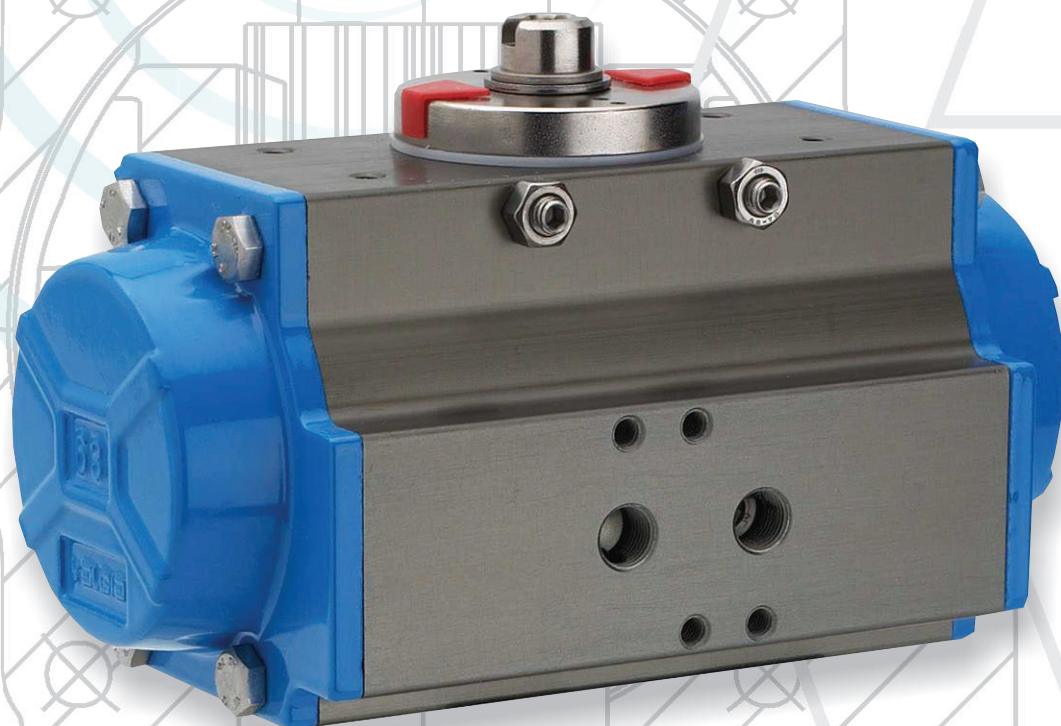


R RANGE

RACK AND PINION ACTUATORS

**INSTALLATION
AND
MAINTENANCE
MANUAL**



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1.0 Introduction

This manual is produced to enable a competent user to install, operate, adjust, inspect, and maintain Rotork Fluid Systems R range actuators. Users are responsible to follow the instructions in this manual as well as any additional documentation that has been supplied regarding the actuator or accessories supplied by Rotork Fluid Systems. Should further information or guidance relating to the safe use of R range actuators be required, it will be provided on request. Users are also responsible to be familiar with and follow any relevant legislation or statutory provisions regarding health and safety.

It is the users responsibility to ensure that the equipment is operated in a safe manner and that any personnel working with or on the equipment are properly trained for the work they are performing and are also aware of their responsibilities relating to health and safety in the workplace. It is extremely important that precautions are taken to avoid spark or static discharge in any areas of potentially explosive atmosphere.

All Rotork Fluid Systems actuators are tested prior to despatch. Job specific documentation is shipped with the actuator. Test certificates and replacement documentation are available upon request. The latest general information regarding any Rotork product is available on our website www.rotork.com.

INSTALLATION

2.0 Installation

2.1 Electrical Considerations

- 2.1.1 Any electrical connections required are the responsibility of the user. Connection documentation is supplied with the actuator. Refer to the applicable wiring diagram to identify functions of terminals. Verify that the electrical supply characteristics are compatible with the supplied actuator control components.
- 2.1.2 Only appropriate certified explosion-proof entry reducers, glands or conduit may be used if the unit is installed in a hazardous area. Remove any plastic transit plugs. Make cable entries appropriate to the cable type and size. Ensure that threaded adaptors, cable glands or conduit are tight and fully waterproof. Seal unused cable entries with a steel or brass plug. In hazardous areas an appropriately certified threaded blanking plug must be used.
- 2.1.3 Access to live electrical conductors is forbidden in hazardous areas unless done under a special permit to work. Otherwise, all power should be isolated and the unit moved to a non-hazardous area for repair or attention.
- 2.1.4 The actuator and control components must be protected from electrical spikes, surges, and lightning strikes as well as magnetic or electro-magnetic fields. This is the responsibility of the user.

