

Bettis RGS Q-Series Spring-Return Actuators

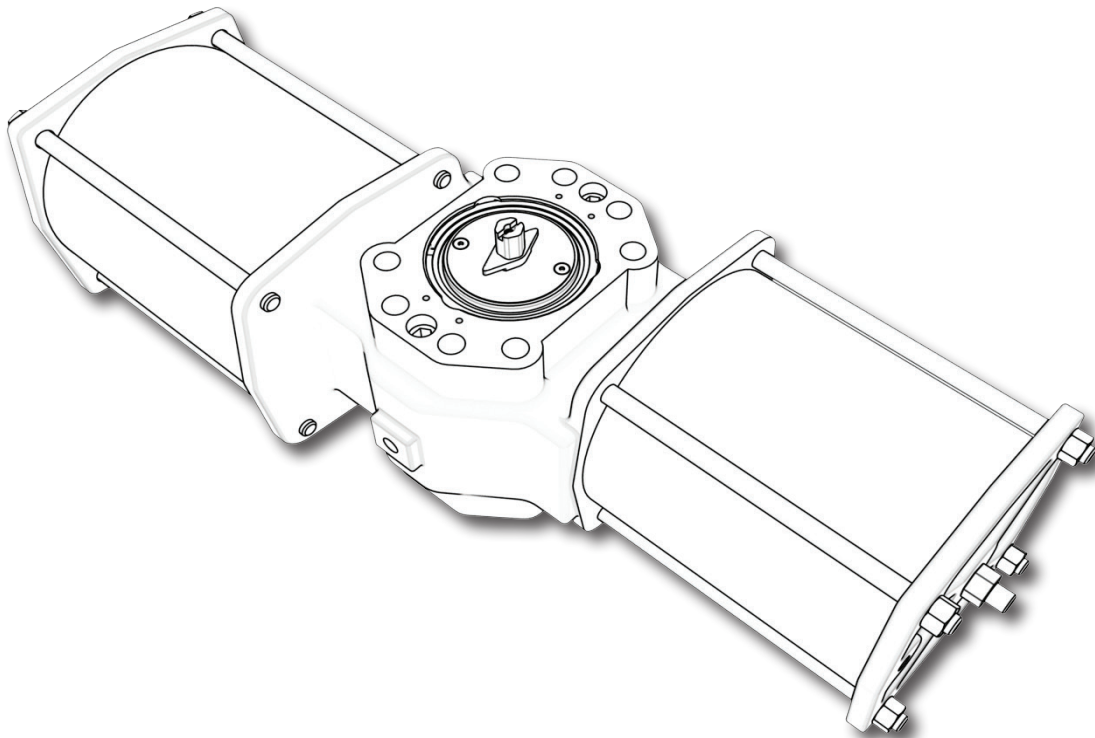


Table of Contents

Section 1: Overview	1
Section 2: Installation	2
2.1 Valve Attachment	3
2.2 Accessory Mounting	4
2.3 Piping and Operation.....	4
2.4 Travel Adjustment.....	7
Section 3: Troubleshooting	10
Section 4: Maintenance.....	11
4.1 Periodic Maintenance Schedule	11
4.2 Lubrication.....	11
4.3 Maintenance Kit.....	13
4.4 Piston Seal Replacement.....	13
4.5 Body Maintenance	16
Appendix A:	23
A.1 Dual Cylinder Model	23
A.2 Single Cylinder Model	25

Section 1: Overview

NOTE:

All activities must be carried out in order to ensure proper actuator operation. Always read all instructions before beginning maintenance.

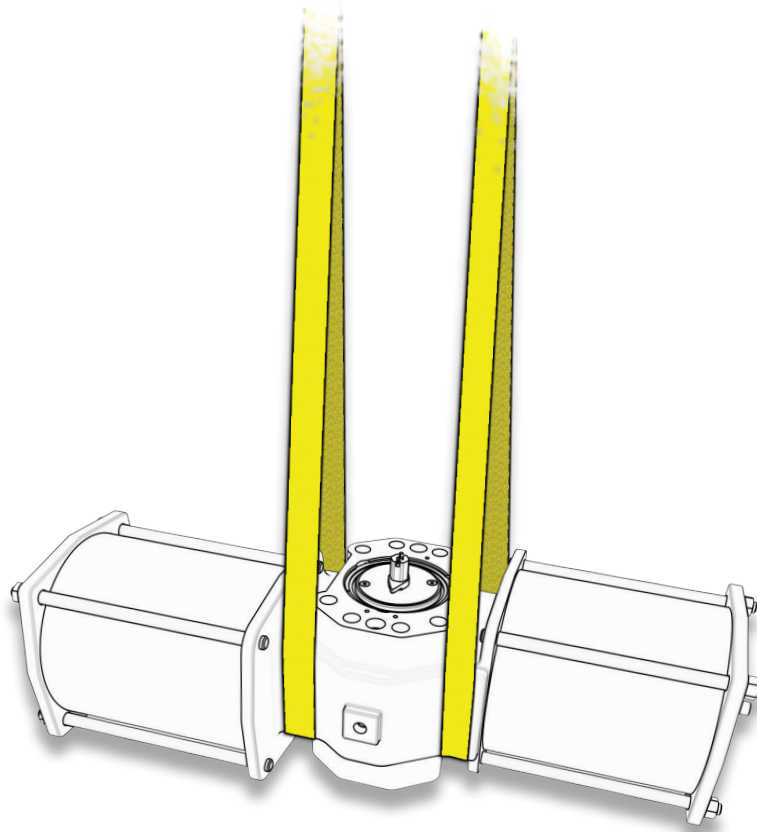
Bettis RGS Q-Series actuators are composed of two or three basic sub-assemblies, one or two force modules and a torque module. The force module contains the piston and rack which provide linear motion. The torque module contains the gear which converts the force modules' linear motion into torque and operates the valve.

Every actuator assembled by Bettis is tested prior to shipment to our customers. Order specific documentation may be available upon request.

Section 2: Installation

Bettis actuators may be mounted in any position/orientation. If necessary, lift the actuator with straps placed inside the framework of the body. Never lift the actuator by the cylinders, tie rods, or travel stops. Lifting the actuator with the valve attached is not generally recommended.

