



Flow Control

Spring Return and Double Acting Pneumatic Quarter-turn Actuators Operations Manual

KEYSTONE

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General

The Figure 79U incorporates design features based on well-proven engineering concepts. This value-engineered product line is available with mounting details according to ISO 5211 (with unified threads) for the Figure 79E. Figures 79U and 79E series actuators are rated for air pressure in the range of 40 psig (2.75 barg) to 120 psig (8.3 barg) and can withstand a maximum of 150 psig (10 barg).

Pneumatic Recommendations

All Keystone and Tyco pneumatic actuators are factory-lubricated with 'Pneumatic Actuator Lubricant' and,

unless the operating environment is extremely poor, additional lubrication should not be required. To maintain maximum efficiency with this, or other pneumatic actuators or pressure vessels, Tyco Valves & Controls advises following these recommendations:

1. Where air pipelines are subjected to extremes of temperature, the system should be fitted with air-drying equipment.
2. Air control lines should be run to a 'Recommended Piping Practice' and should not have exaggerated loops that can trap condensate.
3. All pipe ends should be thoroughly deburred and cleaned after cutting, ensuring that the pipeline is clear of cuttings.
4. If pipelines are hydraulically tested, the lines should be 'blown down' with high pressure air to clear all water. This action must be performed prior to connecting the lines to the actuators.
5. When pipe fitting sealants are used, they should be applied to the male threads only. Failure to do so could foul the actuator control lines. If sealant is applied to female threads, excess compound could be transmitted into the lines.

- When a system is dependent on air filter equipment, the air filters should be placed in positions that allow easy access for maintenance and drainage.
- When pneumatic valve positioners or pneumatic controllers are fitted to valve actuator assemblies, oil mist-lubricated air should not be used unless the manufacturer specifically states that the controllers are compatible with lubricated air.

Construction

Figure 79U and 79E models 003 through 091 are available to produce output torque up to 13,444 lb.in. (1,519 Nm) and are designed to mount directly to the top flange of Keystone butterfly valves.

All models are of the opposed piston type. Each piston incorporates a wide-toothed rack, engaging a one-piece drive shaft. The shaft is Sealbond 'N' * treated for maximum corrosion protection. The actuator body is made of extruded aluminum, hard-anodized for wear and corrosion protection, and is fitted with engineered polymer bearings at the drive shaft locations and on the back side of piston racks. Bearing and piston seals are dynamic O-ring type. The actuator drive shaft has a female bore with two keyways, located 90 degrees apart, to facilitate parallel or transverse mounting. A wide range of adapters is available for fitting to the top and bottom of the drive shaft for accessories (top) and valve stems (bottom).

Disassembly - Double Acting and Spring Return Units

(Please see the exploded parts drawings on pages 9, 10, and 11.)

WARNING

Remove all air pressure and observe normal safety precautions, including use of eye protection. All accessories should be removed from the actuator and the actuator removed from the valve prior to disassembly. Failure to do so could result in personal injury and/or damage to the actuator and valve assembly.

- Remove the position indicator cap (Item 17) by prying the cap upwards with a screwdriver or similar tool.

Note: The position of the shaft keyways should be recorded to ensure correct position for assembly.

- Remove both travel stop assemblies (Items 22 through 26), if present.
- If unit is double acting, loosen the end cap screws (Item 15) evenly and remove the end caps (Item 3) or (Items 3A and 3B on model 003).
- If unit is spring return, loosen spring housing cap screws (Item 15) evenly until the spring load is relaxed ($\frac{1}{8}$ -inch — $\frac{3}{16}$ -inch).

WARNING

If there is still compression on the spring after loosening the screws by $\frac{3}{16}$ -inch, tighten the spring housing cap screws and return the unit to the factory for service. Continued attempts to disassemble the unit, with compression on the spring, could cause damage to the actuator and/or result in personal injury.

- If the spring modules (Item 19) or (Items 19A and 19B on model 003) are loose, remove the cap screws and spring modules.

WARNING

Under no circumstances should attempts be made to disassemble the spring module or adjust the spring height by loosening or tightening the spring retaining bolt. These actions could result in personal injury.

- Insert an appropriately-sized, keyed shaft into the top bore of the pinion shaft (Item 5) and rotate the shaft in the needed direction to drive the pistons apart.

Note: Rotate counterclockwise for double acting and 'fail closed' spring return units and clockwise for 'fail open' spring return units.

- Remove the pistons (Item 2) from the body (Item 1) cylinder bore.
- Remove the retaining ring (Item 12) from the bottom bore of the body.
- Taking care not to damage the top of the shaft bore or keyways, tap the pinion shaft downward and carefully remove it from the bottom of the body.

CAUTION

Do not allow the pinion shaft gear teeth to contact the actuator bore during shaft removal. Such contact could damage the actuator bore.

- If not already removed with the pinion shaft, remove the top shaft bearing (Item 9) and gear shim (Item 4 on models 006 and 012 only) from the actuator body. The bottom shaft bearing (Item 6) will have already been removed along with the shaft.
- Parts to be reused should be thoroughly degreased and blown dry before reassembly.

Assembly - Double Acting and Spring Return Units

(Please see the exploded parts drawings on pages 9, 10, and 11.)

Note: Anti-friction pads are not required on 003 models which have nylon pistons. Backing rings are only fitted to models 065 through 091. Anti-friction pads and backing rings need only a smear of grease on the undersides before fitting them to the pistons.

* Sealbond 'N' is a process of Huyton Heat Treatments Ltd.

1. After O-rings are installed, liberally grease the actuator bores, pistons, pinion shaft and shaft bearings with 'Pneumatic Actuator Lubricant.'
2. Lightly coat all remaining O-ring seals with the same lubricant.
3. Output shaft and bearing assembly:
 - a. From inside the body, install the top bearing assembly (Item 9 with Items 10 and 11) into the top bore of the actuator body (Item 1) with the external O-ring end (Item 11) going in first.
 - b. Install the bottom bearing assembly (Item 6 with Items 7 and 8) onto the bottom of the pinion shaft (Item 5) with the internal O-ring (Item 7) end going onto the shaft first.
 - c. For models 006 and 012 only, slide the gear shim (Item 4) over the top end of the pinion shaft.
4. Insert the pinion shaft assembly into the bottom of the actuator body and through the top shaft bearing as far as it will go.

Note: The bottom shaft bearing must be pushed in far enough to clear the internal retaining ring groove, located in the bottom bore of the body.

5. Install the internal retaining ring (Item 12).
6. Install the O-rings (Item 13) on the pistons (Item 2).

For Double Acting and 'Fail Close' (CW) Spring Return units:

7. a. Orient the output shaft keyways as shown in Figures 2 and 3 on page 6 or Figures 5 and 6 on pages 7 and 8.
- b. Insert both pistons (Item 2), complete with anti-friction pads (Item 18) and backing rings (Item 21 if present), with piston rack on left side of bore (when viewed from the piston head end of the piston) until both racks just engage with the pinion.
- c. Push pistons fully inward to achieve the full closed (CW) position.

