

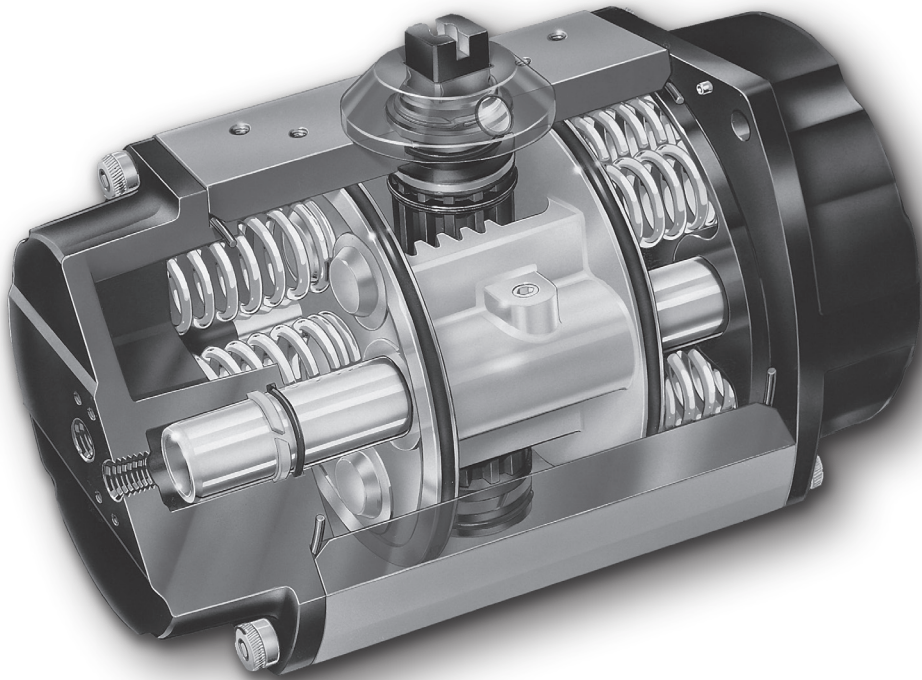


USER INSTRUCTIONS

NORBRO Series 40R Pneumatic Actuator

FCD NBENIM0002-03-A4 07/15

*Installation
Operation
Maintenance*



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1 SAFETY SYMBOLS

The safety terms DANGER, WARNING, CAUTION and NOTE are used in these instructions to highlight particular dangers and/or to provide additional information on aspects that may not be readily apparent.



DANGER: indicates that death, severe personal injury and/or substantial property damage will occur if proper precautions are not taken.



WARNING: indicates that death, severe personal injury and/or substantial property damage can occur if proper precautions are not taken.



CAUTION: indicates that minor personal injury and/or property damage can occur if proper precautions are not taken.



NOTE: indicates and provides additional technical information, which may not be very obvious even to qualified personnel. Compliance with other, not particularly emphasised notes, with regard to transport, assembly, operation and maintenance and with regard to technical documentation (e.g. in the operating instruction, product documentation or on the product itself) is essential, in order to avoid mistakes, which, in themselves, might directly or indirectly cause severe personal injury or property damage.

2 HEALTH AND SAFETY

When installing or maintaining actuators:

- 2.1 Conduct a risk assessment and eliminate or reduce hazards to an acceptable level.
- 2.2 Work in accordance with Safe Systems of Work.
- 2.3 Observe all site Health and Safety Rules in particular Permit to Work and Hot Work procedures.
- 2.4 Wear all necessary Personal Protective Equipment.
- 2.5 Never remove or maintain an actuator or joint unless the supply has been fully de-pressurised, drained and where necessary, purged of toxic / explosive / flammable media. Always operate the actuator to ensure that no trapped pressure exists.
- 2.6 Never handle actuators that have been used on harmful substances unless they have been completely decontaminated and certified safe to handle.
- 2.7 Never use an actuator on a duty, which exceeds its prescribed operating parameters. Refer to Flowserve Flow Control Technical Sales for further information.
- 2.8 Never modify or alter actuators unless the manufacturer has been consulted and/or recommends such changes.