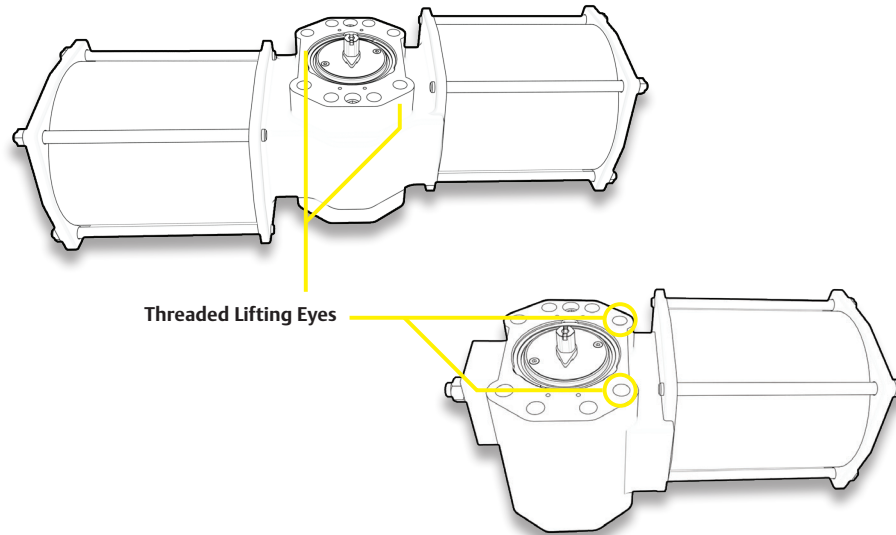
Figure 1



Threaded Lifting Eyes

Lifting eyes may be threaded into the body section and be used to lift the actuator.

Figure 2



2.1 Valve Attachment

NOTE:

Prior to mounting the actuator, verify alignment of coupler and shaft to ensure that the valve will move to correct position.

Ensure the actuator is in the same position as the valve. It may be necessary to stroke the actuator to determine the correct mounting orientation. Attach the actuator to the valve using the proper bracket and coupler, or with a Bettis Universal Mounting Plate (UMP) if provided. Using all mounting holes indicated on Bettis dimensional drawings, tighten all fasteners hand tight, then torque the fasteners to the corresponding value on the table below.

Table 1.

	Thread Pattern	Ft-Lbs	Nm
Q203/204/205	M6	7	9
	M8	16	22
Q207/210	M10	32	43
Q212/214	M20	235	318

2.2 Accessory Mounting

As a standard, Bettis RGS Q-Series actuators are provided with NAMUR slotted accessory mounting geometry. When installing accessories, such as switch boxes or positioners, tighten accessory mounting bolts hand tight, stroke the actuator three times to ensure proper alignment, then tighten the accessory mounting bolts to the proper torque. Check the dimensional drawing or associated product data sheet for exact dimensions.

2.3 Piping and Operation

The operation of a Bettis RGS Q-Series Spring-Return (SR) actuator is comparable to any spring-return rack and pinion actuator.

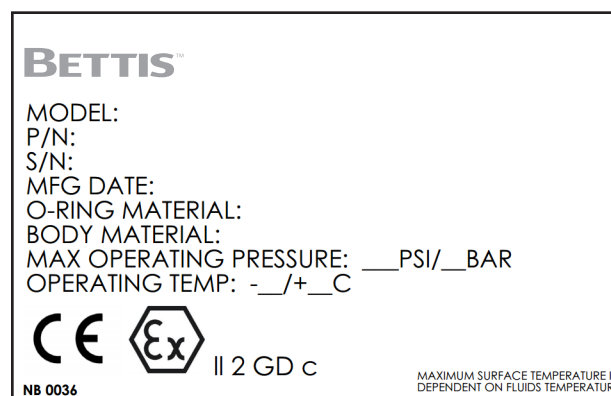
Instrument air, water, and other power gases and fluids may be used to cycle the actuator so long as construction materials were chosen accordingly during assembly and maximum allowable pressure is not exceeded. Air driven stainless-steel actuators with stainless-steel or composite cylinders are not harmed by wet air (so long as freezing does not occur). Aluminum and chrome-plated steel cylinders may be harmed over time by the presence of water.

⚠ WARNING: DO NOT EXCEED PRESSURE RATING

Exceeding the stated maximum pressure may result in damage to equipment and danger to personnel including severe injury or death. Consult the actuator label for operating limits. If an actuator label is missing, contact Bettis to request a replacement.

⚠ WARNING: DO NOT EXCEED TEMPERATURE RATING

Operating outside of the minimum and maximum temperature range may result in damage to equipment and danger to personnel including severe injury or death. Consult the actuator label for operating limits. If an actuator label is missing, contact Bettis to request a replacement. An example of an actuator label is provided below for your reference.



NOTE:

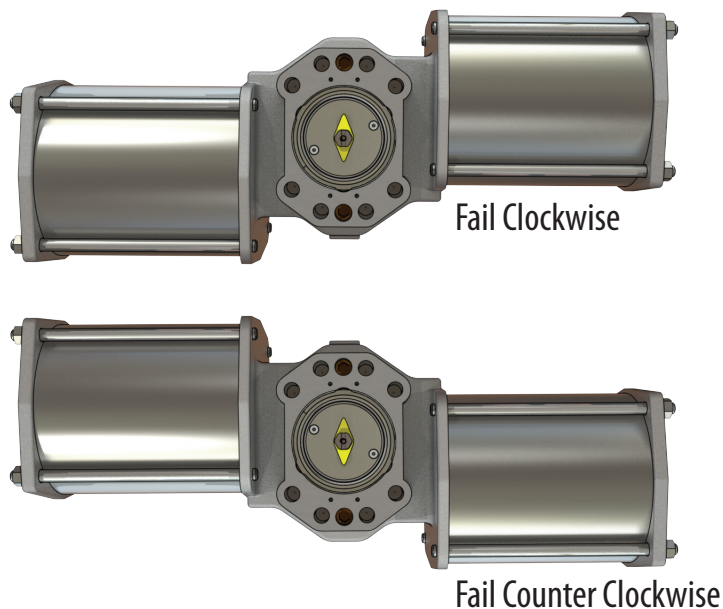
CE marking indicates product conforms to the requirements of applicable directives as listed on the actuator label.

All Bettis actuators are shipped in the fail clockwise (Left-Hand) orientation unless ordered as fail counterclockwise (Right-Hand). The orientation may be reversed in the field by moving all accessories to the opposite side of the shaft and turning the actuator top-side down.

Spring-Return (Left-Hand): pressure on the end cap ports pushes the pistons inward and causes counterclockwise rotation. Springs push the pistons outward resulting in a clockwise rotation.

Spring-Return (Right-Hand): pressure on the end cap ports pushes the pistons inward and causes clockwise rotation. Springs push the pistons outward resulting in a counterclockwise rotation.

Figure 3



Piping Guidelines:

- For dual cylinder models (205, 210, and 214), both end cap pressure ports (P1 and P2) must be utilized for proper operation.
- P1 and P2 are typically connected together and powered by a single air pathway.
- For single cylinder models (203, 204, 207, and 212), P2 does not exist.
- P3 is a breather port on the body and should be fitted with a strainer to prevent contaminants from entering the body.

