

# Bettis RPX-Series

## Rack and Pinion Pneumatic Actuators



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# Section 1: Introduction

This Section explains:

- General pneumatic system recommendations

## 1.1 General Pneumatic System Recommendations

All Bettis RPX Pneumatic Actuators are factory lubricated with Castrol LMM grease, and unless the operating environment is extremely harsh, do not require relubrication.

For applications where the environmental temperature ranges from -40 °C to +65 °C (-40 °F to +149 °F), a low temperature version is available with L-NBR O-ring seals and Cassida Grease LTS 1 grease or Castrol Opti temp TT 1 + TT 1 EP.

For applications where the environmental temperature ranges from -52 °C to +65 °C (-62 °F to +149 °F), an extreme low temperature version is available with L-NBR O-ring seals and MolyKote® 33 Extreme Low temperature grease.

For applications where the environmental temperature ranges from -15 °C to +150 °C (+5 °F / +302 °F), a high temperature version is available with FKM O-ring seals and Castrol Premium Heavy Duty grease.

To maintain maximum efficiency with this actuator, we advise that the following basic system recommendations are followed:

1. For maximum cycle life, the air quality of compressed air should be 2.4.1 as per ISO 8573-1 standard.
2. Where pipelines are subjected to extremes of temperature, the system should be fitted with suitable air drying equipment.
3. When working at low temperatures, it is important that the compressed air has been dried to a dew point of less than the ambient temperature. If this is not the case, water will be condensed from the compressed air and freeze causing damage to the seals inside the actuator, which could result in actuator failure.
4. Air control lines should be fitted in accordance with a “Recommended Piping Practice” and should not have loops, which may trap condensate.
5. All air connection pipe ends should be thoroughly cleaned and deburred after cutting, to ensure that the pipeline is clear of debris.
6. If pipelines are hydraulically tested, then the lines should be “blown down” with pressurized air to clear all traces of water, prior to connecting lines to the actuator.
7. Where pipe fitting sealants are used, they should be applied to the male threads only, to avoid excess compound being forced into the actuator control lines.
8. Where air filter equipment is used, the air filters should be situated in positions that allow easy access to maintain and/or drain.
9. Where pneumatic valve positioners or pneumatic controllers are fitted to the valve actuator assemblies, oil mist lubricated air should not be used unless the manufacturer states specifically that the controllers are compatible with lubricated air.

## 1.1.1 Operating Media

1. Use clean, dry or lubricated air or inert gas.
2. Maximum Operating Pressure (MOP) = 8.3 barg / 120 psig.  
MOP is the pressure required to produce the maximum rated torque at the break position for all actuators. Pressure should not exceed MOP during valve rotation. MOP should be the maximum pressure regulator setting.

### **WARNING**

Do not exceed specifications. It can be assured that the housing will not rupture or burst when applying 10 bar / 145 psi of pressure but the cycle function cannot be guaranteed as it totally depends on the time span to which actuator is subjected at 10 bar / 145 psi and the frequency at which these pressure peaks occurs. Every time this peak occurs will, for sure, have a significantly negative effect on the life expectancy of the actuator.

### **WARNING**

For safety reasons, do not “air assist” Single-Acting Pneumatic Actuators.

## Section 2: Construction

This Section explains:

- General construction principles and storage recommendations

### 2.1 Construction

Bettis RPX Actuators are designed to be mounted to quarter turn valves either directly or using the correct mounting brackets/adapters and sizing products.

All models are of the opposed piston type. Each piston incorporates an integral rack which engages with a one piece pinion drive shaft. The drive shaft is Zinc + Nickel plated for maximum protection. The actuator body is of extruded aluminium, and fitted with “engineered polymer” bearings at the drive shaft locations. Bearing and piston seals are dynamic “O-ring” type.

The drilling pattern and drive of the actuator valve flange complies to EN ISO 5211. The drive is by means of a double square (star-drive) and most actuator sizes have 2 ISO drilling patterns.

The top mounting interface and solenoid mounting interface complies to the VDE/VDI 3845 (NAMUR) standard.

Adjustable travel stops are provided for each end of travel to ensure that the actuator will open and close the valve precisely.

### 2.2 Storage

All actuators leave the factory tested and in excellent working condition and finish. In order to maintain these characteristics until the actuator is installed in the plant, it is necessary to observe the following rules and take appropriate measures during the storage period.

1. Make sure that the transport plugs remain fitted in the air connections. These plastic plugs close the air inlets, but do not have a waterproof function, as they are a means of protection against the entry of foreign matter during transport. For long term and specifically outdoor storage, these plastic plugs need to be replaced with plugs providing a complete weatherproof protection.
2. If the actuators are supplied separately from the valves, they must be placed onto a wooden pallet in order to prevent damaging the valve coupling. For long term outdoor storage it is advised to coat the coupling parts with protective oil or grease.
3. In case of long term storage, it is advised to keep the actuators in a dry place or to provide some means of weather protection.

## Section 3: Standard Installation

This Section explains how to install the Bettis RPX actuators in most common applications like:

- "In-line" installation on quarter turn valves.
- "Transverse" (a.k.a. across line) installation on quarter turn valves.