2.2 Motive Power Supply (pneumatic, hydraulic)

- 2.2.1 Ensure that the actuator will not be exposed to pressure in excess to the maximum rating as indicated on the nameplate.
- 2.2.2 Verify that medium composition (e.g., filtration, hydration) correspond to that for which the actuator was manufactured. Rotork Fluid System must be contacted to verify compatibility of any proposed changes to supply medium.
- 2.2.3 Ensure that throughout the installation that there are no leaks of a potentially explosive supply medium (e.g., natural gas).

Note: Depending upon control circuit design, pneumatically powered actuators may exhaust the power supply gas to atmosphere in the course of normal operation. This may present an unacceptable hazard in some applications. Consult Rotork Fluid Systems if in doubt as to the suitability of the equipment supplied for your application.

2.3 Maximum Allowable Temperature

- 2.3.1 The use of Viton seals and high temperature lubricant in our standard build yields an actuator suitable for operating in environments ranging from -20° C to 150° C (-4° F to 300° F). Other temperature build options are available. It is the responsibility of the user to ensure that the maximum allowable temperature as indicated on the nameplate is not exceeded and also, in the case of sites where a potentially explosive atmosphere may exist, that the surface temperature of the actuator does not exceed the ignition point of the potentially explosive atmosphere.
- 2.3.2 Be aware that the temperature of the contents of the valve/pipeline as well as that of the power supply gas will affect actuator temperature. A build up of dust or dirt on the actuator can inhibit cooling and contribute to increased surface temperatures. The user should plan and provide for a periodic cleaning/maintenance program that will maintain the installation environment per the guidelines set forth in EN 1127-1 par 6.4.2.

2.4 Operating Environment

- 2.4.1 The user must ensure that the operating environment and any materials surrounding the unit cannot lead to a reduction in the safe use of, or the protection afforded by the actuator. Where appropriate, the user must ensure the actuator is suitably protected against its operating environment including, but not limited to, lightning strikes, vibration sources and vehicular movement.
- 2.4.2 If the unit has a nameplate indicating that it is suitable for installation in potentially explosive atmosphere (hazardous area), it must not be installed in a hazardous area that is not compatible with the gas groups and temperature class defined on the nameplate.

2.5 Mechanical Considerations

- 2.5.1 It is recommended that before lifting an actuator onto a valve, great care is taken to ascertain the position of the valve and orientate the actuator accordingly.
- 2.5.2 Rotork actuators can be mounted on valves in almost any desired position. It is usual however to align the centerline of the cylinder to the centerline of the associated pipe work.

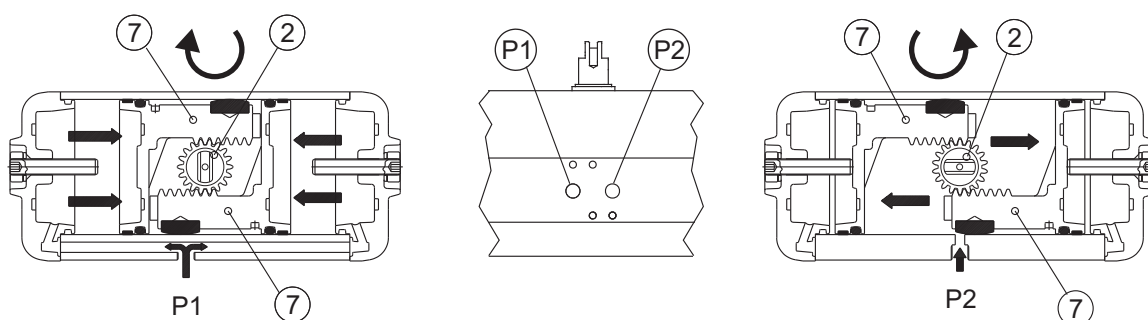
Note: Certain accessory and control components e.g., filter drains, hydraulic reservoirs; require proper orientation with respect to gravity to function properly. Contact Rotork Fluid Systems if in doubt.
- 2.5.3 Ensure all fasteners are adequately tighten to avoid loosening during the course of operation, taking into account vibration induced by the dynamics of the pipeline.
- 2.5.4 All tubing used to provide pneumatic/hydraulic power to the actuator must be free from contaminants and debris. Ensure tubing runs are adequately fastened and supported to minimise repetitive stress induced by any vibration induced by the dynamics of the pipeline.
- 2.5.5 When the actuator has been bolted to the flange or adapter, the position of the stop bolts should be checked to ensure full opening and closing of the valve. If these end of travel positions are not correct, the stop bolts may be adjusted by first loosening the fixing nut and then screwing the bolts in or out until desired end position is obtained. Stroke the yoke away from the stop bolt when adjusting, then return it to check position. When the correct positioning is obtained, re-tighten the fixing nut.
- 2.5.6 Certain valves incorporate their own stops. In these cases it is recommended that the actuator stop bolt positions coincide with the valve stop positions.
- 2.5.7 Ensure there are no leaks from any pneumatic or hydraulic connections. Tighten as required.
- 2.5.8 Once in position, the actuator should operate the valve with a smooth continuous action. If uneven operation occurs, the pneumatic/hydraulic power supply should be checked for correct pressure and volume flow. Flow may be restricted by undersize pipe or fittings. These could throttle the flow thus reducing the pressure and volume at the actuator and causing intermittent motion. Further fault detection procedures are outlined in Section 6.