- d. For models 003 through 036, keyways should be in line with actuator centerlines. For models 065 through 091, the keyways should be approximately 5 degrees past the actuator centerlines in a clockwise direction. If they are not, disengage pistons by rotating the pinion shaft counterclockwise and repeat Steps 7 (a) and (c).

For 'Fail Open' (CCW) Spring Return units:

8. a. Orient the output shaft keyways, as shown in Figure 4, page 7 or Figure 7, page 8.
- b. Insert both pistons (Item 2), complete with anti-friction pads (Item 18) and backing rings (Item 21, if present), with the piston rack on the right side of bore (when viewed from the piston head end) until both racks just engage with the pinion.
- c. Push pistons fully inward to achieve the full open (CCW) position.
- d. For models 003 through 036, keyways should be in line with actuator centerlines. For models 065 through 091, the keyways should be approximately 5 degrees past the actuator centerlines in a counterclockwise direction. If they are not, disengage pistons by rotating the pinion shaft clockwise and repeat Steps 8 (a) and (c).

Note: Instructions 9 through 16 refer only to models 065 through 091 which have bi-directional travel stops. For complete travel stop setting procedures, see page 4.

For Double Acting and 'Fail Close' Models 065 through 091

9. Rotate the pinion shaft counterclockwise (approximately 5 degrees) until the keyways are in line with the centerlines of the actuator body. The shaft is now in the closed position.

10. Install the CLOSE travel stop (Item 22) together with travel stop nut (Item 23), flat washer (Item 24) and thread seal (Item 25) until the stop hits the travel stop cam. Tighten the stop nut. (See Figure 1.)
11. Rotate the pinion shaft counterclockwise through 90 degrees until the keyways again align with the actuator centerlines.
12. Install the OPEN travel stop (Item 22) together with travel stop nut (Item 23), flat washer (Item 24) and thread seal (Item 25) until the stop hits the travel stop cam. Tighten the stop nut. (See Figure 1.)

For 'Fail Open' models 065 through 091

13. Rotate the pinion shaft clockwise (approximately 5 degrees) until keyways are in line with the centerlines of the actuator body. The shaft is now in the open position.
14. Install the OPEN travel stop (Item 22) together with travel stop nut (Item 23), flat washer (Item 24) and thread seal (Item 25) until the stop hits the travel stop cam. Tighten the stop nut. (See Figure 1.)
15. Rotate the pinion shaft clockwise through 90 degrees until the keyways again align with the actuator centerlines.
16. Install the CLOSE travel stop (Item 22) together with travel stop nut (Item 23), flat washer (Item 24) and thread seal (Item 25) until the stop hits the travel stop cam. Tighten the stop nut. (See Figure 1.)

For All Models:

17. For double acting units, install the end cap O-rings (Item 14) on the end caps (Item 3) or (Items 3A and 3B for model 003). For spring return units, the O-rings will be installed on the spring modules (Item 19) or (Items 19A and 19B for model 003).
18. Install the end caps or spring modules to body and alternately tighten the end cap screws (Item 15) until secure. (See the recommended torque table on page 12.)
19. Install the position indicator (Item 17) in the top of the pinion shaft.

20. Using air pressure, cycle the actuator open and close to check for full travel.

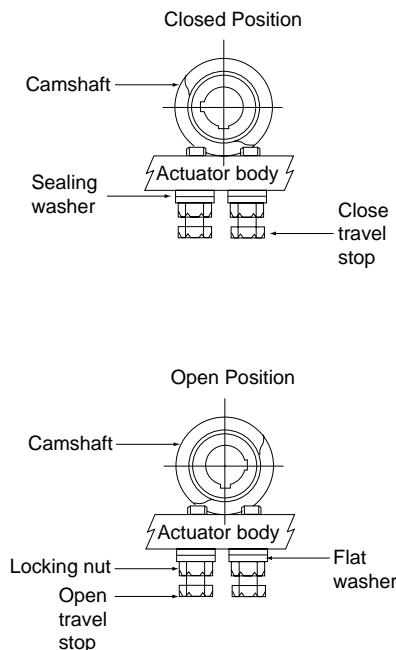
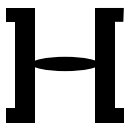


Figure 1

Note: The close travel stop is identified on the actuator body by the symbol below:



Note: The open travel stop is identified on the actuator body by the symbol below:



Travel Stop Setting Procedures

Figure 79U and 79E - 065 through 091 actuators are fitted with integral end of travel stops to enable setting of exact travel for the valve being operated. These stops provide adjustment of 5 degrees overtravel to 7 degrees undertravel at each end of stroke. The range of the actuator travel is, therefore:
 at closed (0°) position -5° to + 7°
 at open (90°) position 83° to 95°

Setting the Stops

WARNING

Never totally withdraw the travel stops from the actuator while compressed air is being applied. This action could result in personal injury.

1. Apply pressure to bring the actuator/valve assembly to the 'closed' position (clockwise).
2. Check disc position. If adjustment is required, go to Step 3. If not, skip to Step 9.
3. Disconnect air supply.
4. Loosen the lock nut on the 'close' travel stop.
5. Turn the stop clockwise to reduce travel, or counterclockwise to increase travel.
6. Retighten lock nut.
7. Reconnect air supply.
8. Check for correct position. If incorrect, start again from Step 3.
9. Apply pressure to operate to the 'open' position (counterclockwise).
10. Check disc position. If adjustment is required, go to Step 11. If not, skip to Step 17.
11. Disconnect air supply.
12. Loosen the lock nut on the 'open' travel stop.
13. Turn the stop clockwise to reduce travel, or counterclockwise to increase travel.
14. Retighten lock nut.
15. Reconnect air supply.

16. Check for correct position. If incorrect, start again from Step 9.
17. Unit is ready for operation.

CAUTION

Never use internal travel stops for manual override. Any accessories mounted to the top of the actuator must be readjusted after setting the travel stops. Failure to adhere to the above procedures may result in damage to the actuator, valve or accessories.

Conversion of Spring Return 'Fail Close' to 'Fail Open'

WARNING

Remove all air pressure and observe normal safety precautions, including the use of eye protection. All accessories should be removed from the actuator and the actuator removed from the valve prior to disassembly. Failure to follow these procedures may result in personal injury and/or damage to the actuator and valve assembly.

Note: 'fail close' spring return units in the 79U/E-065/066 series cannot be converted to 'fail open' in the field unless the pinion shaft (Item 5) is replaced. Units may be ordered from the factory for 'fail open' service.

