

AVCO

Alloy Valves and Control

ACTUATORS PNEUMATIC - Q SERIES

INSTALLATION, OPERATION & MAINTENANCE MANUAL



This manual covers the installation, operation and maintenance of all AVCO Q Series pneumatic actuators as described in the current AVCO catalog.

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1 General Design

- 1.1 AVCO Q Series pneumatic actuators have been designed and engineered to provide long lasting and trouble free service when used in accordance with the instructions and recommendations detailed in this manual.
- 1.2 This compact pneumatic actuator has a 90° Double acting or Spring return rack and pinion system, which has been designed for the actuation of 1/4 turn valves or 1/4 turn applications. Air pressure is applied to the 4 pistons generating thrust which is then transformed from linear motion to rotary motion of the pinion. The four pistons are centrally located around one pinion within an aluminum housing.

2 Design Conditions

WARNING: *Do not operate the actuator with flammable, oxidizing, corrosive, explosive or unstable gases.*

WARNING: *Failure to operate the actuator within the stated limits below could result in death or injury to personnel and irrecoverable damage to the actuator itself. Any warranties will be void.*

2.1 Operating Media

- 2.1.1 Clean, dry or lubricated compressed air.
- 2.1.2 Light hydraulic oil.
- 2.1.3 Inert and non corrosive gases (consult AVCO for more information).

2.2 Supply Pressure

- 2.2.1 40 psig minimum.
- 2.2.2 120 psig maximum.

2.3 Operating Temperature

- 2.3.1 Standard (NBR/Buna N O-Ring): -5 °F to 175 °F
- 2.3.2 Low Temperature (LNBR O-Ring): -40 °F to 175 °F
- 2.3.3 High Temperature (Viton O-Ring): -4 °F to 250 °F

2.4 Lubrication

- 2.4.1 The actuator is supplied ready lubricated and no further lubrication is required.

3 Safety Precautions

- 3.1 Before carrying out any repair or maintenance on the actuator, ensure the pressure supply lines and electrical connections have been safely isolated, removed or disconnected by authorized personnel. The actuator must not be pressurized at any time during installation as injury may result.
- 3.2 Never put any part of your body in the opening or port of the controlled valve or device.
- 3.3 Special attention and precautions should be observed for the stored energy contained in the spring return pneumatic actuators.
- 3.4 Before installing the actuator onto a valve make sure that the rotation of the valve and the actuator are the same and that the position indicator orientation is also correct.
- 3.5 For correct operation, a pneumatic actuator must be sized adequately and with sufficient safety margins of torque output for the correct operating conditions of the valve.

WARNING: *Authorized and skilled personnel should only perform maintenance of these actuators.*

Alloy Valves and Control

4 Air Connections

- 4.1 The actuator air connections are 1/4" NPT located on a NAMUR manifold and marked A & B.
- 4.2 For sizes 15 thru 45 the air connections are horizontal with Port A to the right and Port B to the left.
- 4.3 For sizes 60 and 75 the air connections are vertical with Port A above Port B.
- 4.4 Pressure entering port A flows into the center chamber pushing the pistons outward and rotating the pinion counter clockwise (CCW) as viewed from above.
- 4.5 Pressure entering port B flows into the 4 outer chambers pushing the pistons inward and rotating the pinion clockwise (CW) as viewed from above.

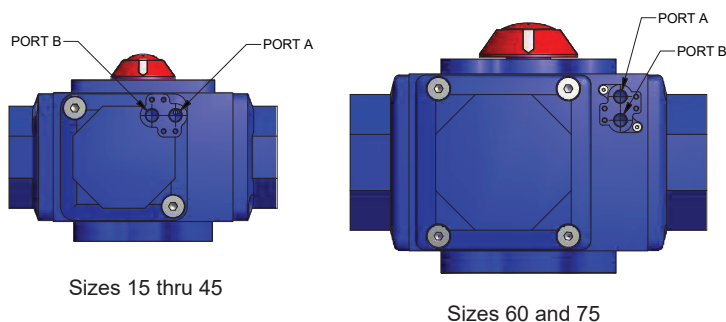


Fig 1 - Air Connections

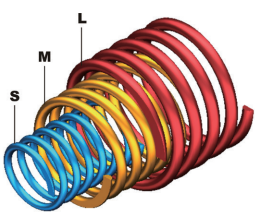
5 Principle of Operation

5.1 Double Acting

- 5.1.1 Air to port A forces the pistons outwards, causing the pinion to turn counter-clockwise, while the air is being exhausted from port B. Air to port B forces the pistons inwards, causing the pinion to turn clockwise while the air is being exhausted from port A.