3.0 Operation

3.1 Double-Acting

On double-acting actuators, pressurising port P1 generates force on the outboard side of both pistons. In the standard build configuration this will yield a clockwise rotation of the output shaft when viewed from the top side of the pinion. Venting is then through port P2.

Pressurizing Port P2 generates force on the inboard side of both pistons. In the standard build configuration this will yield a counter-clockwise rotation of the output shaft when viewed from the topside of the pinion. Venting is then through port P1.



3.2 Spring-Return

On spring-return actuators port P2 is pressurised to yield the air stroke. In the standard build configuration this will yield a counter-clockwise rotation of the pinion when viewed from the top side of the pinion.

De-pressurising port P2 allows spring force to push the pistons inward. In the standard build configuration this will yield a clockwise rotation of the output shaft when viewed from the top side of the pinion. Port P1 feeds the spring chambers and is not to be pressurised.



3.2.1 Spring Setting

Modification of the spring set may be necessary to meet the torque requirements and operational characteristics of your valve application. Consult the charts below to determine the configuration of each spring set. See Rotork publication F401iE for torque output data.

RSR52 - RSR125 SPRING COMPLEMENT		
SET #	INTERNAL	EXTERNAL
01	1	1
02	-	2
03	2	1
04	1	2
05	2	2

RSR160 - RSR200 SPRING COMPLEMENT			
SET #	INTERNAL	CENTRAL	EXTERNAL
01	-	2	-
02	-	-	2
03	-	2	1
04	2	-	2
05	-	2	2
06	2	2	2

RSR270 SPRING COMPLEMENT	
SET #	PER SIDE
01	2/3
02	3/3
03	3/4
04	4/4
05	4/5
06	5/5
07	5/6
08	6/6

4.0 Travel Adjustment

4.1 Adjustment of models 52-140

Rotation is 90° with adjustability of +/- 5° in both directions. Stop bolts threaded through the actuator body act upon a cam mounted to the pinion shaft.



4.2 Adjustment of models 32, 160, 200, 270

Rotation is 90° with adjustability of +/- 5°. Stop bolts threaded through each end cap act upon the piston faces limiting piston travel in the outboard direction only.



- 4.2.1 For models 160 - 270, an optional, externally mounted stop is available to limit inward piston travel +/- 5°. A single stop bolt is threaded through the housing and acts upon lobes on the pinion shaft extension.

Note: Damage may result if the stop bolt is placed in the incorrect hole.

- 4.2.2 If the actuator has been assembled so that inboard travel of the pistons results in clockwise rotation of the pinion when viewed from the top, the bolt should be inserted in the right hand hole as shown below.



- 4.2.3 If the actuator has been assembled so that inboard travel of the pistons results in counter-clockwise rotation of the pinion when viewed from the top, the bolt should be inserted in the left hand hole.

5.0 Maintenance

Rotork R range actuators are designed to be maintenance free and are lubricated for the life of the assembly. A minimum of 1,000,000 cycles can be expected under normal working conditions. They are designed to work for long periods in the most severe conditions, however, a preventative approach to maintenance helps prevent costly downtime and can actually reduce the cost of ownership. Rotork can provide an actuator maintenance contract tailored to meet each customer's individual requirements.

Rebuild kits containing guides and seals are available. It is worth noting, that particularly on the smaller sizes, with consideration of the labor and down time required, replacing the entire actuator may be a more cost effective solution.

5.1 Periodic Inspection

- 5.1.1 Ensure that the actuator correctly operates the valve within the required cycle time. The actuator should be cycled several times with all the existing controls such as remote control, local control and manual override; particularly if the actuator is not frequently operated.
- 5.1.2 Verify that the power gas supply pressure value is within the required range.
- 5.1.3 Visually inspect external components of the actuator for physical damage.
- 5.1.4 Check pneumatic connections for leakage. Tighten pipe fittings as required.
- 5.1.5 Inspect actuator paint work for damaged to ensure continued corrosion protection. Touch-up to applicable paint specification as required.