Figure 4

205SR, 210SR, 214SR

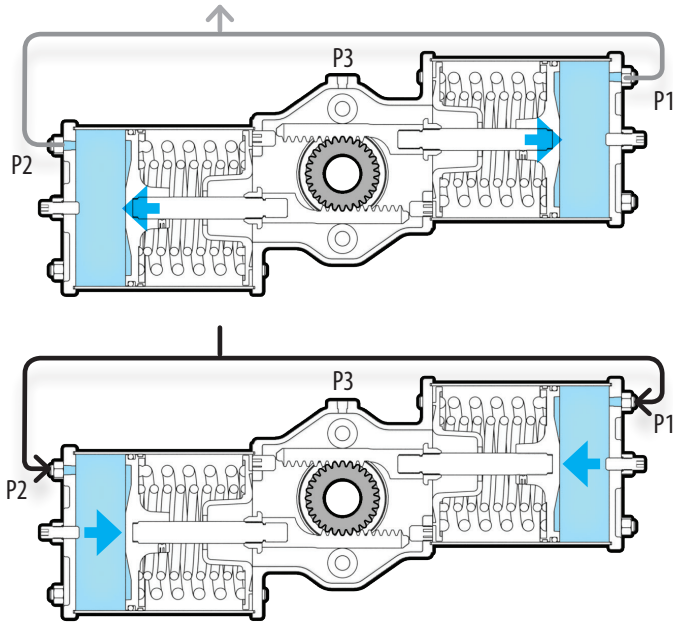
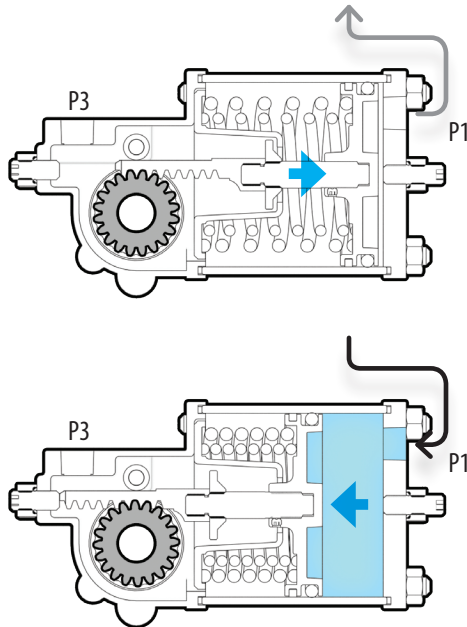


Figure 5

203SR, 204SR, 207SR, 212SR



2.4 Travel Adjustment

The following instructions are for fail clockwise (Left-Hand) orientated actuators. For non-standard models, clockwise and counterclockwise motion will be the inverse of what is described below. Check the actuator model and orientation before adjusting the Travel Stops.

Figure 6

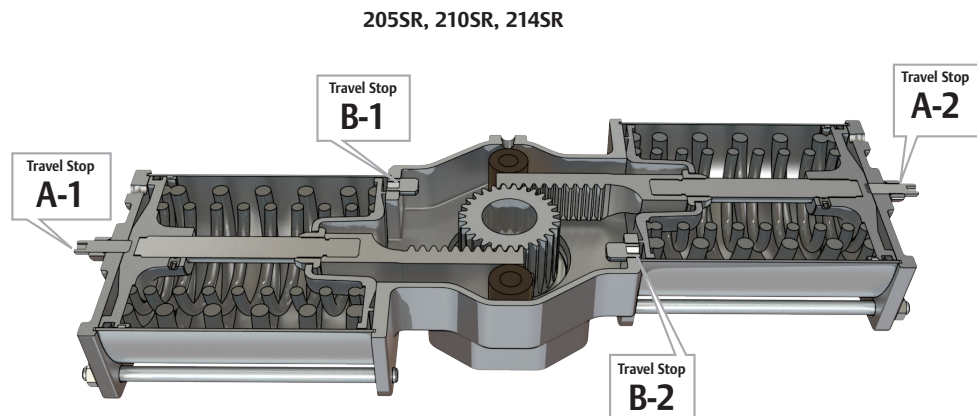
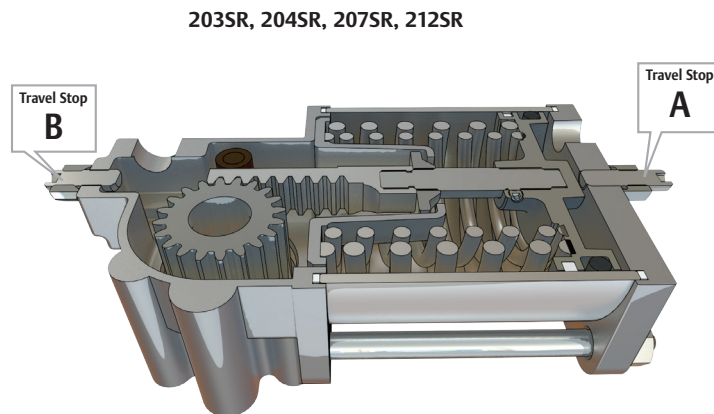


Figure 7



Set Clockwise Rotation (Travel Stop(s) A)

1. Relieve all pressure from the actuator.
2. Loosen Travel Stop Nut(s) on Travel Stop(s) A. Be careful not to misplace the travel stop O-ring(s).
3. Ensure actuator lockout (if provided) is disengaged.*

Single Cylinder Actuators:

- a. Apply sufficient pressure to P1 to relieve the pressure of the piston on Travel Stop A.
- b. Adjust Travel Stop A until travel is set to the desired position. It will be necessary to exhaust pressure between each adjustment to determine the final travel position of the actuator.
- c. With all pressure exhausted, tighten the travel stop nut until it comes in contact with the end cap, then tighten and additional quarter turn.

Dual Cylinder Actuators:

- a. Apply sufficient pressure to P1 and P2 to relieve the pressure of the pistons on Travel Stops A.
- b. Unthread Travel Stop A-2 four to five full turns.
- c. Adjust Travel Stop A-1 until travel is set to the desired position. It will be necessary to exhaust all pressure between each adjustment to determine the final travel position of the actuator.
- d. With pressure exhausted, thread Travel Stop A-2 in until it is in firm contact with the piston.
- e. With pressure still exhausted, tighten both travel stop nut until they are in contact with the end cap, then tighten and additional quarter turn.

** Clockwise rotation of the travel stop will shorten actuator stroke (stroke < 90°), counterclockwise rotation will lengthen actuator stroke (stroke > 90°).*

Set Counterclockwise Rotation (Travel Stop(s) B)

1. Relieve all pressure from the actuator.
2. Ensure actuator lockout (if provided) is disengaged.*

Single Cylinder Actuators:

- a. Loosen the travel stop nut on Travel Stop B. Be careful not to misplace the travel stop O-ring.
- b. Adjust Travel Stop B until the stroke is set to the desired position. It may be necessary to stroke the actuator in the counterclockwise direction between each adjustment. This can be accomplished by applying pressure to P1.
- c. With pressure applied to P1, tighten the travel stop nut until it comes in contact with the body.