The RPX Actuator can be used for butterfly valves, ball valves and all quarter turn devices, in Double-Acting or Spring-Return configuration. Single-Acting Actuators are supplied as FAIL - CLOSE (CW) as standard. Reverse acting (FAIL - OPEN; CCW) must be specified at the time of order. Alternatively, it is possible to change an actuator from FAIL - CLOSE to FAIL - OPEN by a trained and certified mechanical engineer using the assembly/disassembly instructions as described in this document.

These installation instructions assume that the actuator is installed with the cylinder axis parallel to the axis of the valve bore ("In-line" mounting). Please ensure that you have an actuator with the correct drive, and that the valve and actuator are in the following positions:

1. Double-Acting units and Spring-Return units in FAIL - CLOSE position: valve closed, actuator fully clockwise.
2. Double-Acting units and Spring-Return units in FAIL - OPEN position: valve open, actuator fully counterclockwise.

### 3.1 Butterfly Valve Application

Mounting to butterfly valves:

1. Screw the actuator mounting studs tightly into the actuator base.
2. Install the correct shaft adapter if required.
3. Mount the actuator onto the valve top flange and secure using a lock washer and nut on each mounting stud.

### 3.2 Ball Valve Application

Mounting to ball and high performance butterfly valves using a bracket:

1. Screw the actuator mounting studs tightly into the actuator base and secure the mounting bracket to the underside of the actuator using four nuts and washers as shown in Figure 1.
2. Install the appropriate coupling onto the valve stem. The coupling should be lightly tapped or pressed onto the valve stem. The use of a lubricant is recommended.
3. Mount the actuator and bracket onto the valve top flange using the appropriate bolts.



### 3.3 All Quarter-Turn Valve Types

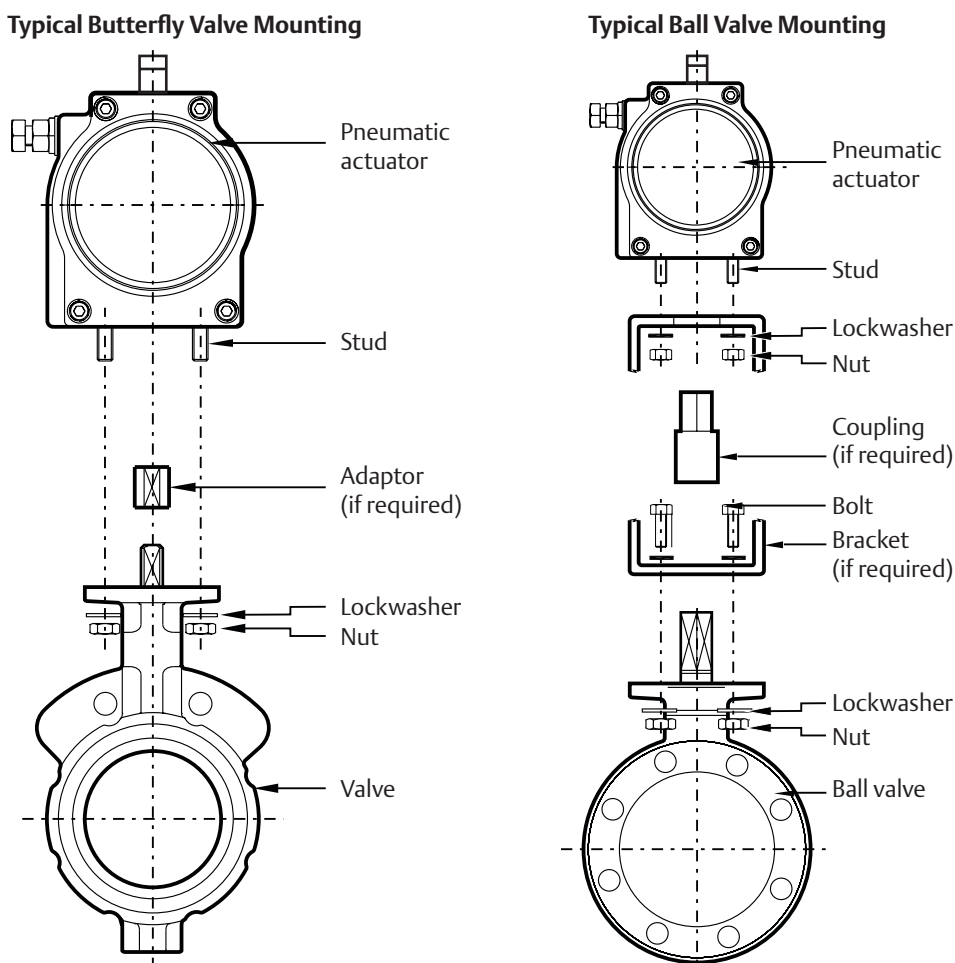
1. Before installing the valve/actuator assembly in a piping system, the disc travel should be verified and adjusted if necessary using the travel stop screws (see Section 5.4, Setting of internal travel stops).
2. When installing the valve/actuator assembly into the pipeline, ensure that the specific instructions relating to the valve installation are followed.