GREASE SPECIFICATION

6.0 Grease Specification

The actuator is lubricated for the life of the assembly under normal operating conditions. The following grease is recommended for any re-lubrication:

Manufacturer:	Mobil
Trade name:	Exxon N2
Consistency: (NLGI GRADE)-ASTM D217:	2
Worked penetration at 25°C-ASTM D217:	280 dmm
Dropping point - ASTM D2265	280°C
Viscosity of base oil at 40°C-ASTM D445:	110 cSt
Viscosity of base oil at 100°C-ASTM D445:	12 cSt
Minimum dispensing temperature:	-10°C

7.0 Disassembly

7.1 Disassembly models 52-140

- 7.1.1 Disconnect all pneumatic and electrical supplies from the actuator.
- 7.1.2 Remove accessories from the actuator.
- 7.1.3 Remove the actuator from the valve.
- 7.1.4 Place the actuator on a stable support.
- 7.1.5 Remove the end cap retaining screws (22) from each end cap (19, 20). **To avoid damage on spring return units, it is imperative to loosen the screws a little at a time, alternating between them.** All spring force will be safely released before the screws are disengaged.
- 7.1.6 Remove the end caps (19, 20).
- 7.1.7 Remove the pinion snap ring (10).
- 7.1.8 Remove the spacer ring (6).
- 7.1.9 Rotate the pinion (2) counter-clockwise in respect to the body (1). This will push the pistons (11) outward disengaging them from the pinion (2).
- 7.1.10 Remove the pistons (11) from the body (1). Do not pry at the edge of the pistons as seal damage may result. Instead, pull on the raised center portion of the piston (7) with pliers or a similar tool.
- 7.1.11 Remove the pinion (2) from the body (1).

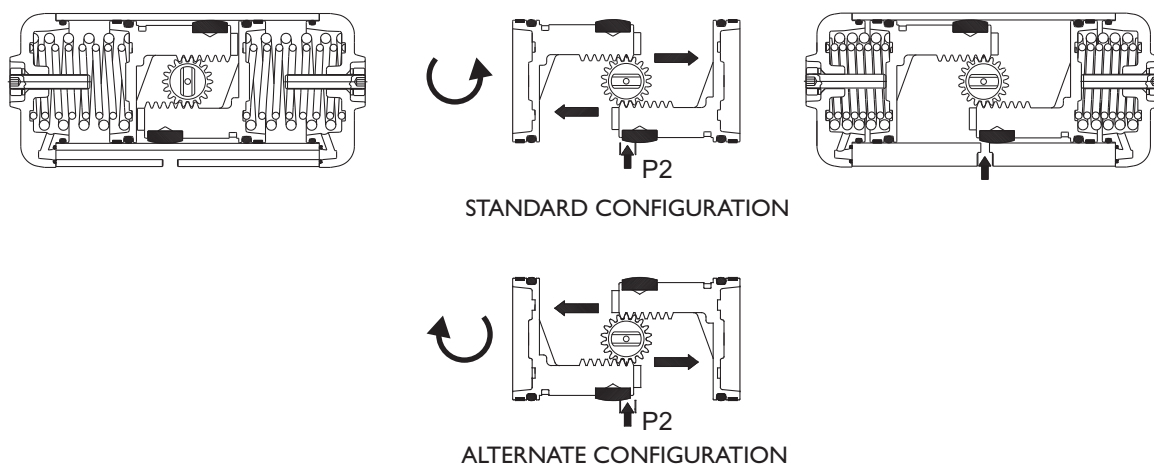
7.2 Disassembly models 160, 200, 270

- 7.2.1 Disconnect all pneumatic and electrical supplies from the actuator.
- 7.2.2 Remove accessories from the actuator.
- 7.2.3 Remove the actuator from the valve.
- 7.2.4 Place the actuator on a stable support.
- 7.2.5 Remove the end cap retaining screws (20) from each end cap (18, 19). **To avoid damage on spring return units, it is imperative to loosen the screws a little at a time, alternating between them.** All spring force will be safely released before the screws are disengaged.
Note: A press to compress the springs and relieve force on the retaining screws is recommended on sizes 160 and larger.
- 7.2.6 Rotate the pinion (2) counter-clockwise in respect to the body (1). This will push the pistons (7) outward against the stop bolts (14) disengaging the end caps (18, 19) from the body (1) and the pistons (7) from the pinion (2).
- 7.2.7 Remove the pistons (7) from the body (1). Do not pry at the edge of the pistons as seal damage may result. Instead, pull on the raised center portion of the piston (7) with pliers or a similar tool.
- 7.2.8 Remove the pinion snap ring (6).
- 7.2.9 Remove the spacer ring (5).
- 7.2.10 Remove the pinion (2) from the body (1).