Dual Cylinder Actuators:

If counterclockwise travel adjustment on a dual cylinder actuator is required in the field, it is recommended the user accomplish this via bracket motion followed by resetting Travel Stops A via the directions listed above. If this cannot be accomplished, follow the steps below.

⚠ WARNING: DEPRESSURIZE COMPONENTS PROPERLY

Do not remove/loosen tie rod nuts unless cylinder is fully depressurized. Components may exit the actuator dangerously if disassembly is attempted under pressure.

- a. Follow Section 4.4, Steps 1 to 3.
- b. Adjust each Travel Stop B the appropriate amount. Use the table below as a guide as travel cannot be checked without fully assembling the actuator.#

Table 2.

Model	Degrees of Travel Per 1/4 Turn
Q205	1.4
Q210	1.1
Q214	0.8

- c. Measure the height of both Travel Stops B protruding through the body and ensure that they are equal.
- d. Follow Section 4.5, Steps 16 to 20.

* Clockwise rotation of the travel stop will shorten actuator stroke (stroke < 90°), counterclockwise rotation will lengthen actuator stroke (stroke > 90°).

These travel stops were installed with thread locker and may require an application of heat before they may be adjusted. It is recommended the user reapply thread locker after their adjustment.

Section 3: Troubleshooting

Table 3.

ISSUE	CAUSE	SOLUTION
Irregular or Stuttering Stroke	Supply pressure too low	Verify operating pressure is correct
	Worn internal components	See Section 4.4 to 4.5
	Damaged valve	Consult valve manufacturer
	Broken Springs	Replace Springpaq™
Leakage	Damaged cylinder seals	See Section 4.4
	Damaged shaft seals	See Section 4.5
	Travel stop nuts not tightened	Tighten travel stop nut
	Piston O-ring damaged	See Section 4.4
Improper Travel	Travel stops not set correctly	See Section 2.4
	Internal cylinder contaminants preventing normal stroke	See Section 4.4 to 4.5
	Damaged valve	Consult valve manufacturer
	Insufficient torque/Broken Springs	Upgrade to a larger actuator, increase supply pressure
	Broken Springs	Replace Springpaq™
Operating/Stroking too slowly	Supply medium pressure too low	Verify operating pressure will produce torque needed to operate valve correctly
	Internal cylinder contaminants preventing normal stroke	See Section 4.4 to 4.5
	Damaged sticky valve	Consult valve manufacturer
	Damaged seals or O-rings causing loss of pressure	See Section 4.4 to 4.5
	Damaged supply lines	Inspect supply lines replace as needed
	Exhaust port on body of actuator is blocked	Inspect port, clean as needed
	Limitation of accessories or port size	Upgrade accessories or port size

Section 4: Maintenance

4.1 Periodic Maintenance Schedule

General service actuators do not require periodic maintenance. Severe service actuators may require periodic maintenance based on operating conditions. Severe service may include but is not limited to high speed, high cycle, highly corrosive, explosive atmosphere, and others. Special applications may require individual maintenance schedules. Contact Bettis for help developing a maintenance schedule for your application.

NOTE:

This product is only intended for use in large-scale fixed installations excluded from the scope of Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS 2).

4.2 Lubrication

Bettis actuators are lubricated for life. For special applications, grease fittings may be provided. Use the grease fittings (if applicable) incorporated into the torque module of your actuator to apply additional lubricant. The frequency of this lubrication will depend on the application of the actuator. For any questions regarding the frequency of this operation or appropriate lubrication compounds, contact your Bettis distributor.

⚠ WARNING: DO NOT DISASSEMBLE SPRINGPAQ™

Take a moment to view the Springpaq™ image. Note how the Springpaq™ cannot expand when the end cap and cylinder are removed from the actuator. The piston and spring retainer contain the spring in its compressed position.

The Spring compresses further during the actuator operation. The piston bolt extend from the piston to the spring retainer and is secured by the safety collar. The safety collar is recessed below the surface of the spring retainer intentionally to prevent the disassembly of the Springpaq™.

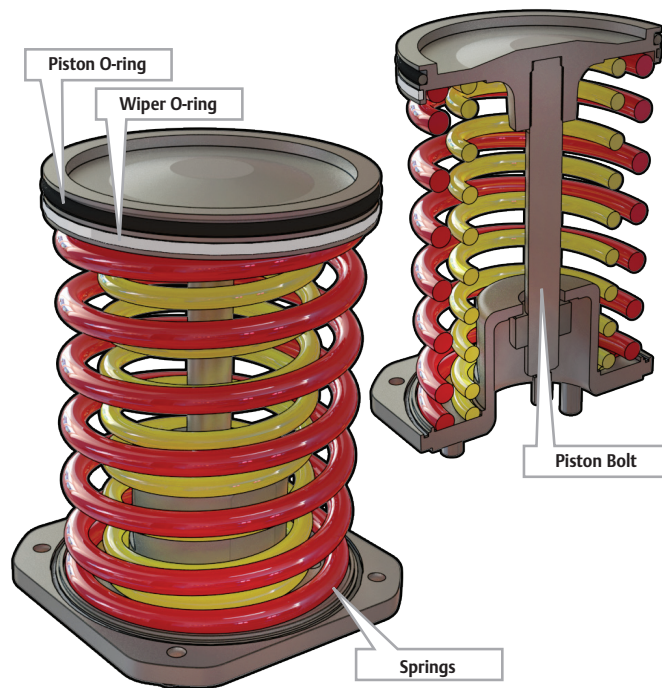
Do not attempt to disassemble the Springpaq™.

Disassembly of the Springpaq™ may expose you to extreme danger, the result of which could be severe injury or death.

There is no reason to take apart a Springpaq™.

If a spring is broken, replace the entire Springpaq™.

Figure 8



WARNING: DEPRESSURIZE COMPONENTS PROPERLY

Do not remove/loosen tie rod nuts unless cylinder is fully depressurized. Components may exit the actuator dangerously if disassembly is attempted under pressure.

Ensure that all process lines are safe.

Read all maintenance instructions before starting work.

⚠ WARNING: ENSURE UNIT IS SAFE TO DISASSEMBLE

When unthreading tie rod nuts, first unthread all nuts until they are flush with the ends of the tie rods. If there is still force pushing outward on the end cap at this point, a dangerous condition may exist. A travel stop or override device may be putting pressure on the springs, or there may be component damage. Fully removing the tie rod nuts in this condition may allow the springs to dangerously decompress. Do not continue further until it is assured that the unit is safe to disassemble.

NOTE:

Performing piston seal replacement on one cylinder at a time will allow maintenance while retaining travel stop adjustment. If both cylinders will be removed at the same time, the travel stops must be fully unthreaded prior to removing the end caps. Leaving the travel stops in place will put spring pressure on the end cap when it is removed, which could cause serious injury or death.