**NOTE:**

Some valves may require to be fitted into the pipeline prior to mounting the actuator. Rubber lined butterfly valves are an example of this.

3. For valves which need to be installed in the pipeline prior to fitting the actuator, ensure that the valve is operated into its failsafe position before mounting the actuator onto the valve.

**Figure 1 Actuator Mounting**



## 3.4 Non-standard Installation - Double-Acting and Spring-Return Actuators

In circumstances where the actuator is required to be installed in the transverse position i.e. at right angles to the valve bore ("across line" mounting), the actuator must be rotated through 90°. This is achieved in the following manner.

All quarter turn valve types:

1. Remove the actuator from the valve or the bracket by removing the 4 fixing bolts/nuts, and withdraw it vertically from the valve.
2. Reposition the shaft insert 90° for Double-D connections. Bored-keyed and star drives do not require this action.
3. Rotate the actuator 90°.
4. Refit the actuator to the top of the valve or to the bracket. Pay attention to the output drive of the actuator to be in line with the valve shaft and/or shaft insert.

## Section 4: Disassembly Procedure

This Section explains:

- How to disassemble an actuator safely.

### 4.1 Double-Acting Actuators

#### **WARNING**

Remove air pressure and observe normal safety precautions, including the use of eye protection.

1. Remove the indicator assembly (25) from the top of the actuator.
2. Remove both travel stop bolts (21), after slackening the lock nuts (23).
3. Verify that the end caps are for Double-Acting actuator (flat), and loosen end cap fixing screws evenly (22).
4. Remove the end caps (4).
5. Using a suitable wrench in the top of the pinion shaft (2), turn the shaft counter clockwise to drive the pistons apart. Remove the pistons (3) complete with backing pads/O-rings, etc.
6. Remove circlip (24) from the bottom bore of the actuator including thrust washer (13).
7. Protect the actuator bore during pinion disassembly, and tap pinion shaft downward. The travel stop cam (5) is firmly attached to the pinion and needs to be released before removing the pinion from the actuator body (1).
8. Remove the pinion, but take care to protect the actuator bore.
9. Remove top and bottom O-rings (16 and 17) from the pinion shaft.
10. Remove top and bottom bearings (10 and 11) from the pinion shaft.

## 4.2 Single-Acting Actuators

### WARNING

Observe safety precautions. Remove air pressure and observe normal safety precautions, including the use of eye protection. Always ensure that Spring-Return actuators are in fail safe position before attempting any maintenance. Pay particular attention to this requirement when manual operators are fitted.

1. Remove the indicator assembly (25) from the top of the actuator.
2. Remove both travel stop bolts (21), after slackening the lock nuts.
3. Loosen end cap fixing screws evenly (22) until the spring load is relaxed (3 - 5 mm).

### WARNING

High spring force. If after loosening the screws by 5 mm there is still compression on the spring pack re-tighten the end cap screws and return the unit to the factory for service.

4. Remove end caps (4) and spring packs. In order to avoid the springs falling out place the actuator with the end cap on top.

### WARNING

High spring force. Do not disassemble the precompressed spring packs, as the springs are under high force.

5. Using a suitable wrench in the top of the pinion shaft (2), turn the shaft counter clockwise to drive the pistons apart. Remove the pistons (3) complete with backing pads/O-rings, etc.
6. Remove circlip (24) from the bottom bore of the actuator including thrust washer (13).
7. Protect the actuator bore during pinion disassembly, and tap pinion shaft downward. The travel stop cam (5) is firmly attached to the pinion and needs to be released before removing the pinion from the actuator body.
8. Remove the pinion, but take care to protect the actuator bore.
9. Remove top and bottom O-rings (16 and 17) from the pinion shaft.
10. Remove top and bottom bearings (10 and 11) from the pinion shaft.

## Section 5: Assembly Procedure

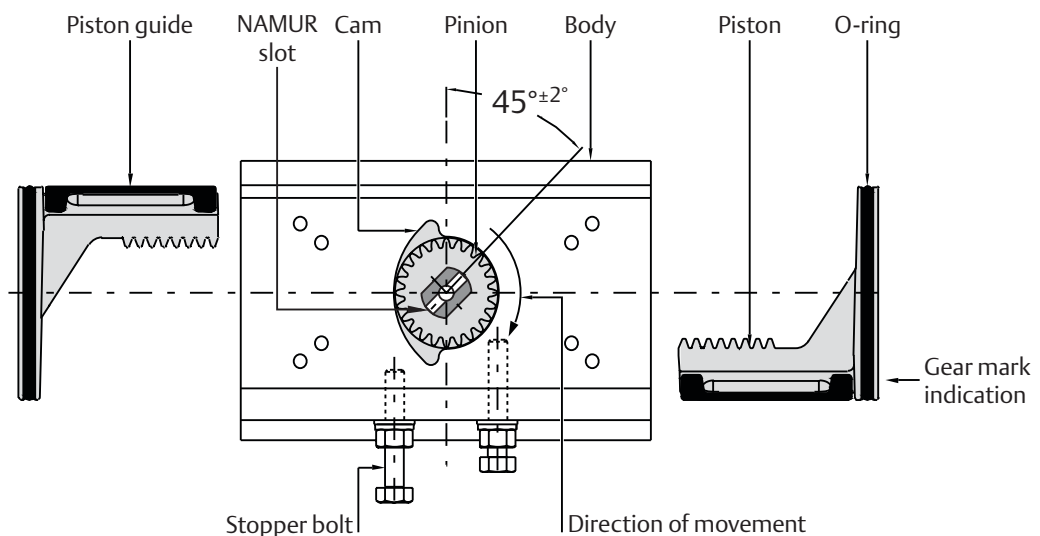
This Section explains:

- How to reassemble a complete actuator.
- How to set the stroke adjustment bolts after reassembly.