5.2 Spring Return

- 5.2.1 Air to port A forces the pistons outwards, causing the springs to compress, the pinion turns counter-clockwise while air is being exhausted from port B. Loss of air pressure on port A allows the stored energy in the springs to force the pistons inwards. The pinion turns clockwise while air is being exhausted from port A.

S4	M4	S2M4**	S4M4	S4M2L2	
					
S4L4	S4M4L2	M4L4*	S2M4L4	S4M4L4	
					

S-small size spring; M-middle size springs; L-large size springs.

* Default spring setting for all QSR actuators except QSR15.

** Default spring setting for QSR15 only.

Fig 2 - Spring Configuration

5.3 NAMUR Solenoid Mounting

- 5.3.1 A NAMUR solenoid valve can be directly mounted onto the actuator via the mounting pad which conforms to NAMUR standards.

5.4 Bi-directional Stroke Adjustment

- 5.4.1 The Q Series actuators feature bi-directional pinion travel stops. These stops allow for true $\pm 5^\circ$ for valve

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travel adjustment to ensure precise positioning with all types of valves.

- 5.4.2 The Q Series actuator travel stops are designed to absorb the maximum rated torque of the actuator and the maximum impact loads associated with the recommended stroke speed.

5.5 NAMUR Solenoid Mounting

- 5.5.1 The Q Series actuators are supplied with a nameplate located on the side of the body. The information includes actuator model, type (Spring Return or Double Acting), spring set, serial number, pressure and temperature limits.

6 Maintenance

- 6.1 Refer to the exploded view in this manual for part number identification.

WARNING: For Spring Return units, ensure pressurized air/gas is completely exhausted.

- 6.2 Safely disconnect all electric power and supply lines connected to the actuator and/or accessories.
- 6.3 Remove all the accessories from the actuator (solenoid, limit switch box, etc.).
- 6.4 Remove the actuator from the valve.
- 6.5 Remove indicator screw (#11) and pull the position indicator (#12) from the shaft by using a smooth flat tool between the bottom of the indicator and the top of the actuator to carefully pry up the indicator, working your way around the indicator.

NOTE: Mounting the actuator on an AVCO coupler secured in a vice can aid the following procedures.

6.6 Disassembly of Double Acting Covers

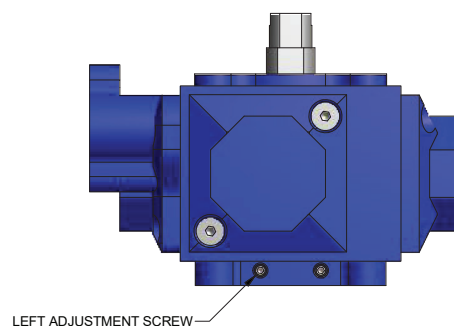
- 6.6.1 Mark the covers with the body before disassembly.
- 6.6.2 Remove the cover screws (#1).
- 6.6.3 Remove the covers (#2 and #20) making sure not to damage the Cover O-Rings (#4 or #19). When removing the NAMUR cover (#2), ensure the Air Supply O-Ring (#3) connecting to the inner chamber is secure in its groove.

6.7 Disassembly of Spring Return Covers

- 6.7.1 Mark the covers with the body before disassembly.
- 6.7.2 Remove the cover screws in sequence by turning each opposing screw two rotations at a time. When there are 4 screws in the cover (sizes 60 and 75), remove only two opposing screws first and then the remaining set.
- 6.7.3 Remove the covers (#2 and #20) one at a time making sure not to damage the Cover O-Rings (#4 or #19). When removing the NAMUR cover (#2), ensure the Air Supply O-Ring (#3) connecting to the inner chamber is secure in its groove.
- 6.7.4 Remove the springs (#5, #6, #7) from the cylinder and place them together as a set in their respective covers.

6.8 Piston Disassembly

- 6.8.1 Unscrew the two left most Adjustment Screws (#22), located toward the bottom of the actuator, about a 1/4" (6-10mm). This will allow the stop to rotate past the 90° limit allowing the pistons to come out.



**Fig 3 - Adjustment Screws
(opposite face similar)**

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- 6.8.2 Hold the actuator body with both hands and rotate it in the CW direction to eject the pistons.
- 6.8.3 Carefully remove the Piston O-Rings (#8). Do not use a sharp object to pry them out.