8.0 Assembly

8.1 Assembly model 52-140

- 8.1.1 Ensure all parts are clean before proceeding.
- 8.1.2 Lightly coat the bore area of the body, all seals and their mating surfaces, and the rack and pinion gear teeth with Exxon Unirex N2 or equivalent.
- 8.1.3 Insert the pinion (2) into the body (1). Orient the pinion so that the flats of the double 'D' on the top of the pinion are parallel to the bore axis.
- 8.1.4 Place the actuator on a stable support.
- 8.1.5 In the standard build configuration spring stroke/inward piston travel generates a clockwise rotation of the output shaft when viewed from the top (double 'D') side of the pinion. Alternatively, the actuator can be assembled so the spring stroke/inward piston travel will generate a counter-clockwise rotation of the output shaft. The piston/pinion orientation to determine direction of rotation is shown below.



Slowly insert the pistons (11) into the body (1) from either end until the rack teeth engage the teeth of the pinion (2).

- 8.1.6 Rotate the pinion (2) 90° clockwise with respect to the body (1), or 90° counter-clockwise for the alternative configuration.
- 8.1.7 Confirm proper assembly by measuring the pistons are equidistant from the ends of the body.
- 8.1.8 On the top of the pinion, assemble the cam (6), spacer (7), washer (9) and snap ring (10).
Note: The snap ring required must be DIN471 - UNI7436.
- 8.1.9 Insert the travel stop bolts (16) into the body (1) and screw on the nuts (15).
- 8.1.10 For double acting actuators, mount the end caps (19, 20) with end cap retaining screws (22).
- 8.1.11 For spring return actuators, rotate the pinion (2) so that the pistons (11) are in the most inboard position. Insert the spring sets into the body (1) and onto the seats on the ends on the pistons (11).
- 8.1.12 Mount the end caps (19, 20) with end cap retaining screws (22). **To avoid damage, it is imperative to tighten the screws a little at a time, alternating between them.**

8.2 Assembly models 160, 200, 270

8.2.1 Ensure all parts are clean before proceeding.

8.2.2 Lightly coat the bore area of the body, all seals and their mating surfaces, and the rack and pinion gear teeth with Exxon Unirex N2 or equivalent.

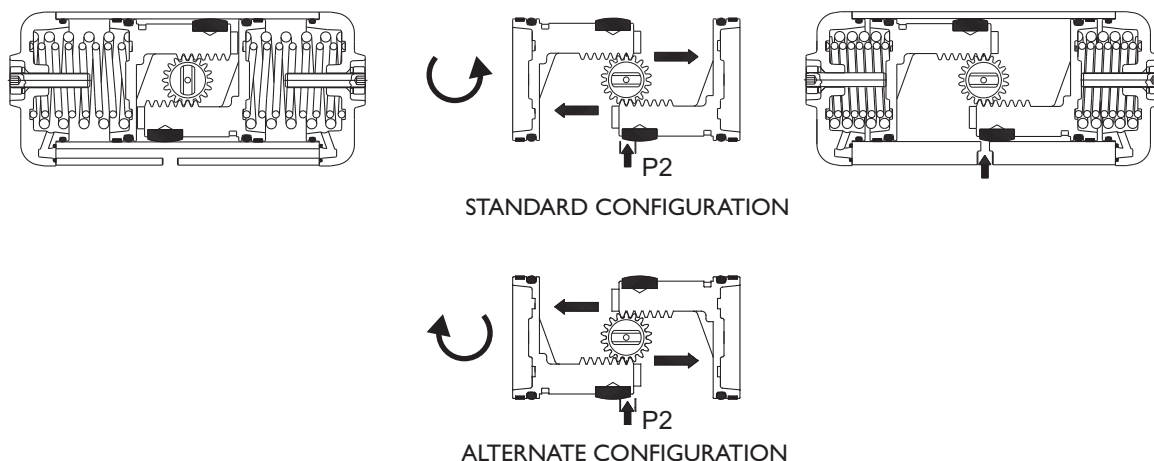
8.2.3 Insert the pinion (2) into the body (1). Orient the pinion so that the flats of the double 'D' on the top of the pinion are parallel to the bore axis.

8.2.4 Place the actuator on a stable support.

8.2.5 Secure the pinion with spacer ring (5) and pinion snap ring (6).

Note: Make sure the snap ring is properly seated in the groove or damage to the pistons and or pinion may result.

8.2.6 In the standard build configuration the spring stroke/inward piston travel generates a clockwise rotation of the output shaft when viewed from the top (double 'D') side of the pinion. Alternatively, the actuator can be assembled so the spring stroke/inward piston travel will generate a counter-clockwise rotation of the output shaft. The piston/pinion orientation to determine direction of rotation is shown below.