1. Remove the position indicator cap (Item 17) by prying the cap upwards with a screwdriver or similar tool.
2. Remove both travel stop assemblies (Items 22 thru 26), if fitted.
3. Loosen spring housing cap screws (Item 15) evenly until the spring load is relaxed (1/8 inch - 3/16 inch).

WARNING

If there is still compression on the spring after loosening the screws by 3/16-inch, tighten the spring housing cap screws and return the unit to the factory for service. Continued attempts to disassemble the unit, with compression on the spring, could cause damage to the actuator and/or result in personal injury.

4. If the spring modules (Item 19) or (Items 19A and 19B on Model 003) are loose, remove the cap screws and spring modules.

WARNING

Under no circumstances should attempts be made to disassemble the spring module or adjust the spring height by loosening or tightening the spring retaining bolt. These actions could result in personal injury.

5. Insert an appropriately-sized keyed shaft into the top bore of the pinion shaft (Item 5) and rotate the shaft in a direction to drive the pistons apart (Counterclockwise for 'fail close' spring return units).
6. Remove the pistons (Item 2) along with the anti-friction pads (Item 18) and backing rings (Item 21), if present) from the body (Item 1) cylinder bore.
7. Installation of pistons:
 - a. Orient the output shaft keyways, as shown in Figure 4, page 7 or Figure 7, page 8.
 - b. Insert pistons (Item 2), complete with anti-friction pads (Item 18) and backing rings (Item 21, if present), with piston rack on right side of the bore (when viewed from the piston head end) until the racks just engage with the pinion.
 - c. Push pistons fully inward to achieve the 'full open' (CCW) position.
 - d. For models 003 through 036, keyways should be in line with actuator centerlines. For models 090 through 091, the keyways should be approximately 5 degrees past the actuator centerlines in a counterclockwise direction. If not, disengage pistons by rotating the pinion shaft clockwise and repeat Steps 7 (a) and (c).

For Models 003 through 036, refer to Instruction 17, page 3.

For Models 065 through 091 refer to Instruction 13, page 3.

Special Information

As standard, the actuator rotates clockwise (CW) to close and counterclockwise (CCW) to open.

For Double Acting Units:

When viewed from the actuator pressure port side, the left hand port is the closed direction port and the right hand port is the open direction port.

For Spring Return Units ('Fail Close' or 'Fail Open'):

When viewed from the actuator pressure port side, the right hand port is the pressure port and the left hand port is normally vented.

Maintenance

If basic pneumatic system procedures are maintained, the Figure 79U and 79E series actuators will require minimum maintenance for many thousands of cycles.