### 5.1 Assembly Double-Acting Actuators

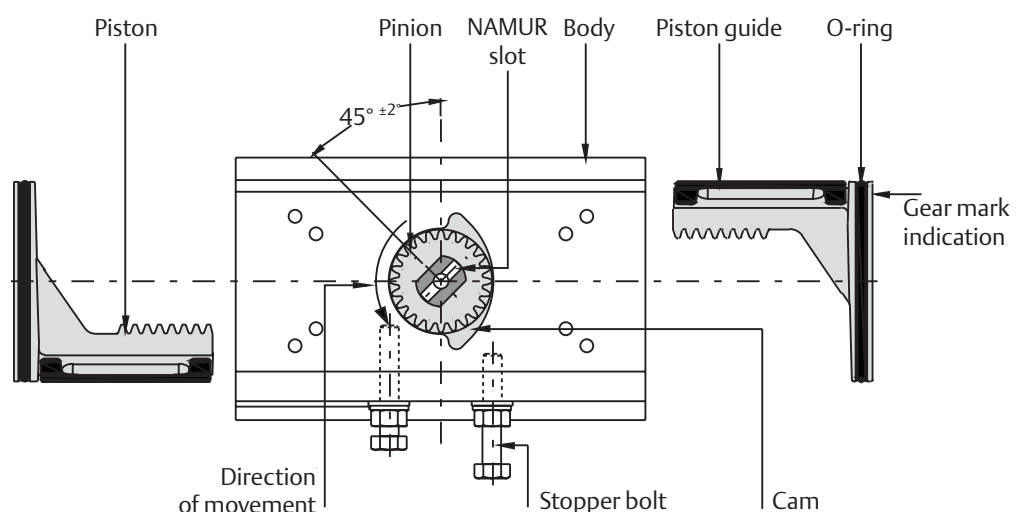
1. Clean all disassembled items and replace all items as O-rings, bearings, and backing pads as provided in the soft good kit.
2. Liberally grease the body bore with the grease specified.
3. Coat all O-rings and seals with the grease specified.
4. Output shaft assembly:
  - a. Fit the top bearing assembly (10) on the top of the pinion shaft (2) with the top O-ring (16) uppermost.
  - b. Fit the bottom bearing assembly (11) on to the bottom of the pinion shaft with the bottom O-ring (17) at the bottom.
  - c. Fit the top thrust washer (12).
5. Carefully insert pinion shaft assembly from underside of the actuator.
6. While inserting, fit the travel stop cam (5) on top of the pinion shaft from within the actuator bore and monitor the position of the NAMUR-slot in the shaft top and the travel stop cam as shown in Figure 2. Finish with a firm push to ensure full location.

**Figure 2** Standard direction of Rotation



7. Fit bottom thrust washer (13) and internal circlip (25) to bottom recess of body to locate the shaft assembly.
8. Fit the O-ring seals (18) on the pistons (3), and grease the rack.
9. Orientate the output shaft at  $45^\circ$  as in Figure 2.
10. Insert pistons completely with backing pads (9) with piston legs on left hand side of the bore when viewed from the O-ring end of the piston (Figure 2), until racks engages with the pinion and then push gently inward. The actuator is now in the fully closed position, and the shaft indication should be at  $-5^\circ$  (pointing slightly to the right).
11. Turn the pinion shaft counterclockwise until it is orientated in line with the major axis of the actuator body. The shaft is now in the closed position.
12. Insert the right (close) travel stop bolt (21) together with the O-ring (19), washer (14) and lock nut (23) until the bolt hits the travel stop cam. Tighten the lock nut.
13. Turn the shaft counterclockwise through  $90^\circ$  to bring it in line with the center line of the actuator bore. The actuator is now in the open position.
14. Insert the left (open) travel stop bolt (21) together with the O-ring (19), washer (14) and lock nut (23) until the bolt hits the travel stop cam. Tighten the lock nut. The position of the travel stop bolts need to be verified after valve assembly and adjusted if required.
15. Fit end cap gaskets (20) to the end caps (4) using a light smear of grease.
16. Fit Double-Acting end caps (flat model) to body evenly and tighten the end cap screws with the recommended torque (Table 1).
17. Fit position indicator assembly (25) to top of the actuator.
18. Operate the actuator to open and close positions using compressed air and note the actual positions. Adjust the travel stops if required following the routine described in this document. If the required travel is not achieved, refer to the troubleshooting guide.