Slowly insert the pistons (7) into the body (1) from either end until the rack teeth come into contact with the teeth of the pinion (2). When the pistons are flush with the end of the body, the pinion flats must be parallel to the bore axis.

8.2.7 Rotate the pinion (2) 90° clockwise with respect to the body (1), or 90° counter-clockwise for the alternative configuration.

8.2.8 Confirm proper assembly by measuring the pistons are equidistant from the ends of the body and the flats of the pinion are now perpendicular to the bore axis.

8.2.9 For double acting actuators, mount the end caps (18, 19) with end cap retaining screws (20).

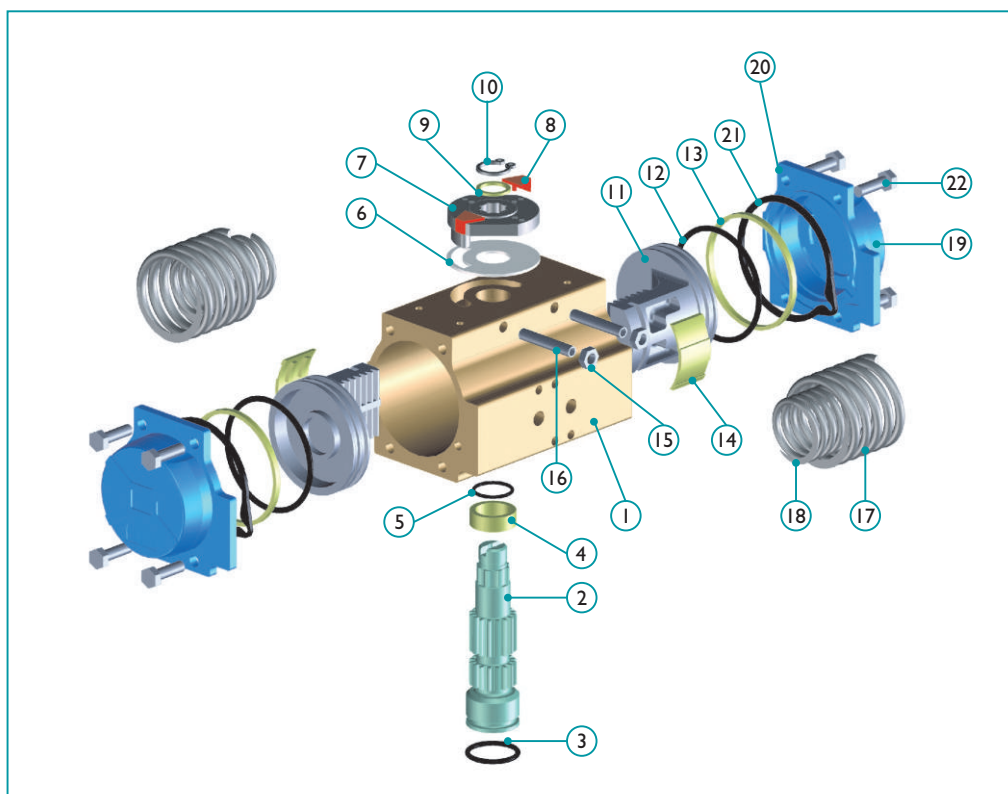
8.2.10 For spring return actuators, rotate the pinion (2) so that the pistons (7) are in the most inboard position. Insert the spring sets into the body (1) and onto the seats on the ends on the pistons (7). Mount the end caps (18, 19) with end cap retaining screws (20). To avoid damage, it is imperative to tighten the screws a little at a time, alternating between them.

Note: A press to compress the springs is recommended on actuator sizes 160 and larger.

9.0 Fault Detection

In the unlikely event of a fault developing, the following Fault Location table is provided to assist the maintenance technician. This table is designed to cover as wide a range of Rotork Fluid Systems actuators as possible. Reference to equipment not supplied should be ignored.