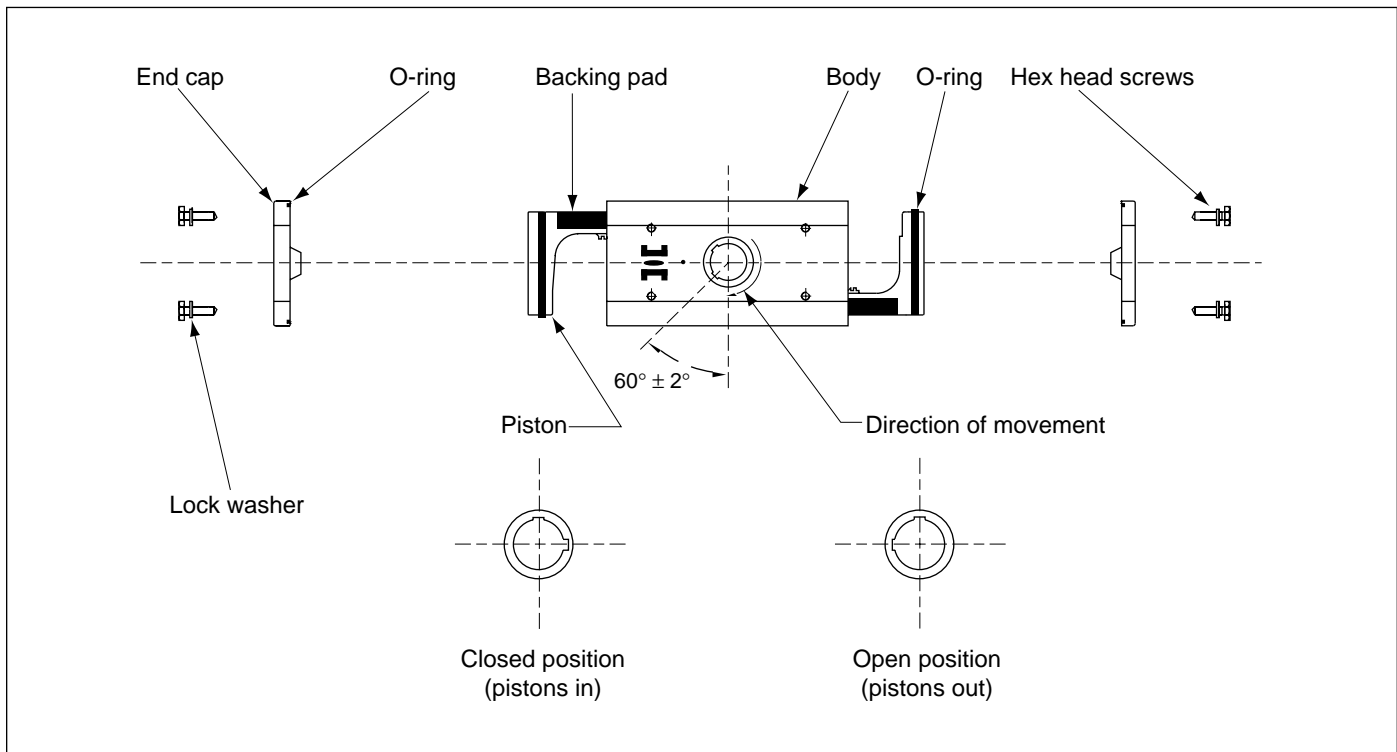


Figure 2 - Top view of Standard Double Acting Actuator Assembly - Model 003-036

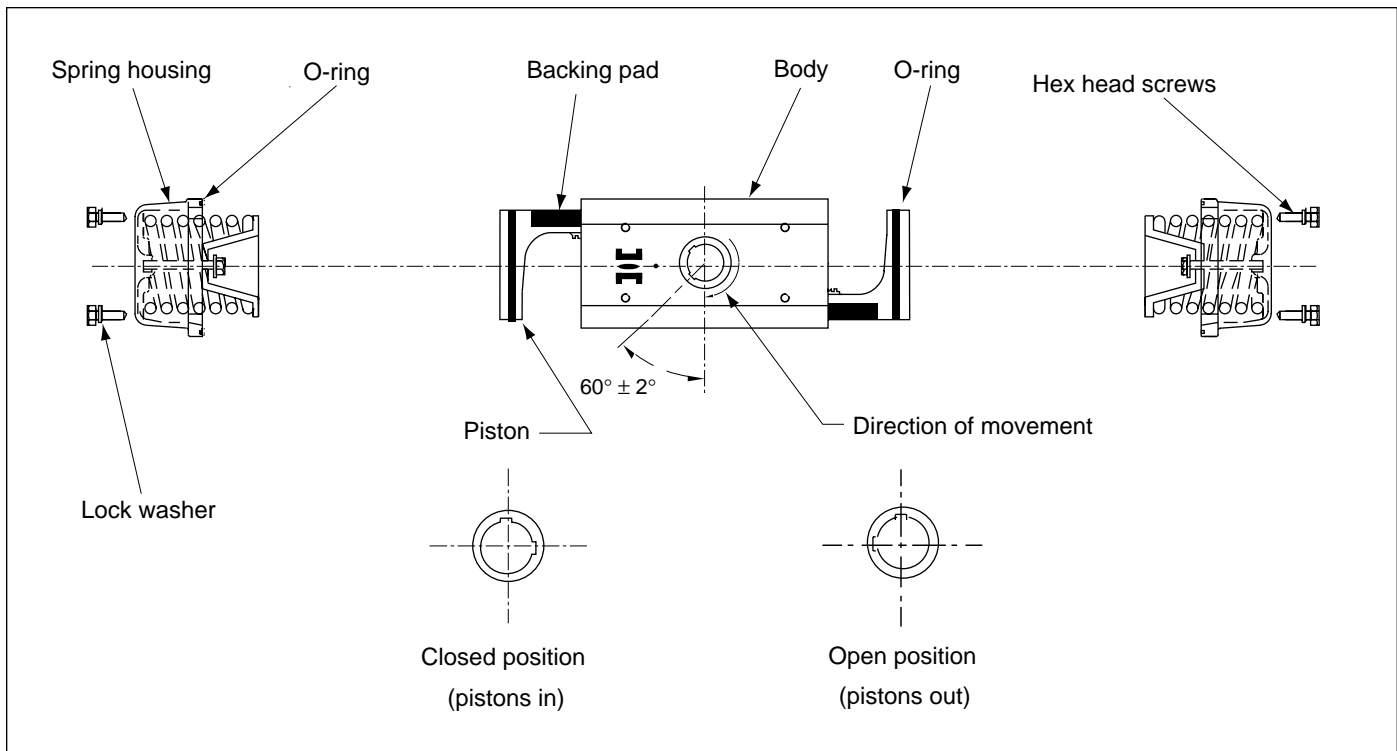


Figure 3 - Top view of (Fail Close) Single Acting Actuator Assembly - Models 003-036

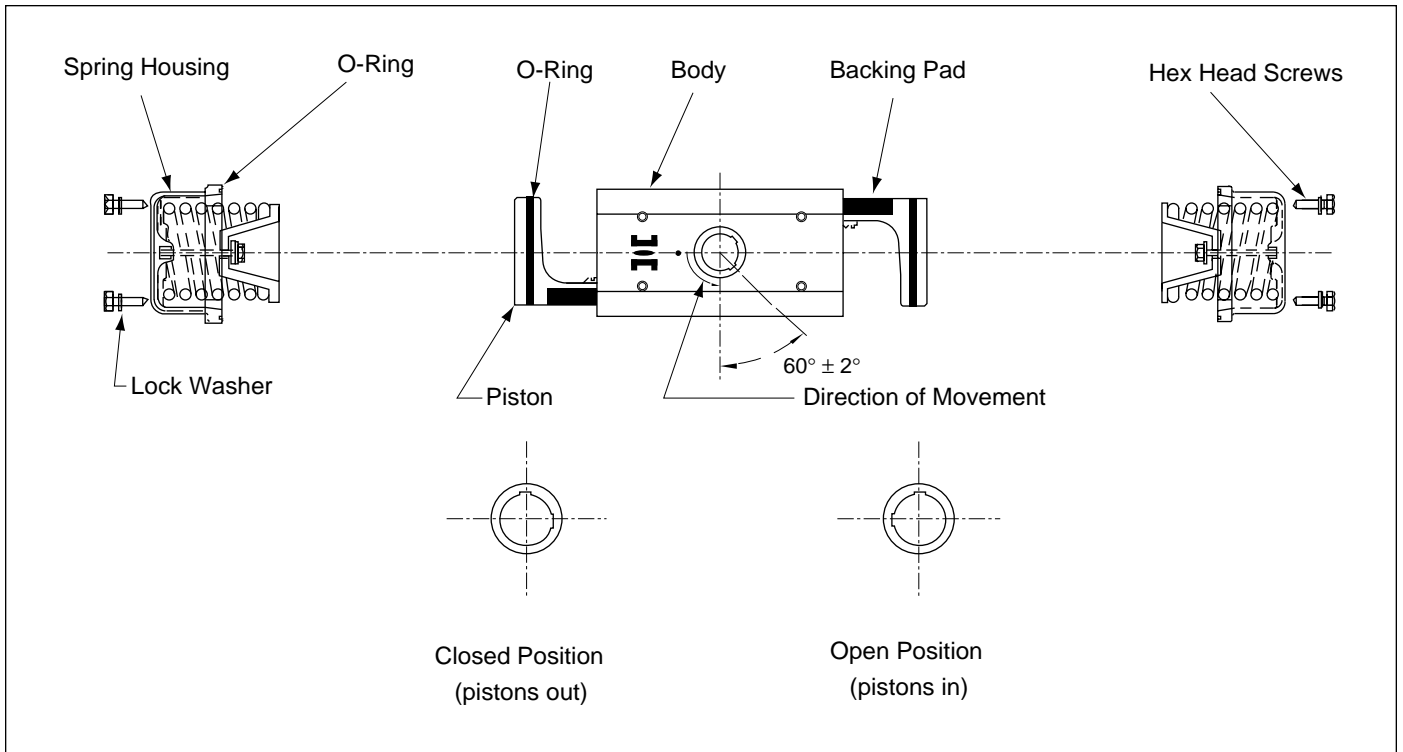


Figure 4 - Top view of (Fail Open) Single Acting Actuator Assembly - Models 003-036