6.9 Pinion Disassembly

NOTE: *The pinion is removed through the bottom of the actuator - opposite to the indicator end.*

- 6.9.1 Sizes 15 thru 30
 - Remove the Circlip/Snap-ring (#13).
 - Push the pinion (#18) downwards and remove it from the body.
 - The Stroke Adjustment Stop (#17), Thrust Washer (#14) and Pinion O-ring (#16) will drop out with the pinion. The Stop and the Pinion should remain assembled.
- 6.9.2 Sizes 45 thru 75
 - Remove the Circlip/Snap-Ring (#13) and the Bearing (#15).
 - Carefully push the Pinion (#18) down and remove it from the body.
 - The top Thrust Washer (#14) is inserted in the body of the actuator and the top O-Ring (#16) is fitted to the Pinion. Both of them come out with the Pinion at the bottom of the body.
 - The Stroke Adjustment Stop (#17), Thrust Washer (#14) and Pinion O-Ring (#17) will come out with the Pinion. Make sure the Stroke Adjustment Stop (#17) remains on the Pinion in the same orientation that it was in when the Pinion was removed. Model Q75 has an integral Stroke Adjustment Stop.

6.10 Reassembly

- 6.10.1 If you have removed the pads (#21), push them back into their holes.
- 6.10.2 Sizes 15 thru 30
 - If the Stroke Adjustment Stop (#17) has been removed from the Pinion (#18), insert it back into place. Make sure the Stop Protrusions are at 45° to the NAMUR slot. There are two grooves on the bottom of the Stop which will help identify the stop orientation.
 - Once the Stroke Adjustment Stop (#17) is in place, fit the Thrust Washer (#14) and Pinion O-Ring (#16) on the Pinion (#18).
 - Insert the Pinion assembly into the body, from the bottom. Confirm that the tongue of the Thrust Washer (#14) engages into the groove in the body.
 - Insert the Pinion into the body by bringing the grooves of the Stroke Adjustment Stop (#17) perpendicular to the Adjustment Screws (#22) to ensure correct angle of rotation. Next, rotate the Pinion CCW until the protrusion flats contact the Adjustment Screws and the grooves in the Stroke Adjustment Stop are aligned with the threaded holes.
 - Fit the top Pinion O-Ring (#16), Thrust Washer (#14), Bearing (#15) over the top of the Pinion. Confirm that the tongue of the Thrust Washer (#14) engages into the groove in the actuator body.
- 6.10.3 Sizes 45 thru 75
 - If the Stroke Adjustment Stop (#17) was removed, place it over the Pinion (#18) followed by the bottom Thrust Washer (#14) and bottom Pinion O-Ring (#16).
 - Assemble the top Thrust Washer (#14) on the shoulder of the Pinion (#18).
 - Fit the top Pinion O-Ring (#16) in the groove on the Pinion. Apply grease to the Pinion assembly.

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- Insert the Pinion assembly into the body from the bottom. Confirm that the tongue of the Thrust Washer (#14) engages into the corresponding groove in the body. Be careful not to damage the top Pinion O-Ring (#16).
- Insert the Pinion into the body by bringing the grooves of the Stroke Adjustment Stop (#17) perpendicular to the Stroke Adjustment Screws (#22) to ensure correct angle of rotation. Next, rotate the Pinion CCW until the protrusion flats contact the Adjustment Screws.
- Insert the bearing (#15)

- 6.10.4 Insert a NEW Circlip/Snap-Ring (#13) on the Pinion. (NOTE: Always use a new Circlip/Snap-Ring!).
- 6.10.5 Slide the Indicator (#12) on the top of the Pinion and tighten with the Indicator Screw (#11).
- 6.10.6 Place the assembled actuator body on the coupler in the vice.
- 6.10.7 Rotate the body of the actuator 90° CW plus another 35° to 40° to bring it to the proper position for inserting the Pistons (#9).
- 6.10.8 Fit the Piston O-Rings (#8) on the Pistons (#9).
- 6.10.9 Apply Type B grease to the grooves and rack on the Pistons, the Piston O-Rings and inside the body cylinders.
- 6.10.10 Insert the four Pistons into the cylinders. The teeth of the racks must engage with the grooves on the Pinion. The Pistons will protrude slightly outside the actuator body.
- 6.10.11 Grasp the body of the actuator firmly with both hands and rotate the body CCW until it stops against the Adjustment Screws (#22) and all four pistons are drawn inside. Confirm that all four pistons are in the same position inside the cylinder.
- 6.10.12 Rotate the body back 90° CW to the open position so the outside face of the Pistons are almost flush with actuator body.
- 6.10.13 Using the Stroke Adjustment Screws (#22), adjust them until the Pinion flats are parallel with the outside plane of the actuator body.
- 6.10.14 Rotate the body freely back and forth to get the Pistons running smoothly.
- 6.10.15 Rotate the body to get the Pistons back in to the closed (drawn inside) position and once again apply Type B grease inside the cylinders, behind the pistons.
- 6.10.16 Apply grease to all of the Springs (#5, #6, #7 as applicable to your Model).
- 6.10.17 Insert the three Cover O-Rings (#19) into the groove on the inside of the three Covers (#20) and the NAMUR Cover O-Ring (#4) into the groove on the inside of the NAMUR Cover (#2).

NOTE: If the O-Rings are damaged, replace them with a new set.