4.3 Maintenance Kit

To purchase your actuator maintenance kit, contact your Bettis distributor. Please have the serial number of your actuator available. This number may be found on the actuator label or stamped into the body of the actuator.

4.4 Piston Seal Replacement

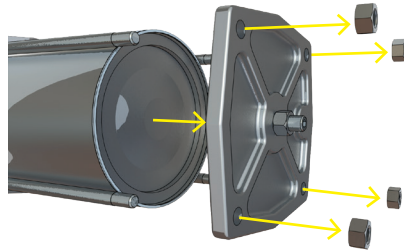
1. Exhaust all pressure and disconnect all supply lines.
2. Loosen all tie rod nuts until they are flush with the ends of the tie rods.
3. Check that there is no pressure against the end cap by verifying that the end cap is not being forced against the tie rod nuts.

⚠ WARNING: EXHAUST ALL PRESSURE AGAINST END CAP

If there is force against the end cap, stop. Do not continue further until it is assured that the unit is safe to disassemble.

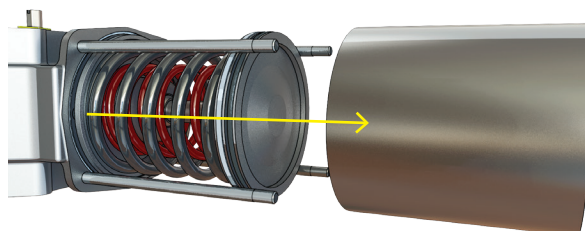
4. Remove the end cap. Be careful not to lose the cylinder seal located on the internal side of the end cap.

Figure 9



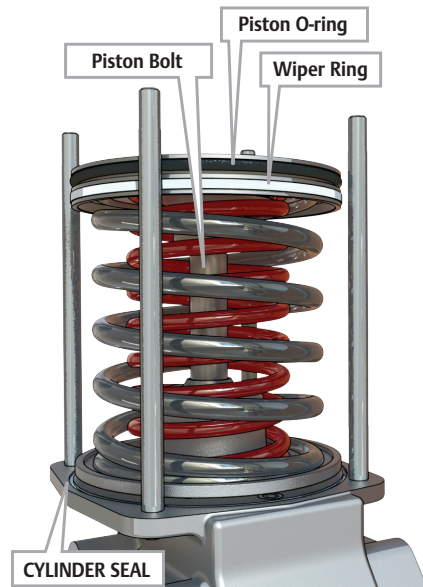
5. Remove the cylinder. Be careful not to damage the internal surface of the cylinder as this will compromise the piston's ability to seal.

Figure 10



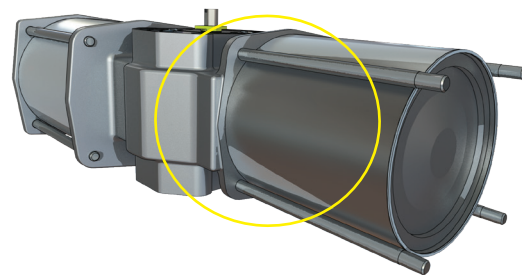
6. Replace the piston O-ring and wiper ring as needed. Be sure to lubricate the new O-ring and wiper ring with the correct Bettis approved lubricant if they are replaced.

Figure 11



7. Inspect the piston bolt for any corrosion or wear (pitting, cracking). If excessive corrosion or wear is apparent, a new actuator or actuator components may be necessary.
8. Lubricate the internal surface of the cylinder with a light coat of the correct Bettis approved lubricant and slide the cylinder back over the piston and into the cylinder seal groove of the base plate, taking care not to pinch the piston O-ring.

Figure 12

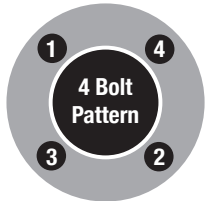


9. Place the end cap back over the tie rods. Be sure that the cylinder is seated in the cylinder seal groove of the end cap with the cylinder seal still in place between the cylinder and the end cap.
10. Secure the end cap with the tie rod hex nuts you removed in step two. Hand tighten, and then torque the hex nuts to half and then full values according to the table below using the pattern designated.

Table 4.

Model	Ft-Lbs	Nm
203	10	14
204/205	10	14
207/210	20	27
212/214	35	48

Figure 13



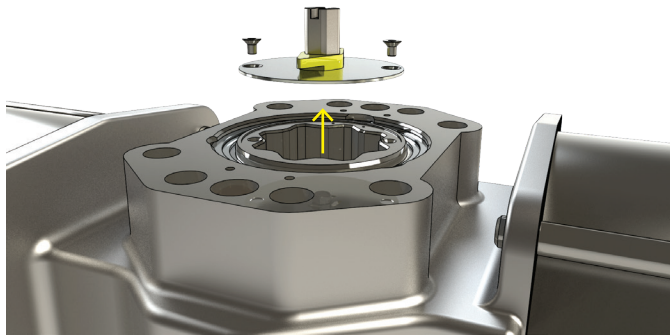
11. Complete Steps 1 to 10 on the second force module of the actuator (dual cylinder models).
12. Leak Test.
13. Reinstate the actuator to service.

4.5 Body Maintenance

To perform this maintenance, the actuator must be removed from the valve.

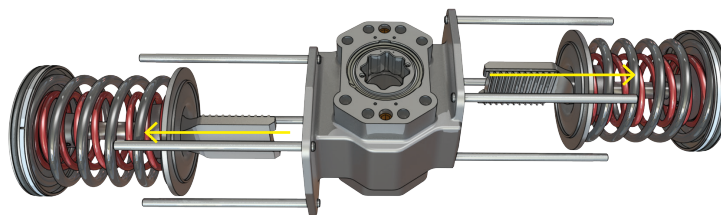
1. Follow Section 4.5, Steps 1 to 5.
2. Remove the top hat assembly by removing the top hat mounting bolts.

Figure 14



3. Remove the piston assembly(s) by pulling away from body of actuator. If model is a dual cylinder, this may require two people. Rotate the shaft until the teeth of the shaft and rack are no longer engaged.

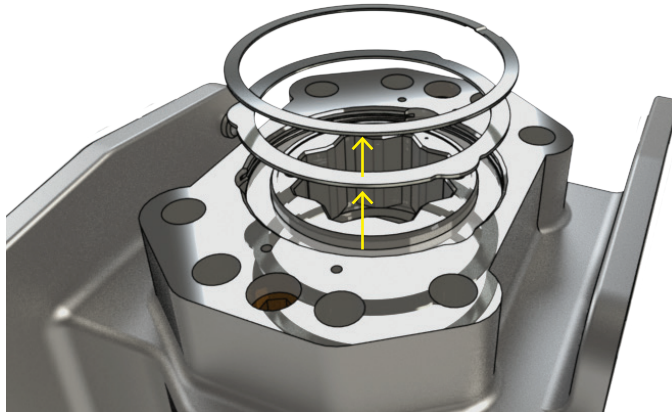
Figure 15



4. Clean and inspect rack teeth for wear. If teeth are excessively worn, a new rack(s) may be necessary for continued reliable/safe operation.