- 2.9 Due to the large physical size and weight of some sizes of this product, always use correct lifting methods and equipment when installing, removing and maintaining the product, and that it is correctly supported in its final operating location.
- 2.10 Due to the variety of duties on which this product can be employed, it is the end users responsibility to ensure the compatibility of the product with the specific application (i.e. air supply, torque, corrosion, which may effect it's suitability).
- 2.11 Before equipment is installed in areas which may be subject to seismic activity or extreme climatic conditions consult Flowserve Flow Control Technical Sales.
- 2.12 If the processes or environments that the products are used in are likely to cause temperatures (high or low) that may cause injury to personnel if touched, then adequate insulation/protection must be fitted.
- 2.13 If the equipment is to be used on unstable gas duty, ensure that the operational parameters as indicated on the product label cannot be exceeded.
- 2.14 This equipment should be protected by other devices to prevent over-pressurisation. (i.e. caused by external fire etc).
- 2.15 This equipment must be installed in a system that is designed to prevent excessive forces acting on the mounting kit, switch box/positioner, connections etc.
- 2.16 Care must be taken when removing the actuator or accessing the valve that the actuator does not unexpectedly operate due to the stored failsafe spring torque, causing personal injury.
- 2.17 This equipment is not a safety device and must be controlled / guarded by other devices.
- 2.18 Do not rub actuator with a dry cloth as this can cause a build up of static charge. Only clean with a damp cloth.

Standard units feature an extended top shaft for manual override capabilities and a completely modular design which allows simple attachment of a variety of accessories. All units allow the direct mounting a solenoid control block which properly directs supply air to the actuator.



WARNING: Series 40R actuators are electro-mechanical devices subject to normal wear and tear. Actuator life is dependent upon application and environmental conditions. If applied in hazardous services such as, but not limited to, media temperature extremes, toxins, flammables, or other services where improper or incomplete operation could produce a safety hazard, it is incumbent upon the system designer and the user to provide proper warning devices such as temperature sensors, oxygen sensors and flow sensors. Flowserve also recommends that the optional auxiliary limit switches be used for monitoring and/or electrical interlock.



CAUTION: When actuator is installed in outdoor conditions, water can enter the exhaust holes of the double-acting solenoid block, and then freeze. Flowserve suggests a cover be used, or mount the actuator such that the solenoid block is upside down.

Do not install spring-return models with air connection in end cap or with integral solenoid vertical, without proper precautions to eliminate the ingress of water spray or rainfall. Exposed end cap or solenoid vent port will allow water to accumulate in spring chambers.

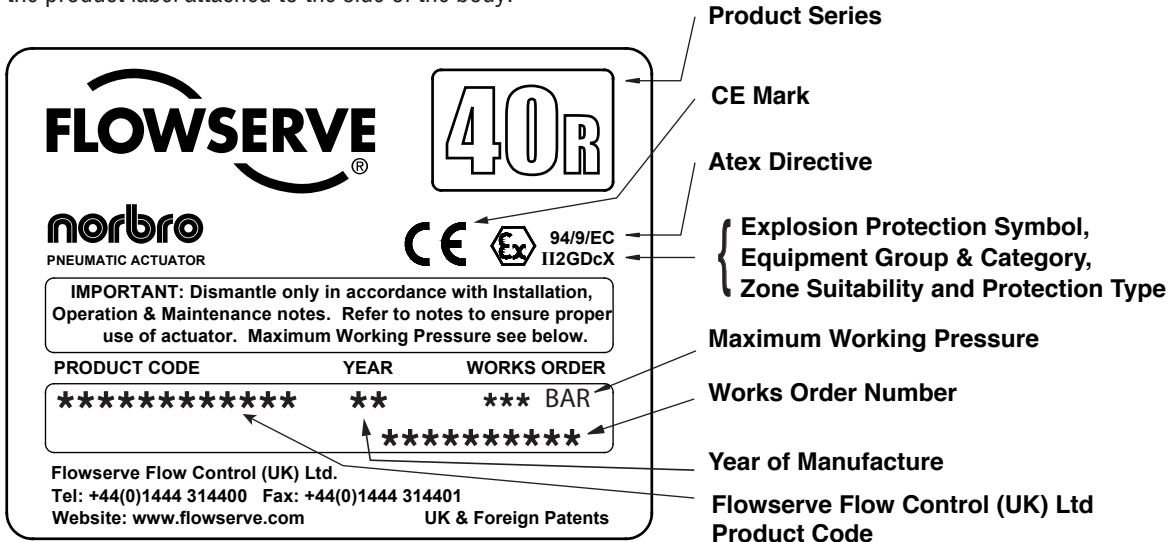
Flowserve recommends that all products which must be stored prior to installation be stored indoors, in an environment suitable for human occupancy. Do not store product in areas where exposure to relative humidity above 85%, acid or alkali fumes, radiation above normal background, ultraviolet light, or temperatures above 50 °C or below 4 °C may occur. Do not store within 50 feet of any source of ozone.