SYMPTOM	CAUSE	REMEDY
9.1 Erratic movement	9.1.1 Irregular supply of operating medium.	9.1.1.1 Check operating medium for consistent supply pressure and correct as necessary.
	9.1.2 Inadequate lubrication.	9.1.2.1 Dismantle, re-lubricate and reassemble.
	9.1.3 Worn parts	9.1.3.1 Dismantle. Visually inspect for significant wear. Actuator replacement may be required.
	9.1.4 Defective valve.	9.1.4.1 Consult the valve manufacturer's documentation.
9.2 Short stroke	9.2.1 Incorrectly set stops (valve and /or actuator).	9.2.1.1 Check the position of the travel stops and readjust as necessary.
	9.2.2 Hardened grease.	9.2.2.1 Dismantle, remove any hard grease, re-lubricate and reassemble.
	9.2.3 Debris left in the cylinder or housing during maintenance.	9.2.3.1 Disassemble cylinder assembly to remove debris. Reassemble cylinder assembly as necessary.
	9.2.4 Defective valve.	9.2.4.1 Consult the valve manufacturer's documentation.
9.3 Apparent lack of power	9.3.1 Inadequate supply pressure.	9.3.1.1 Ensure supply pressure is above the minimum operating pressure of the actuator and that output torque produced at supply pressure exceeds valve torque demand.
	9.3.2 Incorrect speed control settings.	9.3.2.1 Adjust speed controls to increase flow.
	9.3.3 Exhaust port blocked.	9.3.3.1 Remove and clean the exhaust port silencers and replace.
	9.3.4 Pipe work blocked, crushed or leaking.	9.3.4.1 Examine the pipe work for blockages, crushed pipe or leakage. Clear or replace as necessary.
	9.3.5 Defective controls.	9.3.5.1 Examine the controls, refurbish or renew as necessary. Refer to component manufacturer's documentation.
	9.3.6 Defective piston seal.	9.3.6.1 Dismantle the cylinder assembly, remove the defective piston seal. Fit new seal and reassemble.
	9.3.7 Defective rod seal.	9.3.7.1 Dismantle the cylinder assembly, remove the defective rod seal. Fit new seal and reassemble.
	9.3.8 High valve torque or valve seized.	9.3.8.1 Consult the valve manufacturers documentation.