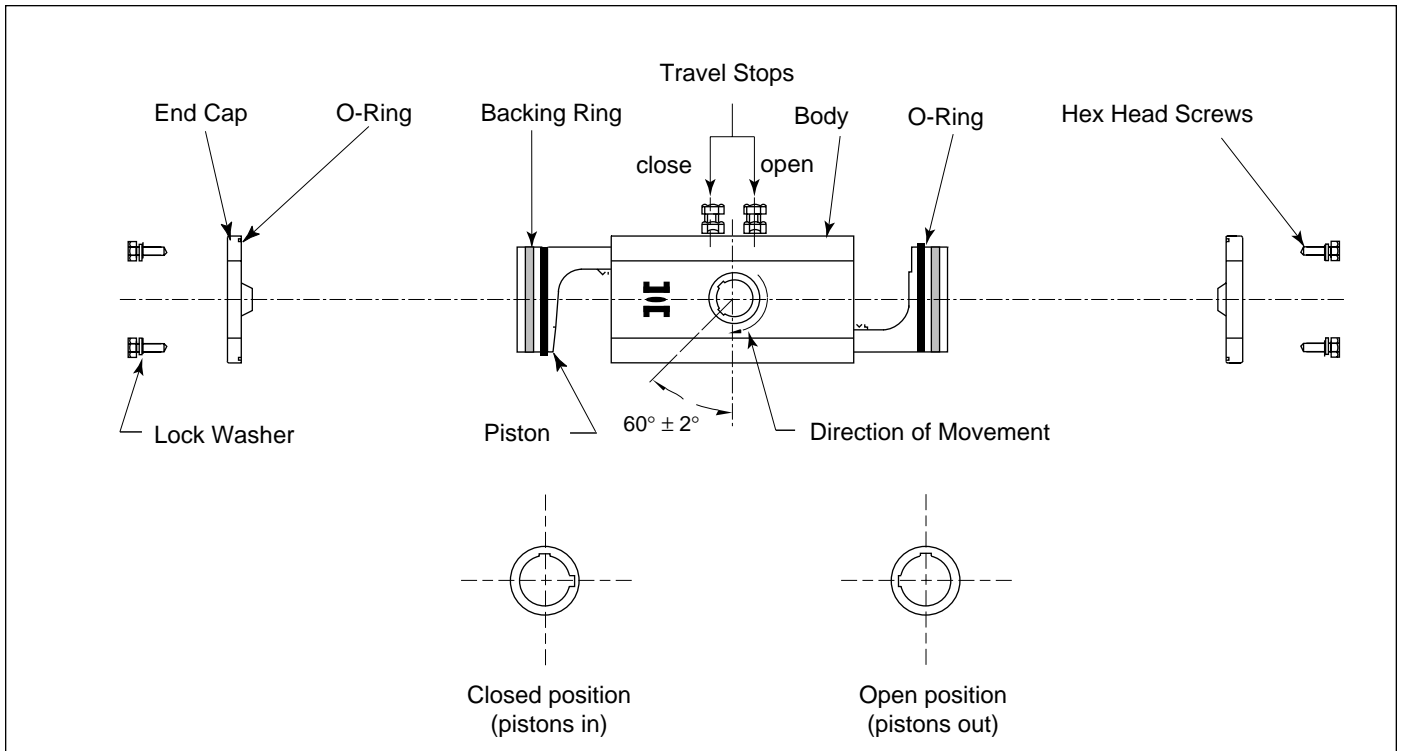


Figure 5 - Top View of Standard Double Acting Actuator Assembly - Model 065-091

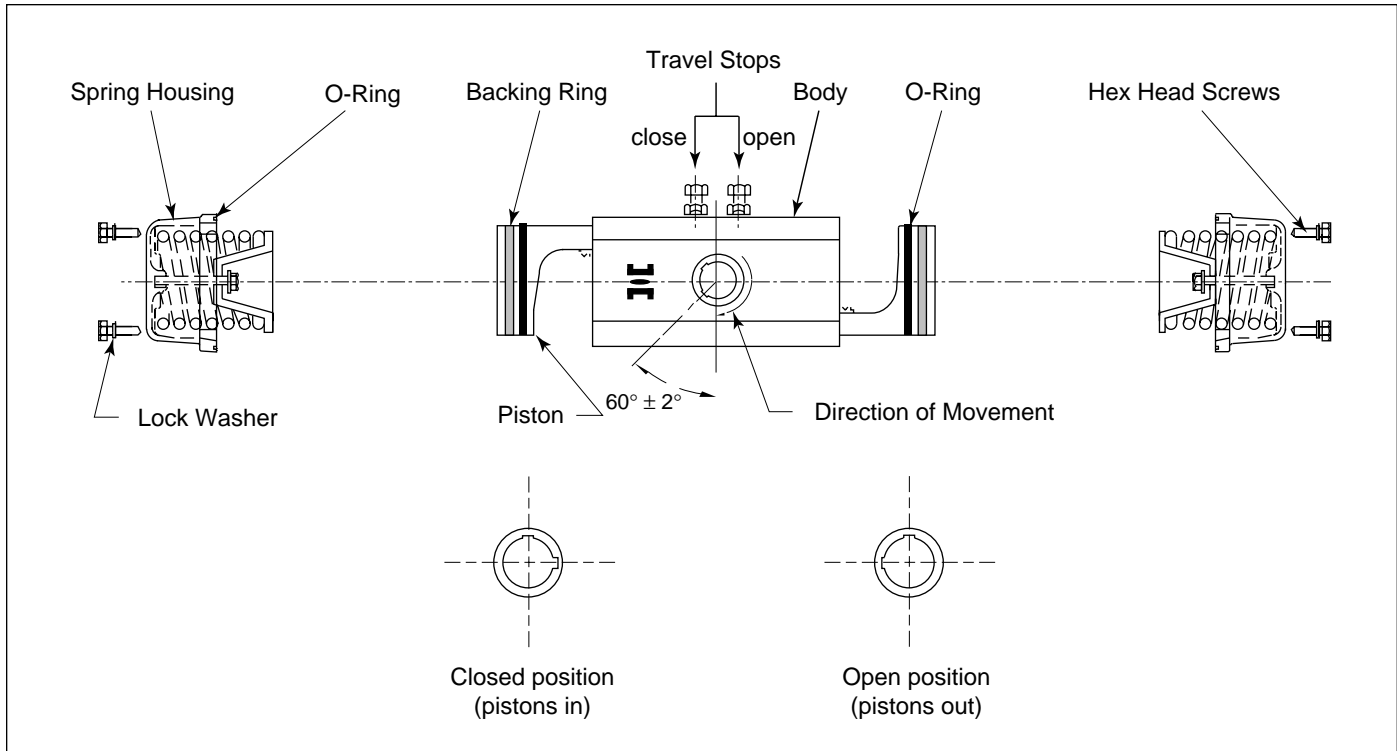


Figure 6 - Top View of Standard (Fail Close) Single Acting Actuator Assembly - Model 065-091