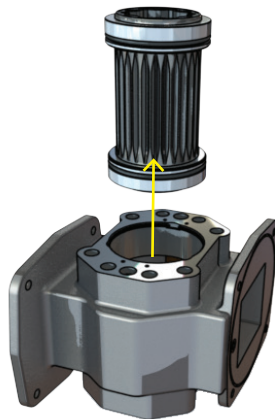
5. Remove retainer ring and thrust washer from top side of shaft.

Figure 16



6. Push shaft through top of shaft hole (shaft will only exit body in one direction). If necessary, a drive key may be inserted into the bottom of the shaft and tapped with a hammer to free the shaft from the body.

Figure 17

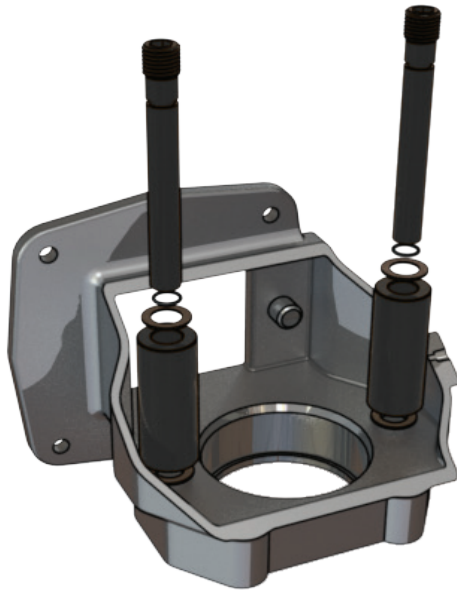


7. Remove bushings and O-rings from shaft and actuator body.
8. Clean and inspect the shaft for wear. If wear is found, a new shaft or actuator may be necessary for further safe/reliable operation.

Reassembly:

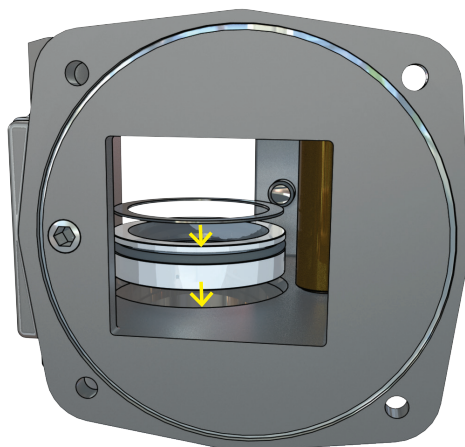
9. Lubricate and install O-ring(s), saddle pin(s), saddle pin thrust washers and roller(s).
10. Lightly coat all O-rings and bushings with lubricant.
11. Install O-rings on internal and external surfaces of bushing(s) in respective O-ring grooves.

Figure 18



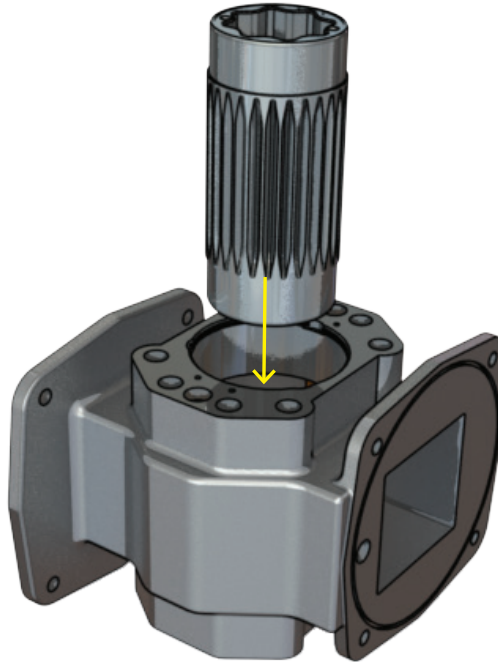
12. Insert one bushing into bottom side of shaft hole (side which contains shoulder to prevent bushing from falling out). The bushing should be placed with external O-ring closer to the center of the body of the actuator.

Figure 19



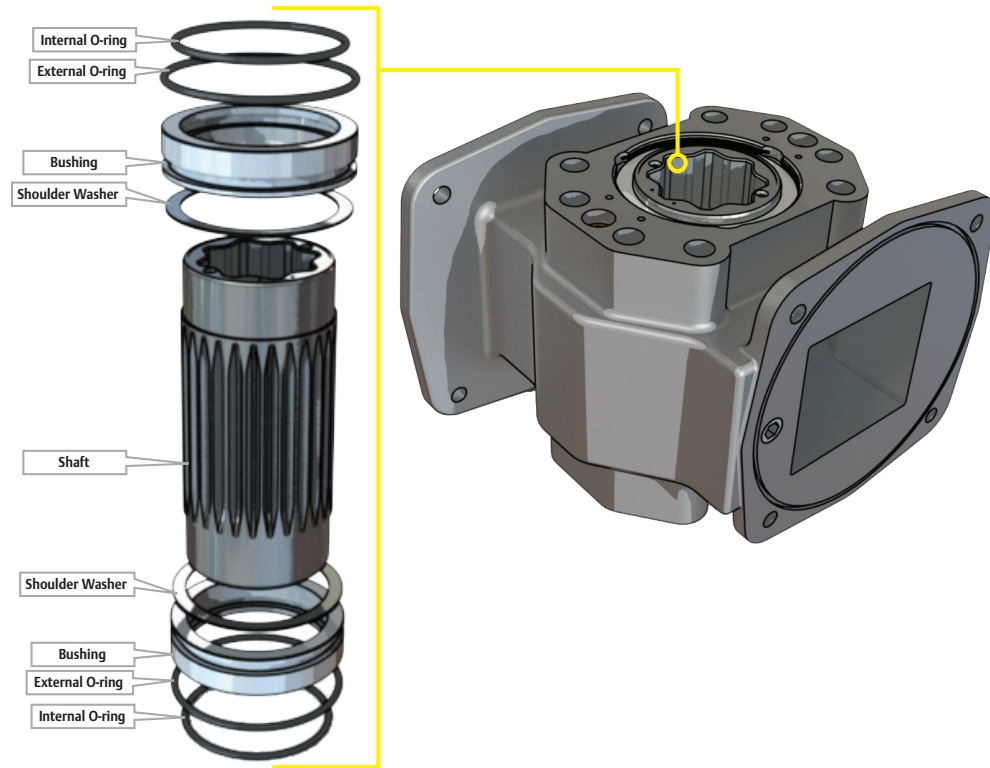
13. Place shaft shoulder washer on top of bushing and insert shaft through top of shaft hole (shaft shoulder washers not applicable for 203, 204, and 205 models).

