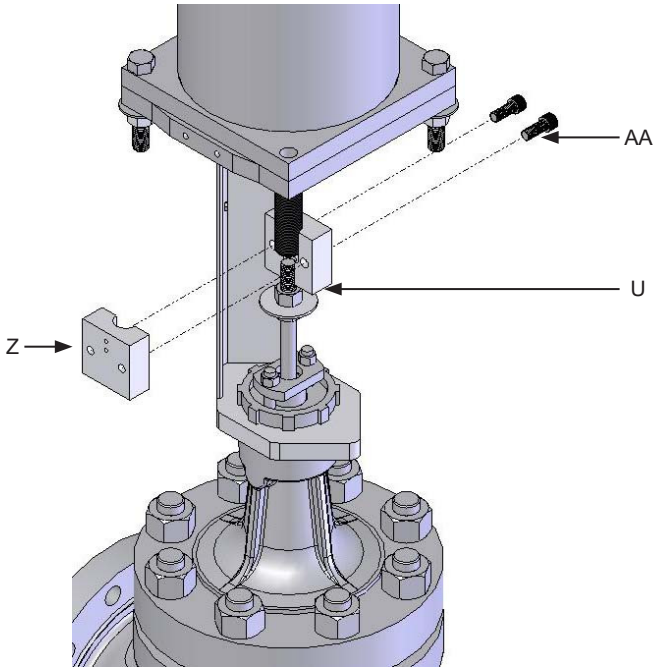


Figure 72. Finishing the Rod Clevis Assembly (Section of Housing Assembly hidden for clarity)

15. Fasten INDICATOR BAR (BB) to HOUSING ASSEMBLY (R) using 2, ROUND HEAD MACHINE SCREWS (CC) and 2, HEX HEAD JAM NUTS (DD). Tighten the JAM NUTS (DD) hand tight only. Finished assembly should resemble figure 74.

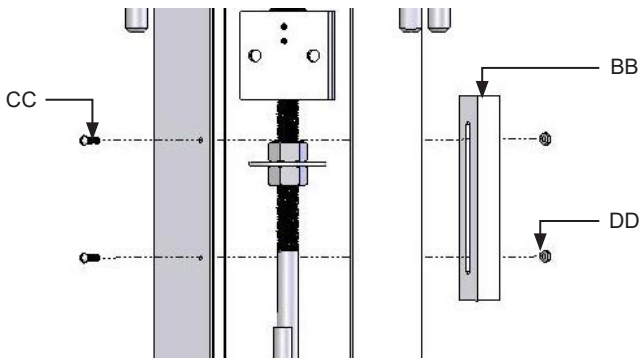


Figure 73. Front View of Indicator Bar Assembly

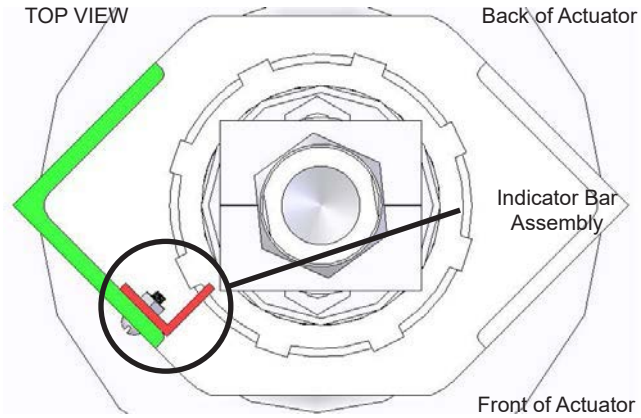


Figure 74. Top View of Indicator Bar Assembly (Cylinder and Spring Cartridge hidden for clarity)

16. Check INDICATOR (AA) and INDICATOR WASHER (P). INDICATOR WASHER (P) should be matched with a “fully closed” reading on INDICATOR (AA). If readings do not match, loosen INDICATOR JAM NUTS (DD) and slide INDICATOR (AA) up or down until the correct reading is given. Secure INDICATOR (AA) in place by fully tightening INDICATOR JAM NUTS (DD) after all adjustments have been made.