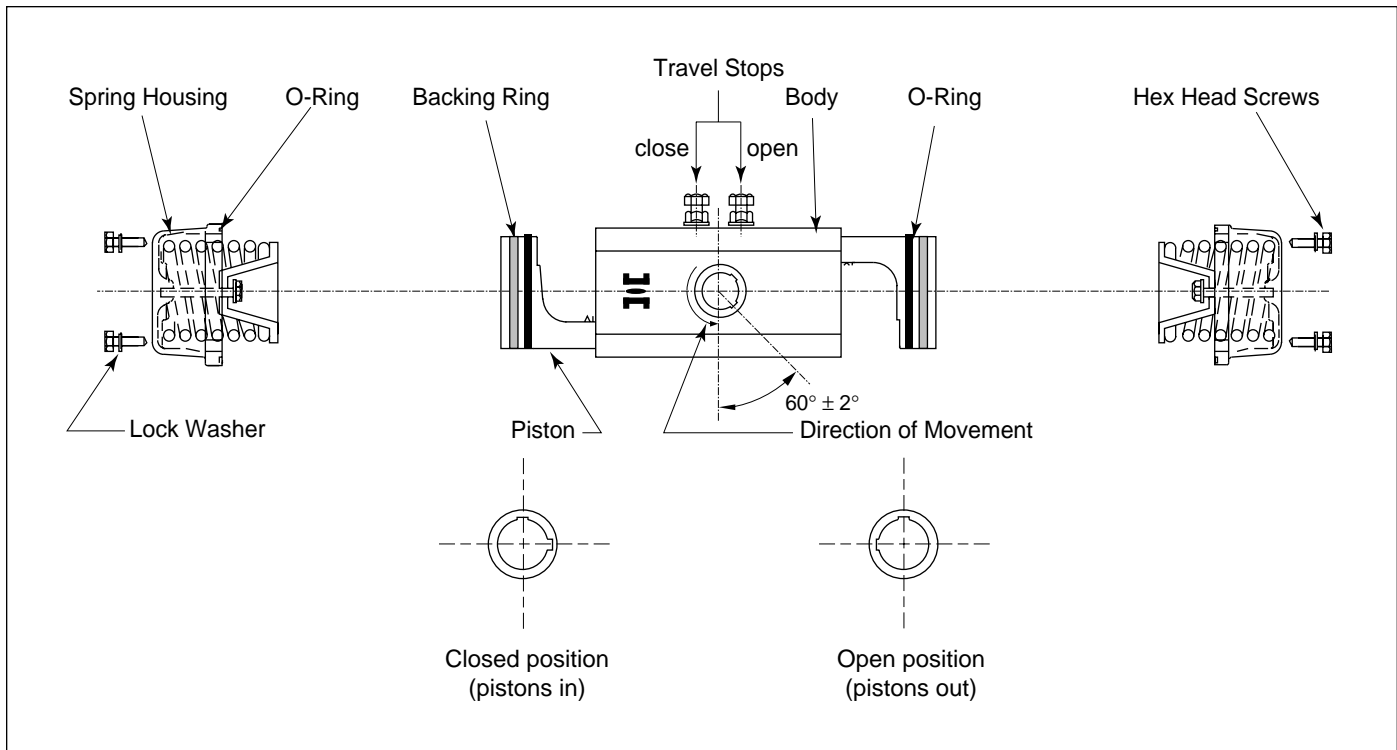
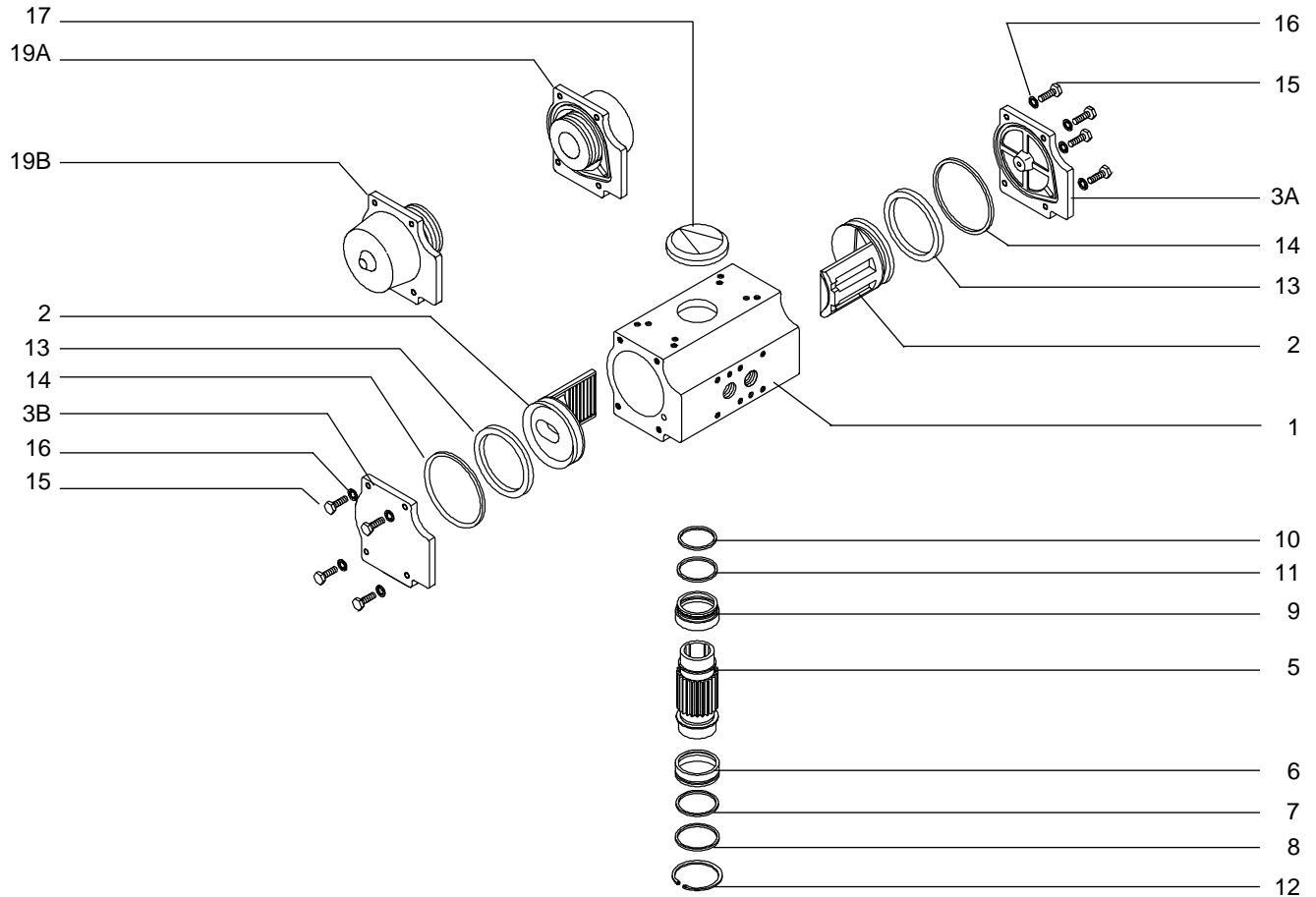


Figure 7 - Top View of (Fail Open) Single Acting Actuator Assembly - Model 065-091