Figure 20



14. Insert second shaft shoulder washer on top of shaft, followed by bushing (already containing both O-rings) again with external O-ring closer to the center of the body of the actuator (shaft shoulder washers not applicable to 203, 204, and 205 models).

Figure 21



15. Place thrust washer (not applicable on 203, 204, 205) on top of bushing followed by retaining ring. Ensure the retaining ring is seated in groove.
16. Rotate shaft until positioning markers are in the position shown below. Note the orientation of the body NPT port as well as the orientation of the high and low sides of the actuator.

Figure 22

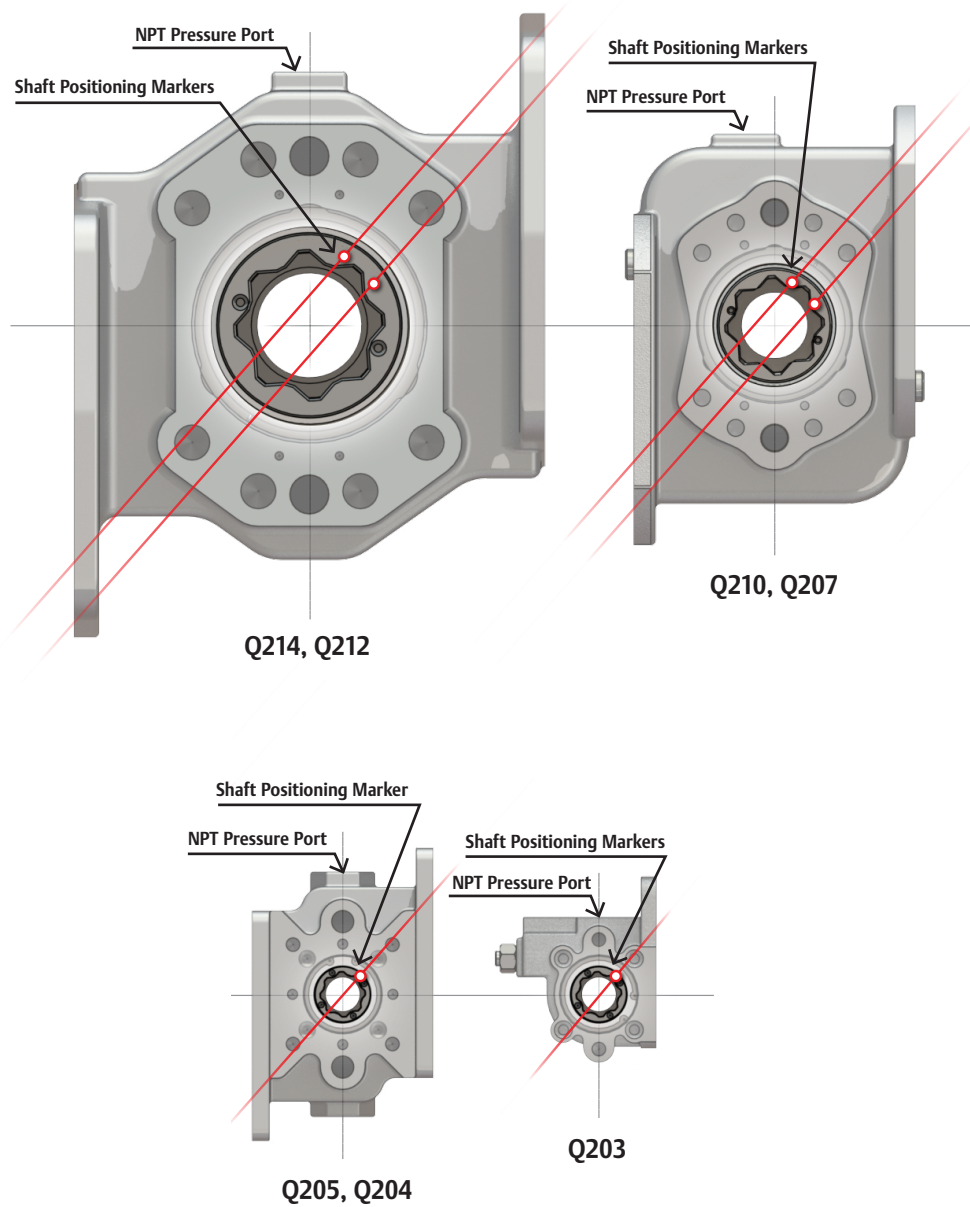
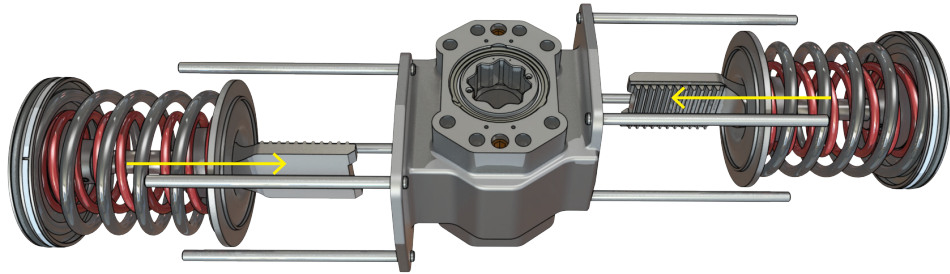


Figure 23



Single Cylinder Models:

- a. Insert the piston and engage rack teeth with shaft teeth after ensuring proper alignment.
- b. Press inward on piston until the point of refusal.

Dual Cylinder Models:

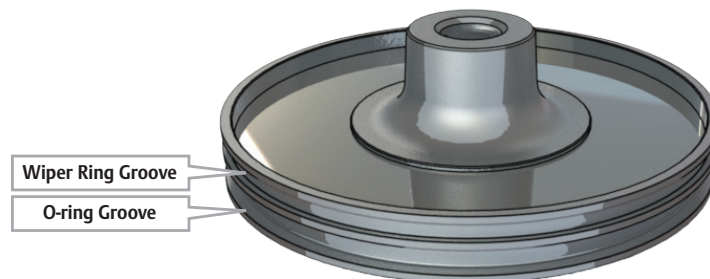
- a. Simultaneously insert the pistons and align teeth on racks and shafts.
- b. Simultaneously press both pistons into the body engaging the rack and shaft teeth until the point of refusal.