**Figure 3** Non-standard direction of rotation



## 5.2 Assembly Spring-Return

### 5.2.1 FAIL - CLOSE - Clockwise to CLOSE

1. Follow the steps 1 to 14 of the Double-Acting assembly procedure.
2. For Spring-Return actuators, the following additional actions are required:
  - a. Turn the pinion (2) clockwise to the close position.
  - b. Position the actuator vertically with the piston top in a horizontal plane (make sure that the lower part is placed on a clean surface).
  - c. Locate the correct number of spring packs (6) in the cavities on the piston head. For durability, make sure to divide the number of springs evenly on both sides, with a maximum difference of 1 spring, and use the configuration as indicated in Figure 4 based on the number of springs.
  - d. Fit the first end cap as described in the following description and repeat the sequence for the other side.
3. Fit end cap gaskets (20) to the end caps (4) using a light smear of grease.
4. Place end cap on top of the spring packs and make sure that the springs are located in the spring pockets (cavities). Fit end cap to body evenly using end cap screws (22) and washer (15). Tighten the end cap screws with the recommended torque (Table 2). Make sure that the springs remain in position during assembly of the end cap.
5. Fit position indicator (25) to top of the actuator.
6. Operate the actuator to open and close positions using compressed air and note the actual positions. Adjust the travel stops if required following the routine described in this document. If the required travel is not achieved, refer to the troubleshooting guide.

### 5.2.2 FAIL - OPEN - Counterclockwise to OPEN

1. Follow the steps 1 to 8 of the Double-Acting assembly procedure.
2. Orientate the output shaft at 45° as in Figure 3.
3. Insert pistons completely with backing pads (9) with piston legs on right hand side of the bore when viewed from the O-ring end of the piston (Figure 5), until racks engages with the pinion and then push gently inward. The actuator is now in the fully open position, and the shaft indication should be at 95°.
4. Turn the pinion shaft clockwise until it is orientated in line with the center line of the actuator bore (90° position). The shaft is now in the open position.
5. Insert the left (open) travel stop bolt (21) together with the O-ring (19), washers (14) and lock nut (23) until the bolt hits the travel stop cam. Tighten the lock nut.
6. Turn the shaft clockwise to 0° to bring it in line with the major axis of the actuator body. The actuator is now in the close position.
7. Insert the right (close) travel stop bolt (21) together with the O-ring (19), washer (14) and lock nut (23) until the bolt hits the travel stop cam. Tighten the lock nut. The position of the travel stop bolts need to be verified after valve assembly and adjusted if required.

8. For Spring-Return actuators the following additional actions are required:
  - a. Turn the pinion counterclockwise to the open position.
  - b. Position the actuator vertically with the piston top in a horizontal plane (make sure that the lower part is placed on a clean surface).
  - c. Locate the correct number of springs in the cavities on the piston head. Use the configuration as indicated in Figure 6 based on the number of springs. For durability, make sure to divide the number of springs evenly on both sides, with a maximum difference of 1 spring.
  - d. Fit the first end cap as described in the following description and repeat the sequence for the other side.
9. Fit end gap gaskets (20) to the end caps (4) using a light smear of grease.
10. Place end cap on top of the spring packs, and fit end cap to body evenly using end cap screws (22) and washer (15). Tighten the end cap screws with the recommended Torque Table. Make sure that the springs remain in position during assembly of the end cap.
11. Fit position indicator (25) to top of the actuator.
12. Operate the actuator to open and close positions using compressed air and note the actual positions. Adjust the travel stops if required following the routine described in this document. If the required travel is not achieved, refer to the troubleshooting guide.

### 5.2.3 End Cap Bolt Torque Values

As the end caps are pressurized during normal operation, it's important to fix them correctly and not damage the threading due to excessive torque. Please use the torque values as indicated in Table 1.

**Table 1. End Cap Bolts Tightening Torque**

Actuator size	Bolt size	Tightening torque (Nm)	Tightening torque (lbf-in)
003	M5	3	27
004	M5	3	27
006	M5	3	27
009	M6	9	80
014	M8	15	133
020	M8	15	133
032	M10	28	248
052	M12	40	354
084 / 085	M12	40	354
140 / 141	M16	110	974
240	M16	110	974