3 DESCRIPTION

NORBRO Series 40R actuators are pneumatic quarter-turn valve actuators. The design utilizes a double-rack, single pinion concept, with each rack integrally cast to a piston. On sizes 10-50, both pistons are supported and centered by large, stainless steel guide rods that are also used to control the rotation of actuator via externally mounted stroke adjustment screws. In double-acting units, both pistons are pressurized on both strokes of the actuator.

4 ACTUATOR MARKINGS

Each actuator has the following identification information on the product label attached to the side of the body:



ATEX Directive: If the product label carries the ATEX Directive number '94/9/EC' followed by the Explosion Protection Symbol and codes identifying the equipment group and category, the zone suitability and protection type beside the CE mark, the product complies with the ATEX Directive and The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996.

Definition of product label marking above:

'II' = Equipment Group.

'2' = Equipment Category.

'G' = Gas Zone suitability (Zones 1 & 2).

'D' = Dust Zone suitability (Zones 21 & 22).

'c' = type of protection i.e. constructional safety (prEN 13463-5).

'X' = Special temperature reference (Surface Temperature: As per BS EN 13463-1:2001 paragraph 14.2g, the temperature class or maximum surface temperature cannot be marked on the product as it is dependent on the operating conditions).

The operational temperature range is as follows:

(S) = Standard -20 °C to +100 °C.

(L) = Low Temperature variant -40 °C to +85 °C.

(H) = High Temperature variant -20 °C to +150 °C.

! **NOTE:** Under constant use the surface temperature of expose parts may rise by a maximum 20 °C above the operating media temperature.

5 INSTALLATION



NOTE: The Series 40R actuator is normally installed with its major axis parallel to the pipe line. The actuator can be oriented above, beside or beneath the valve without affecting its operation.

Sizes 10-35 actuators may come with an ISO locating ring, used for optional ISO mounting.

Size 40-50 actuators have an integral ISO location ring.

- 5.1 Determine mode of operation desired (normally open or normally closed) of the valve.
- 5.2 Determine desired quadrant for bracket attachment and direction of mounting of actuator (in-line or cross-line).
- 5.3 Attach mounting bracket to actuator using four (4) cap screws and lock washers provided in mounting kit. To avoid any damage to the Series 40R actuator body, ONLY the proper length screws supplied with the mounting kit should be used.
- 5.4 If an ISO locating ring is used, insert ISO locating ring into groove on bottom of actuator before attaching to bracket. Ring can be permanently held in groove by applying Loctite® 638 to ring before inserting in groove.



NOTE: Size 40R, if furnished with factory solenoid, shall be "cross-line" mounted (i.e. at 90 degrees to the pipe run) to ensure adequate clearance for air connections.

5.5 Prepare valve for actuation:



CAUTION: Ball valves can trap pressurized media in the cavity. If it is necessary to remove any valve body bolts, stem nuts, or remove valve from the line, and if the valve is or has been in operation, make sure there is NO pressure to or in the valve and operate valve one full cycle.



NOTE: It is not normally necessary to remove any valve body bolts or remove valve from line in order to mount actuator.

5.5.1 Rotate valve ball and stem to position necessary to achieve desired operation.

5.6 Attach bracket/actuator assembly to valve as follows:

5.6.1 Center coupling on valve stem.

5.6.2 Lower mounting bracket/actuator assembly over coupling and onto valve, making sure that female star drive or NORBRO square actuator shaft engages in the correct orientation with the coupling.