** Both pistons should contact the body simultaneously. If they do not, remove piston assemblies, reset shaft into correct position and try again.*

General Reassembly (continued)

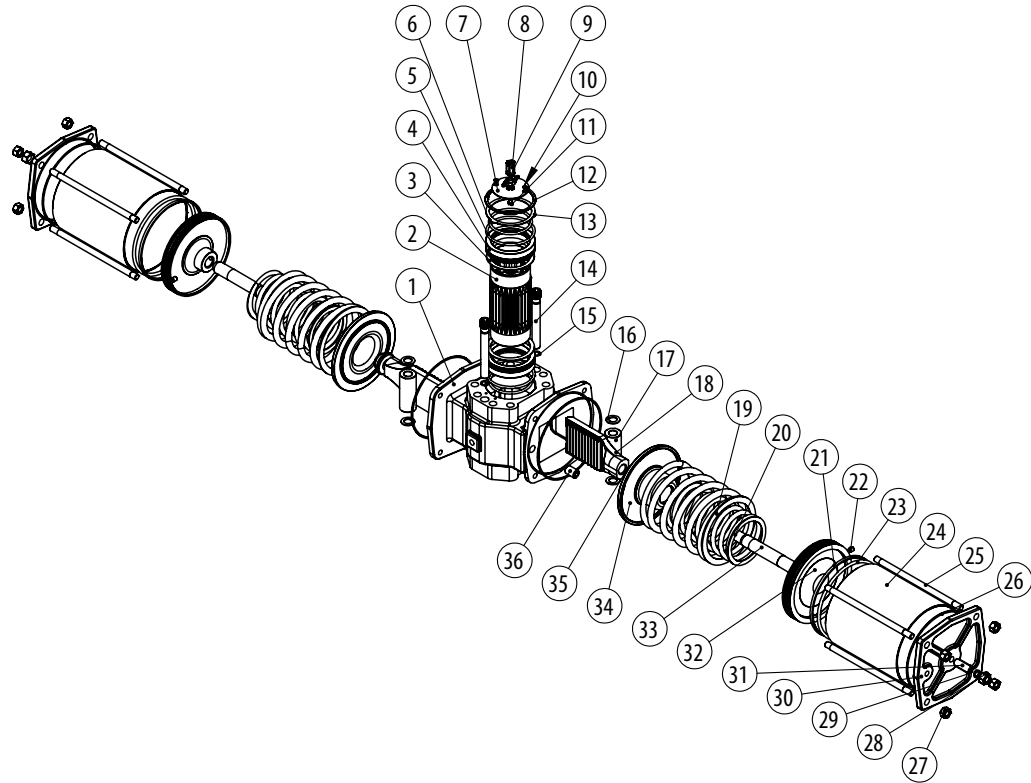
17. Place cylinder seal(s) into cylinder seal groove(s) on body.
18. Lightly lubricate wiper and piston O-ring grooves.
19. Lubricate the wiper and piston O-ring(s) and place them into their respective grooves on piston(s).
20. Follow Section 4.4, Steps 8 to 13.

Figure 24



Appendix A:

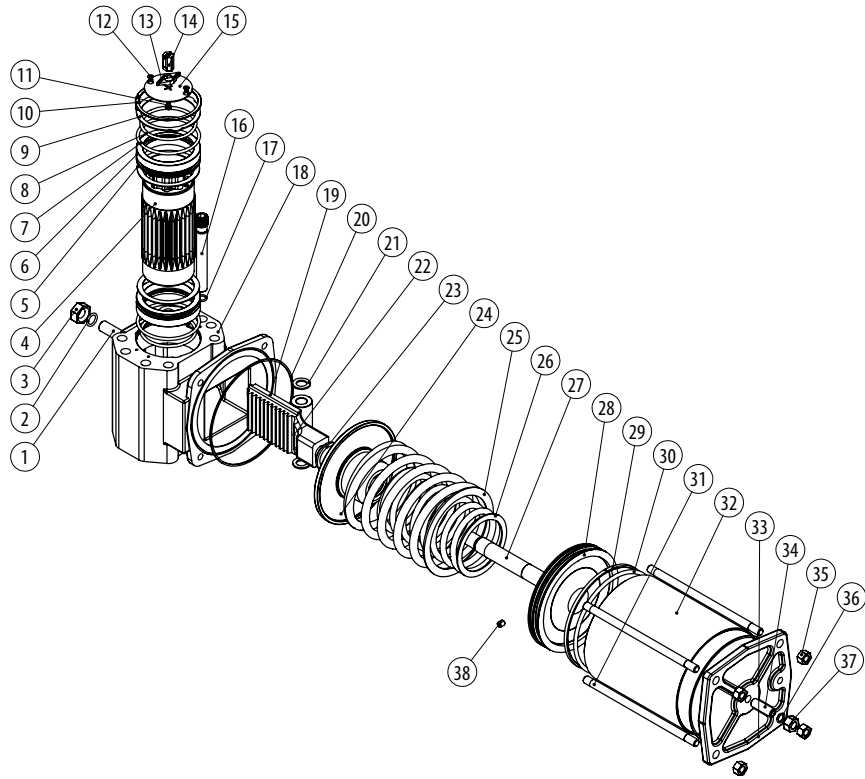
A.1 Dual Cylinder Model



4.5.1 Dual Cylinder Model Part Number

Number	Part
1	Body
2	Shaft
3	Shaft Shoulder Washer*
4	Shaft Bushing
5	Bushing External O-ring
6	Bushing Internal O-ring
7	Top Hat Base
8	Top Hat
9	Top Hat Indicator
10	Top Hat Mounting Bolt
11	Top Hat Bolt
12	Retaining Ring
13	Anti Rotate Washer
14	Saddle Pin
15	Saddle Pin O-ring
16	Roller Thrust Washer
17	Roller
18	Rack
19	Outer Spring*
20	Inner Spring*
21	Wiper Ring
22	Piston Bolt Set Screw
23	Piston O-ring
24	Cylinder
25	Tie Rod
26	Cylinder Seal
27	Hex Nut
28	Travel Stop Nut
29	Travel Stop O-ring
30	End Cap
31	Travel Stop A
32	Piston
33	Piston Bolt
34	Spring Retainer
35	Safety Collar
36	Travel Stop B
* May not be present on all models	

A.2 Single Cylinder Model



4.5.2 Single Cylinder Model Part Number

Number	Part
1	Travel Stop B
2	Travel Stop O-ring B
3	Travel Stop Nut
4	Shaft
5	Shaft Shoulder Washer*
6	Shaft Bushing
7	External Bushing O-ring
8	Internal Bushing O-ring
9	Shaft Thrust Washer
10	Retaining Ring
11	Top Hat Bolt
12	Top Hat Mounting Bolt
13	Top Hat Indicator
14	Top Hat
15	Top Hat Base
16	Saddle Pin
17	Saddle Pin O-ring
18	Body
19	Rack
20	Cylinder Seal
21	Saddle Pin Thrust Washer
22	Roller
23	Safety Collar
24	Spring Retainer
25	Outer Spring*
26	Inner Spring*
27	Piston Bolt
28	Piston
29	Wiper Ring
30	Piston O-ring
31	Tie Rod
32	Cylinder
33	End Cap
34	Travel Stop A
35	Hex Nut
36	Travel Stop O-ring A
37	Travel Stop Nut
38	Piston Bolt Set Screw
*May not be present on all models	

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