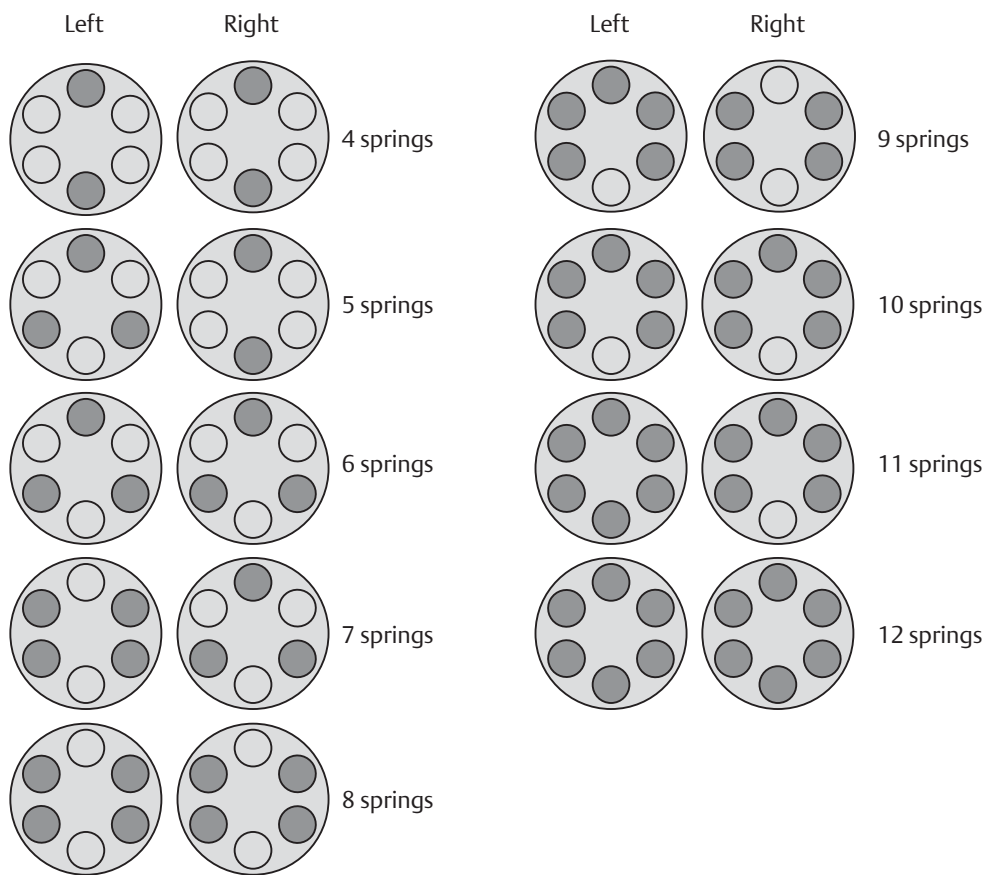
## 5.3 Spring Allocation

In Spring-Return applications, the number of springs used to determine the torque provided for fail safe applications. For optimal performance, the number of springs used is based on the valve type used using the RPX Actuator Torque Table (normally closed applications):

- Ball valves: use spring torque level which matches the spring torque at 90° with the supplied air starting torque at 0°.
- Butterfly valves: use spring torque level which matches the spring torque at 0° with the supplied air torque at 0°.

The number of springs used can vary between 4 and 12 pieces. For durability, make sure to divide the number of springs evenly on both sides, with a maximum difference of 1 spring, and use the configuration as indicated in Figure 4 based on the number of springs.

Figure 4 Spring Allocation



## 5.4 Setting of Internal Travel Stops

The Bettis RPX-Series Actuator is fitted with integral travel stops to enable setting of exact travel for the valve being operated. These stops allow over and under travel adjustment of  $\pm 5^\circ$  on each end.

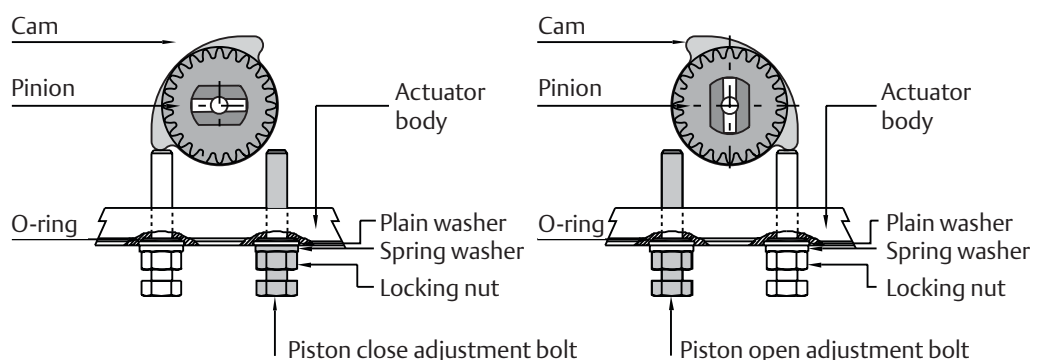
### **⚠ WARNING**

Under no circumstances the travel stop bolts should be completely withdrawn from the actuator while compressed air is being applied. Travel stop bolts should not be used for manual override actions. After setting the travel stops, accessories mounted to the top of the actuator must be re-adjusted accordingly.

### 5.4.1 Double-Acting Actuator

1. Operate the valve/actuator assembly to the closed position.
2. Remove air supply.
3. Slacken lock nut on the close travel stop (right).
4. Turn the travel stop clockwise to reduce travel or counterclockwise to increase travel.
5. Re-tighten lock nut.
6. Reconnect air supply and check that the close position is correct. If not, repeat from instruction 2.
7. Apply air to the open position.
8. Remove air supply.
9. Adjust open travel stop bolt (left) as per instruction 3 to 6 above.