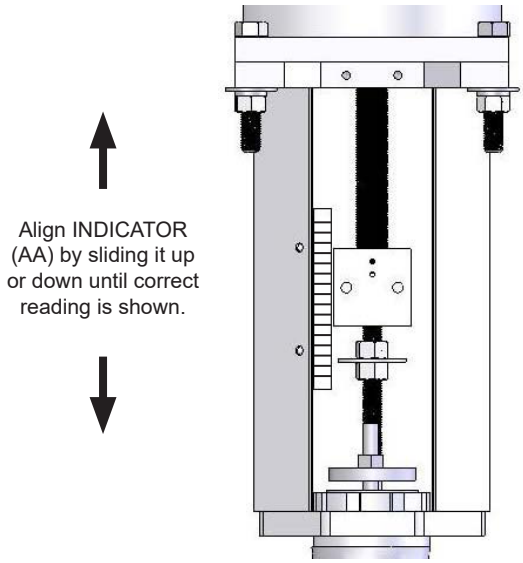


Figure 75. After adjustment, fully tighten Indicator Jam Nuts to ensure accurate readings

NOTES

NOTES

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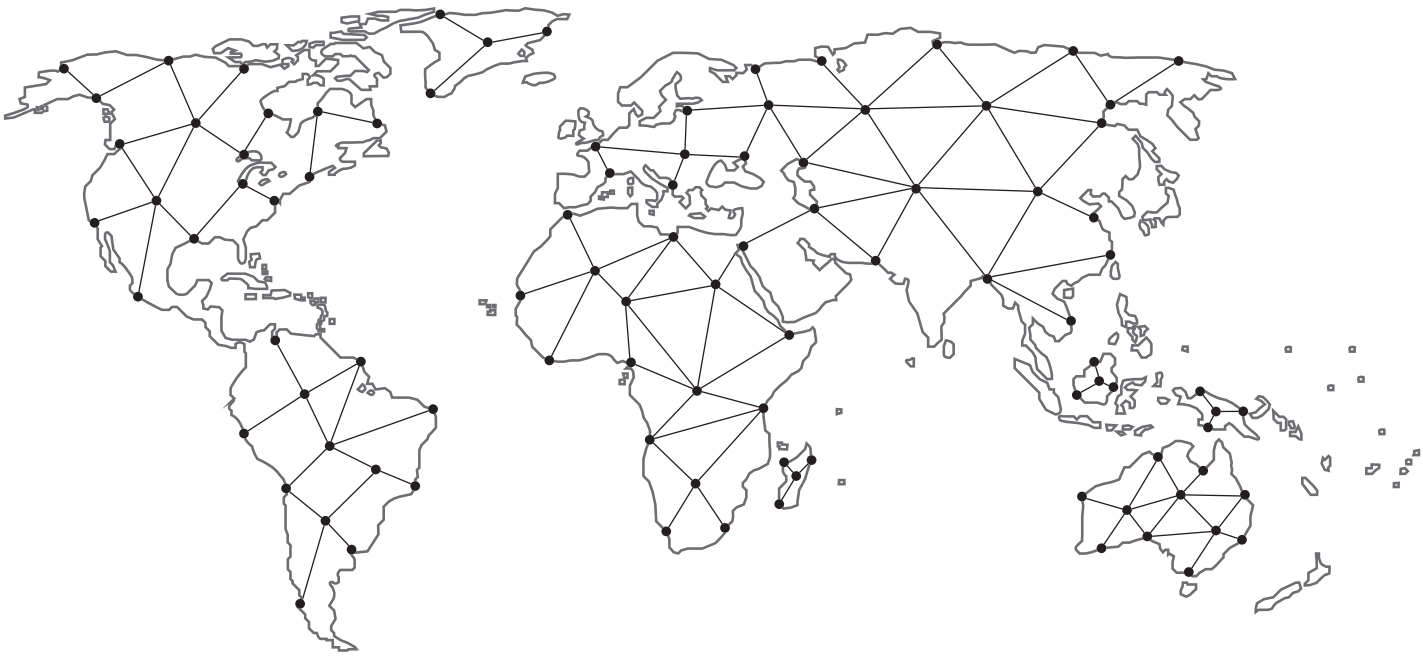
valves.bakerhughes.com/contact-us



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