Exploded view of Actuator Assembly - Model 003 Double Acting and Spring Return

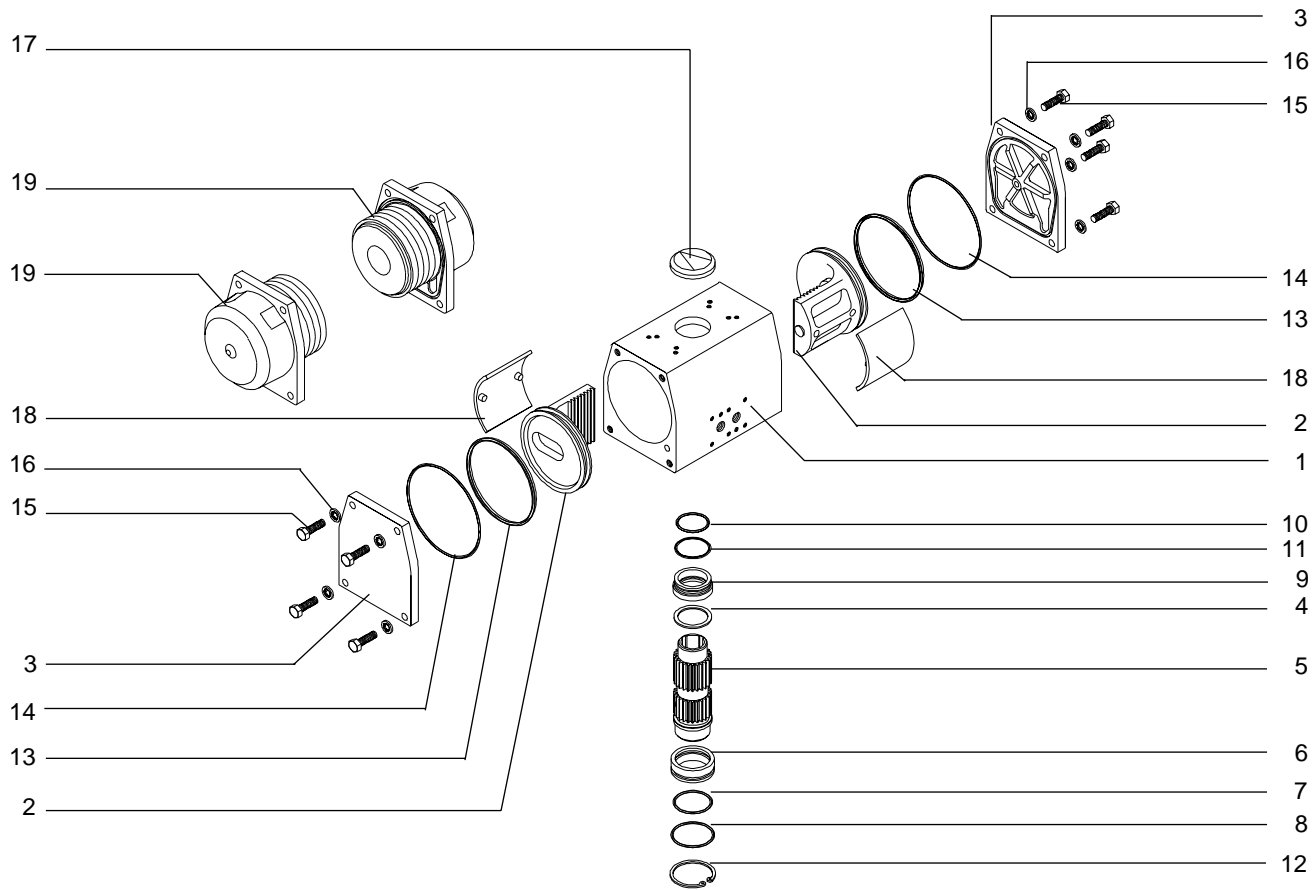


Materials of Construction - Model 003 Double Acting and Spring Return

Item	Description	Quantity	Material
1	Body	1	Aluminum
2	Piston	2	Nylon
3A	End Cap - right hand	1	Aluminum
3B	End cap - left hand	1	Aluminum
5	Pinion shaft	1	Steel
6	Bottom shaft bearing	1	Engineered polymer
7	O-ring, internal, bottom shaft bearing	1	NBR
8	O-ring, external, bottom shaft bearing	1	NBR
9	Top shaft bearing	1	Engineered polymer
10	O-ring, internal, top shaft bearing	1	NBR
11	O-ring, external, top shaft bearing	1	NBR
12	Retaining ring, internal	1	Spring steel
13	O-ring, piston	2	NBR
14	O-ring, end cap	2	NBR
15	Hex cap screw, end cap	8	Stainless steel
16	Lock washer	8	Stainless steel
17	Position indicator	1	ABS
19A	Spring Module - right hand	1	Aluminum and steel
19B	Spring Module - left hand	1	Aluminum and steel
20	Filter, breather vent, (SR only) not shown	1	Sintered bronze

Keystone Figure 79U/E Pneumatic Actuator

Exploded view of Actuator Assembly - Models 006 - 036 Double Acting and Spring Return