- 6.10.18 Insert the Air Supply O-Ring (#3) into the groove on the inside of the NAMUR Cover (#2).
- 6.10.19 Apply Type B grease to Cover Screws (#1).
- 6.10.20 Install the NAMUR Cover (#2) first. If this is a Spring Return actuator, place the Spring Set(s) in the NAMUR Cover (#2) and then install the NAMUR Cover.
- 6.10.21 Place the Spring Set(s) in the three remaining Covers (#20) and install them, matching their

Model Size	Cover Screw	
	Size	Torque (in.lbs)
15 & 20	M5	30
25 & 30	M8	80
35	M10	160
45 thru 75	M12/M16	360

Table 1
Cover Screw Torque



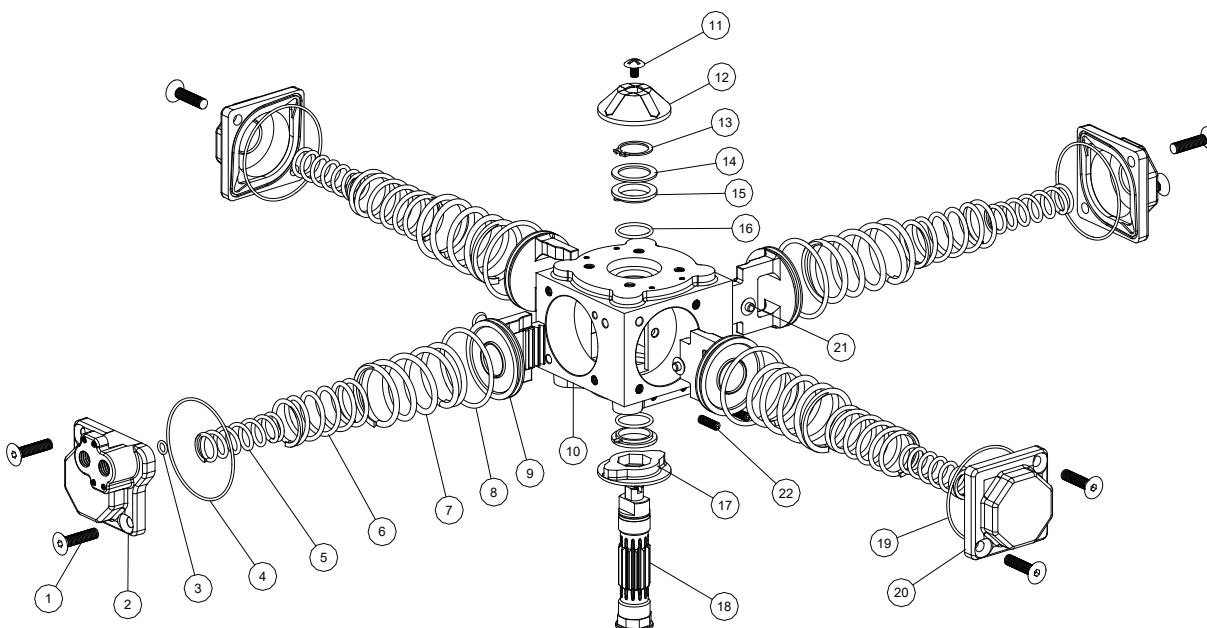
ACTUATORS PNEUMATIC - Q SERIES

Alloy Valves and Control

original location prior to disassembly.

6.10.22 Tighten the Screws (#1) - NOTE: Always tighten in sequence and only two turns at a time!

6.10.23 Torque the Screws to the to the torque values listed in table 1.



Item	Parts	Material	Qty.
1	End Cap Screw	Stainless Steel	8
2	NAMUR End Cap	Die Cast Aluminum 356	1
3	Air Supply O-Ring	NBR/Viton	1
4	NAMUR End Cap O-Ring	NBR/Viton	1
5	Spring - Small	Spring Steel	4
6	Spring - Medium	Spring Steel	4
7	Spring - Large	Spring Steel	4
8	Piston O-Ring	NBR/Viton	4
9	Piston	Die Cast Aluminum 356	4
10	Body	Gravity Cast Aluminum 356-T6	1
11	Indicator Screw	Stainless Steel	1

Item	Parts	Material	Qty.
12	Indicator	Plastic (ABS)	1
13	Circlip	Stainless Steel	1
14	Thrust Washer	POM	1
15	Bearing	POM	2
16	Pinion O-Ring	NBR/Viton	2
17	Travel Stop	Stainless Steel	1
18	Pinion	Nickel Coated Alloy Steel	1
19	End Cap O-Ring	NBR/Viton	3
20	End Cap	Die Cast Aluminum 356	3
21	Position Pad	POM	4
22	Stroke Adjustment Screw	Stainless Steel	4