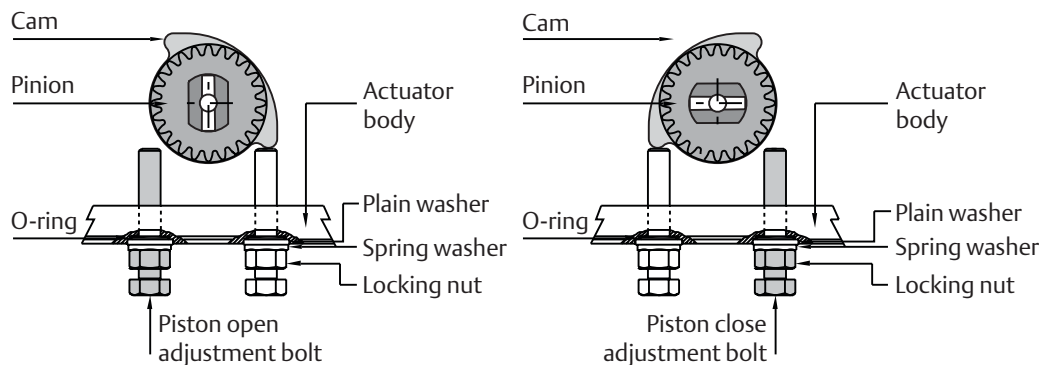
**Figure 5** Cam adjustment (standard direction of rotation)



## 5.4.2 Spring-Return Actuator FAIL - CLOSE

1. Remove air supply and check actual close position.
2. Apply air to operate the actuator to the open position.
3. Whilst the air supply is maintained, slacken lock nut on the close travel stop (right) as the close position is now able to be adjusted.
4. Turn the travel stop clockwise to reduce travel or counterclockwise to increase travel.
5. Re-tighten lock nut.
6. Remove air supply to close the actuator. If correct close position is not achieved repeat from instruction 2.
7. Apply air to drive the actuator to the open position and check actual open position.
8. Remove air supply so that actuator closes, and the open travel stop bolt (left) can be adjusted.
9. Adjust open travel stop bolt as per instruction above.
10. Re-tighten lock nut.
11. Apply air and check open position. If correct open position is not achieved, repeat from instruction 7.

**Figure 6 Cam Adjustment (Non-standard direction of rotation)**



### 5.4.3 Spring-Return Actuator FAIL - OPEN

1. Remove air supply and check actual open position.
2. Apply air to operate the actuator to the close position.
3. Whilst the air supply is maintained, slacken lock nut on the open travel stop (left) as the open position is now able to be adjusted.
4. Turn the travel stop clockwise to reduce travel or counterclockwise to increase travel.
5. Re-tighten lock nut.
6. Remove air supply to open the valve. If correct open position is not achieved repeat from instruction 2.
7. Apply air to operate the actuator to the close position and check actual close position.
8. Remove air supply so that actuator opens, and the close travel stop bolt (right) can be adjusted.
9. Adjust close travel stop bolt as per instruction above.
10. Re-tighten lock nut.
11. Apply air and check open position. If correct close position is not achieved, repeat from instruction 7.

## Section 6: Maintenance

### 6.1 Maintenance

Under normal operating conditions and when basic pneumatic system maintenance procedures are applied, the Bettis RPX Actuator will require minimum maintenance for hundred thousands of cycles.

If O-rings wear out and air leakage occurs, a soft goods kit can be ordered. Please use the (dis)assembly routines as described in this document. Carefully inspect all other components for wear and replace if required.

### 6.2 Troubleshooting

If the actuator fails to operate the valve correctly, carry out the following checks:

1. Check that the air supply is at the required pressure.
2. Ensure that the air supply is not restricted in any way.
3. Check for air leakage on supply lines to the actuator.
4. Check for air leakage at the top and bottom of the pinion shaft.
5. Check for air leakage across the piston seals by applying pressure to port 4 (B) and looking for leakage from port 2 (A) and/or reverse.
6. Check that the valve torque has not increased due to problems with the valve itself.