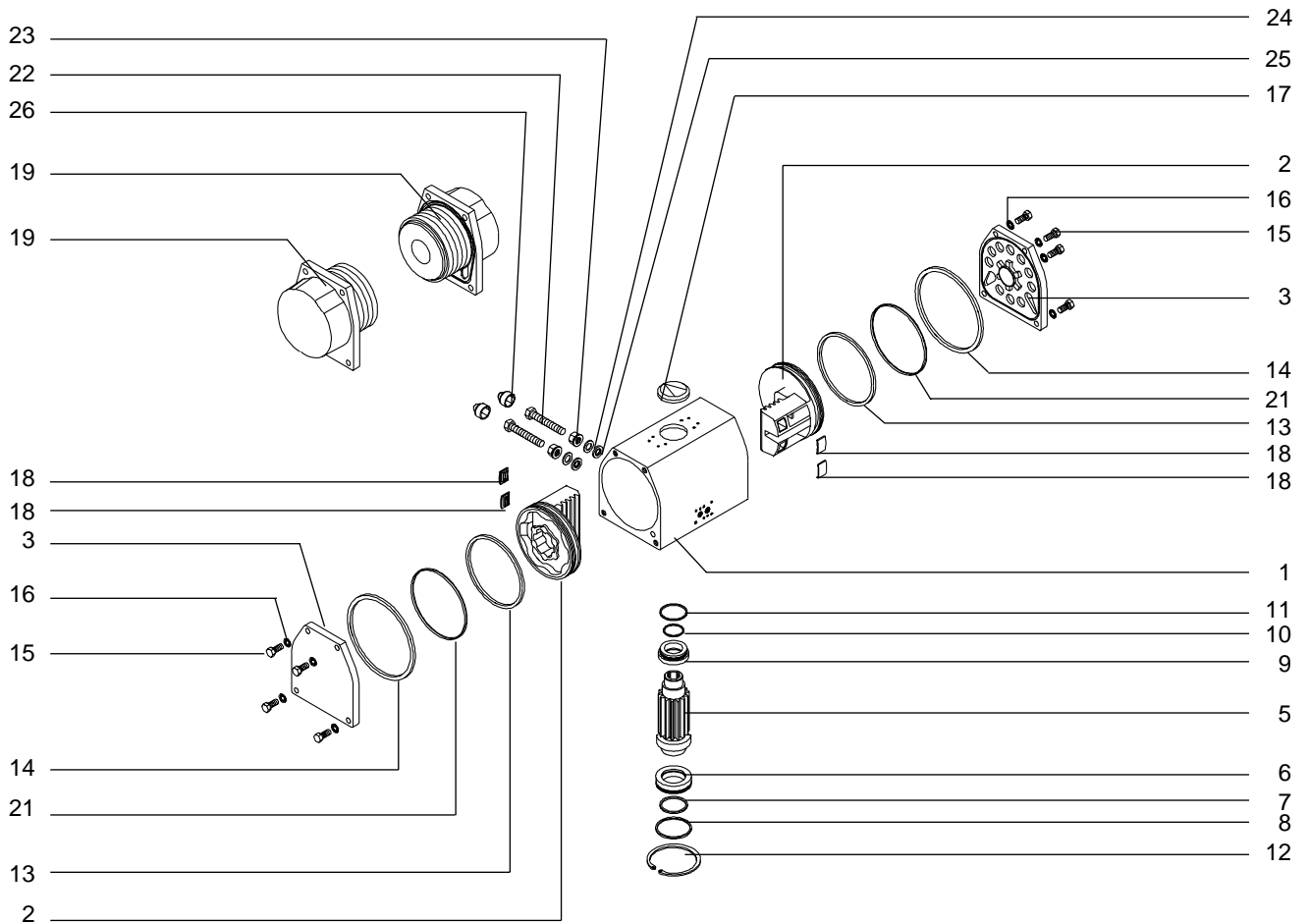


Materials of Construction - Models 006/036 Double Acting and Spring Return

Item	Description	Quantity	Material
1	Body	1	Aluminum
2	Piston	2	Aluminum
3	End Cap	1	Aluminum
4	Gear Shim (models 006 & 012 only)	1	Stainless steel
5	Pinion shaft	1	Steel
6	Bottom shaft bearing	1	Engineered polymer
7	O-ring, internal, bottom shaft bearing	1	NBR
8	O-ring, external, bottom shaft bearing	1	NBR
9	Top shaft bearing	1	Engineered polymer
10	O-ring, internal, top shaft bearing	1	NBR
11	O-ring, external, top shaft bearing	1	NBR
12	Retaining ring, internal	1	Spring steel
13	O-ring, piston	2	NBR
14	O-ring, end cap	2	NBR
15	Hex cap screw, end cap	8	Stainless steel
16	Lock washer	8	Stainless steel
17	Position indicator	1	ABS
18	Anti-friction pad, piston	2	Engineered polymer
19	Spring Module	2	Aluminum & Steel
20	Filter, breather vent (SR only) not shown	1	Sintered bronze

Keystone Figure 79U/E Pneumatic Actuator

Exploded view of Actuator Assembly - Models 065/066 - 090/091 Double Acting and Spring Return



Materials of Construction - Model 065/066 - 090/091 Double Acting and Spring Return

Item	Description	Quantity	Material
1	Body	1	Aluminum
2	Piston	2	Aluminum
3	End Cap	2	Aluminum
5	Pinion shaft	1	Steel
6	Bottom shaft bearing	1	Engineered polymer
7	O-ring, internal, bottom shaft bearing	1	NBR
8	O-ring, external, bottom shaft bearing	1	NBR
9	Top shaft bearing	1	Engineered polymer
10	O-ring, internal, top shaft bearing	1	NBR
11	O-ring, external, top shaft bearing	1	NBR
12	Retaining ring, internal	1	Spring steel
13	O-ring, piston	2	NBR
14	O-ring, end cap	2	NBR
15	Hex cap screw, end cap	8	Stainless steel
16	Lock washer	8	Stainless steel
17	Position indicator	1	ABS
18	Anti-friction pad, piston	2	Engineered polymer
19	Spring Module	2	Aluminum & steel
20	Filter, breather vent (SR only) not shown	1	Sintered bronze
21	Backing ring	2	Engineered polymer
22	Travel adjuster	2	Stainless steel
23	Travel stop nut	2	Stainless steel
24	Flat washer	2	Stainless steel
25	Thread seal	2	Steel/NBR
26	Cap (protective)	2	Plastic

Recommended Tightening Torques for End Cap Screws

Actuator Size	Screw Diameter	Torque (lb. ft.)
003/006	#10-32 UNF	7-9
012	5/16-18 UNC	21-23
024/036	3/8-16 UNC	31-34
065/091	1/2-13 UNC	68-72

Standard Spring Color Codes (chart)

Spring Rating	No. of Springs in Module	Model 003 to 091
40 psi	1	White stripe on spring
60 psi	1	Red stripe on spring
80 psi	2	*White stripe on outer spring
100 psi	2	*Red stripe on outer spring

*Nested springs

Troubleshooting Guide

Symptom	Possible Cause	Resolution
Loss or reduction of output torque	<ol style="list-style-type: none"> 1. No air supply 2. Insufficient air supply to produce required valve torque 3. Loss of air due to seal leakage 	<ol style="list-style-type: none"> 1. Connect air supply 2. Increase air supply 3. Replace worn seals
Air leak at top or bottom bearings	<ol style="list-style-type: none"> 1. Damage to bearing internal or external O-ring seal 2. Damage to body bore 3. Damage to pinion shaft O.D. 	<ol style="list-style-type: none"> 1. Replace bearings and O-ring seals 2. Replace body 3. Replace pinion shaft
Air leak at end cap and body seal	<ol style="list-style-type: none"> 1. Damaged end cap seal 	<ol style="list-style-type: none"> 1. Replace end cap seals
Air leaking from either port after operation	<ol style="list-style-type: none"> 1. Damaged piston seal 2. Damaged body cylinder bore 	<ol style="list-style-type: none"> 1. Replace piston seal 2. Replace body
Insufficient valve rotation	<ol style="list-style-type: none"> 1. Actuator has failed 2. Insufficient air supply to produce required valve torque 3. Actuator mechanical stop (if present) not properly adjusted 4. Incorrect fit between actuator output bore and valve stem 	<ol style="list-style-type: none"> 1. Repair or replace 2. Increase air supply 3. Adjust actuator stops to allow more travel 4. Check actuator to valve adapter for proper size and fit



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Flow Control

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