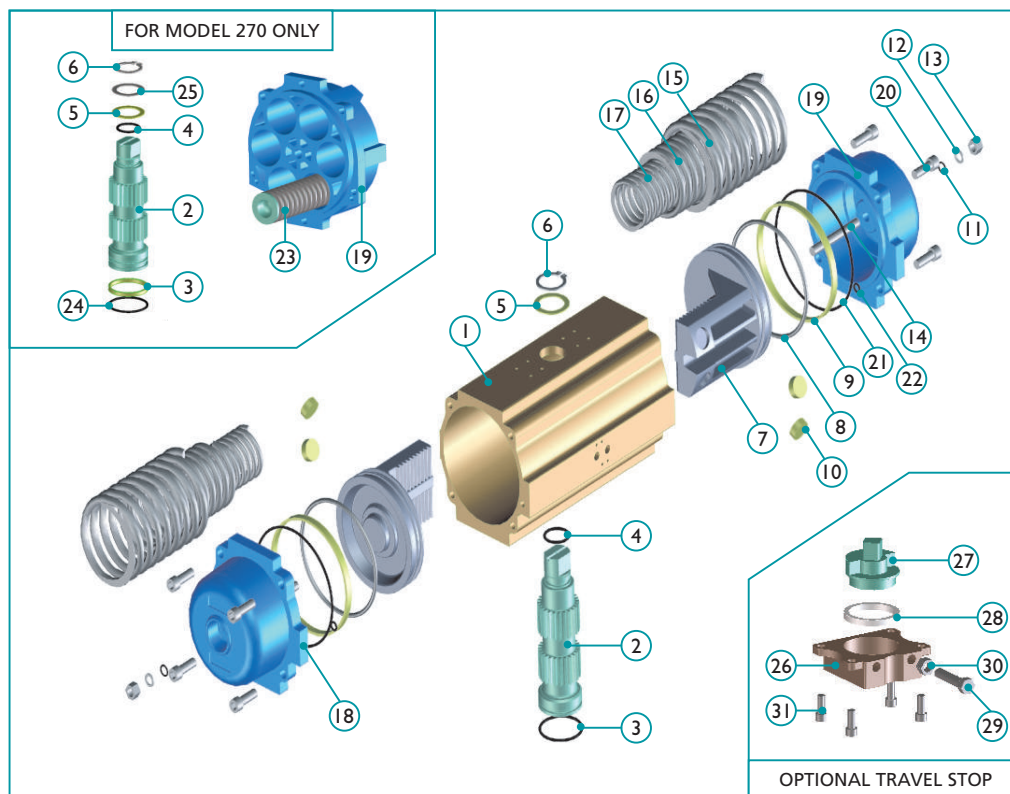


ITEM	DESCRIPTION	MATERIAL	QTY
1	Body	Extruded Aluminum UNI6060	1
2	Pinion	Nickel-Plated Steel	1
● 3	Lower Pinion O-Ring	Viton	1
▲ 4	Pinion Spacer Ring	POM	1
● 5	Upper Pinion O-Ring	Viton	1
▲ 6	Cam Spacer Ring	POM	1
7	Cam	Stainless Steel	1
8	Position Indicator	Nylon	1
9	Pinion Washer	Stainless Steel	1
▲ ● 10	Pinion Retaining Ring	Steel	1
11	Piston	Die Cast Aluminum	2
● 12	Piston O-Ring	Viton	2
▲ 13	Anti-friction Ring	POM	2
14	Piston Thrust Block	POM	2
▲ 15	Stop Bolt Retaining Nut	Stainless Steel	2
16	Stop Bolt	Stainless Steel	2
17	External Spring	Steel	■
18	Internal Spring	Steel	■
19	Left End Cap	Die Cast Aluminum	1
20	Right End Cap	Die Cast Aluminum	1
● 21	End Cap O-Ring	Viton	2
22	End Cap Retaining Screw	Stainless Steel	8

■ Applicable for spring return units only. Quantity varies based on torque requirement.

● Included in seal kit.

▲ Included in guide kit.



ITEM	DESCRIPTION	MATERIAL	QTY
1	Body	Extruded Aluminum	1
2	Pinion	Nickel Plated Steel	1
● 3	Lower Pinion O-Ring	Viton	1
● 4	Upper Pinion O-Ring	Viton	1
▲ 5	Pinion Spacer Ring	PTFE 15% Graphite	1
▲ 6	Pinion Snap Ring	Nickel Plated Steel	1
7	Piston	Die Cast Aluminum	2
● 8	Piston O-Ring	Viton	2
▲ 9	Anti-Friction Ring	PTFE 15% Graphite	2
▲ 10	Piston Thrust Block	PTFE 15% Graphite	4 6★
11	Stop Bolt O-Ring	Viton	2
12	Stop Bolt Washer	Stainless Steel A2	2
13	Stop Bolt Retaining Nut	Stainless Steel A2	2
14	Stop Bolt	Stainless Steel A2	2
15	External Spring	Steel Zinc Phosphated	■
16	Central Spring	Steel Zinc Phosphated	■

ITEM	DESCRIPTION	MATERIAL	QTY
17	Internal Spring	Steel Zinc Phosphated	■
18	Left End Cap	Die Cast Aluminum	1
19	Right End Cap	Die Cast Aluminum	1
20	End Cap Retaining Screw	Stainless Steel A2	8 12★
● 21	End Cap O-Ring	Viton	2
22	Supply Passage O-Ring	Viton	2
23 *	Spring	Steel Zinc Phosphated	Varies
24 *	Anti-friction Ring	PTFE 15% Graphite	1
25 *	Pinion Washer	Stainless Steel A2	1
OPTIONAL INWARD PISTON TRAVEL ADJUSTMENT			
26	Housing	Ductile Iron	1
27	Coupling	Nickel-Plated Steel	1
28	Anti-friction Ring	PTFE	1
29	Stop Bolt	Steel	1
30	Stop Bolt Retaining Nut	Stainless Steel	1
31	Mounting Bolt	Stainless Steel	4

■ Applicable for spring return units only. Quantity varies based on torque requirement.

● Included in seal kit.

▲ Included in guide kit.

★ Valid for model 270 only.

Manufacturing Centres

Germany Melle

Tel: +49 (0)5422 9414-0
Fax: +49 (0)5422 9414-10
sales@rfs-pci.de

Italy Tassignano - Lucca

Tel: +39 0583 93061
Fax: +39 0583 934612
fluid@fluidsystem.com

Sweden Falun

Tel: +46 (0)23-587 00
Fax: +46 (0)23-587 45
Email:
info@remotecontrol.se

United States Rochester, NY

Tel: +1 585 247 2304
Fax: +1 585 247 2308
rfsinfo@rotork.com

Centres of Excellence

Australia Bayswater, Victoria

Tel: +61 (0) 3 9729 8882
Fax: +61 (0) 3 9729 8884
sales@rfsaustralia.com

Canada Calgary, Alberta

Tel: +1 403 569 9455
Fax: +1 403 569 9414
info@rotork.ca

Singapore

Tel: + 65 6457 1233
Fax: + 65 6457 6011
mail@rotork.com.sg

Spain Bilbao

Tel: + 34 94 676 6011
Fax: + 34 94 676 6018
rotork@rotork.es

United Kingdom Bramley, Leeds

Tel: +44 (0)113 236 3312
Fax: +44 (0)113 205 7266
sales@rotorkfluidsystem.co.uk

United States Houston, TX

Tel: +1 713 856 5640
Fax: +1 713 856 8127
rfsinfo@rotork.com

United States Petaluma, CA

Tel: +1 707 769 4880
Fax: +1 707 769 4888
rfsinfo@rotork.com

United States North Kingstown, RI

Tel: +1 401 294 1400
Fax: +1 401 294 3388
Email: sales@remotecontrol.us

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