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**NOTE:**

1. Refer to disassembly and assembly procedures for gaining access to O-rings and actuator internals if required.
  2. Reduced stroke i.e. valve not traveling the required stroke or “backlash” may be caused by an incorrect fit between output bore and valve stem.
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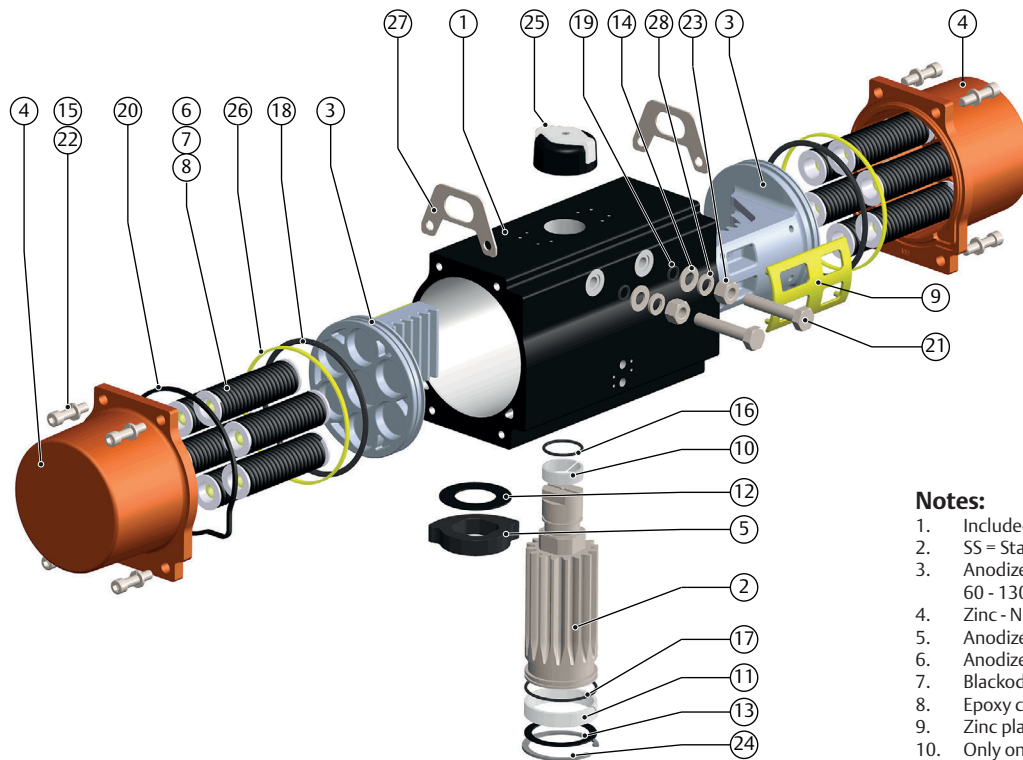
### 6.3 Pneumatic Air Connection

The Bettis RPX Actuator has 2 pieces of 1/4” BSP or NPT air connections which can be used for tube connection. Alternatively, it is possible to mount a NAMUR solenoid valve directly.

Comments:

1. As standard, applying air to port 2 (A) will cause the actuator to rotate in a counter clockwise (CCW) direction to open the valve.
2. For Double-Acting applications, applying air to port 4 (B) will cause the actuator to rotate in a clockwise direction to close the valve.
3. Single-Acting (also called Spring-Return) actuators should not be “air assisted” as this will apply excessive load to the valve stem and cause damage.

## Section 7: Parts and Materials



**Notes:**

1. Included in repair kits
2. SS = Stainless steel
3. Anodized: 5 - 8 microns + ESPC  
60 - 130 microns
4. Zinc - Nickel plated: 8 - 12 microns
5. Anodized
6. Anodized + ESPC 60 - 130 microns
7. Blackodised
8. Epoxy coated 20 - 30 microns
9. Zinc plated
10. Only on size 084 and larger.

**Table 2. Parts and Materials**

Pos.	Description	Qty.	Notes	Material	Material standards:		
					US ASTM	British	DIN
1	Body	1	3	Extruded Aluminium	B221: 6063T6	BS 1474: 6063	DIN 3.33206.51
2	Pinion	1	4	Hot rolled carbon steel	A108: grade 1045	BS 970: 080M40	V40
3	Piston	2	5	Die cast aluminium alloy	B85 A380	BS 1490: grade LM24	DIN1725: 2300 or 226
4	End cap	2	6	Die cast aluminium alloy	B85 A380	BS 1490: grade LM24	DIN1725: 2300 or 226
5	Cam	1	7	Cast grade SAE 1045/C45/ EN8			
6	Spring	max 12	8	Spring steel	A401	BS 5216 HS3	DIN 17223 Pti
7	Spring retainer	max 12	9	Carbon steel			
8	Spring cap	max 12	- 5	Polyamide grade 66 (up to size 052) Die cast aluminium (size 084 and larger)	- B85 A380	- BS 1490: grade LM24	- DIN1725: 2300 or 226
9	Backing pad	2	1	Zytel 101F NCO10			
10	Top bearing	1	1	POM Acetal Resin + 25% glass filled			
11	Bottom bearing	1	1	POM Acetal Resin + 25% glass filled			
12	Top thrust washer	1	1	Polyamide grade 66			
13	Bottom thrust washer	1	1	Polyamide grade 66			
14	Travel stop washer	2	2	SS ISO 3506 A2-70 grade			
15	End cap washer	8	2	SS ISO 3506 A2-70 grade			
16	O-ring pinion top	1	1	NBR shore 70 A			
17	O-ring pinion bottom	1	1	NBR shore 70 A			
18	O-ring Piston	2	1	NBR shore 70 A			
19	O-ring travel stop	2	1	NBR shore 70 A			
20	Gasket end cap	2	1	NBR shore 70 A			
21	Travel stop screw	2	2	SS ISO 3506 A2-70 grade			
22	End cap screw	8	2	SS ISO 3506 A2-70 grade			
23	Travel stop nut	2	2	SS ISO 3506 A2-70 grade			
24	Circlip	1	1/4	Carbon steel			
25	Indicator assy	1		ABS + SS A2-70 grade screw			
26	Piston head guide	2	1/10	Zytel 101F NCO10			
27	Lifting eye	2	10	Stainless steel			
28	Travel stop lock washer	2	2	SS ISO 3506 A2-70 grade			

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