5.6.3 Secure bracket to valve using cap screws and lock-washers, or bolts and nuts provided in mounting kit. Tighten securely.

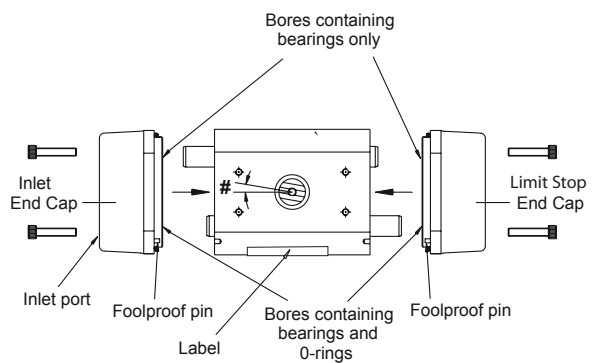
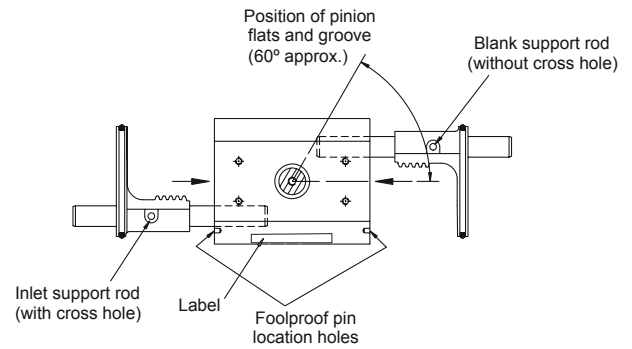
5.6.4 Install set screws (if any) in coupling and tighten securely.

5.6.5 Determine if mode of operation (air to open or close/fail open or closed) is as desired; if not:

Air to Open or Close - On all sizes of 40R double-acting and spring-return actuators, the female drive shaft is either a NORBRO square or a star drive. This allows selection of either mode of operation by indexing the coupling (including valve ball and stem) 90° to the actuator shaft, while keeping the actuator in an in-line orientation.

Fail Open or Fail Close - The normal method of mounting is to have the actuator in line with the pipe line and the valve and actuator in the “FAIL-CLOSED” (Clockwise to close) position. “FAIL-OPEN” can be achieved using the method above but the actuator will then work as Clockwise to open).

For “FAIL-OPEN” but with Clockwise to close operation, the pistons in the actuator will need to be removed and reassembled from the opposite ends of the actuator (keeping the guide rods the same sides relative to the body). This will result in a slight offset of pinion position on some sizes. See following:



Actuator Size	Pinion Offset Angle #
05	0°
10	10°
15	2°
20	2°
25	2°
30	2°
33	2°
35	2°
40	0°
42	0°
45	0°
50	12°

6 FITTING INDICATORS

Actuator sizes 10, 15, 20

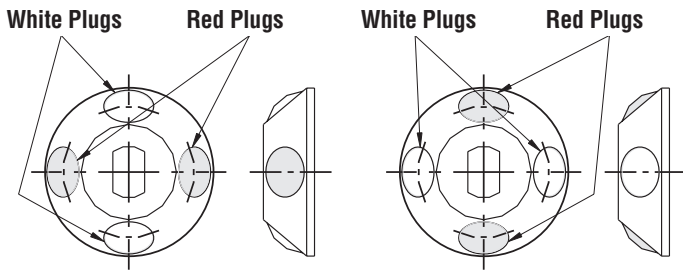


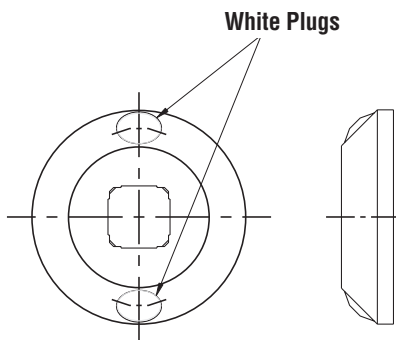
Fig.: 1
As supplied

Fig.: 2
Alternative Indicating Position

! **NOTE:** Indicator is set up to show pistons together on actuator, i.e. valve closed when in-line mounting - See Fig. 1.

- 6.1 Check which visual indication is required.
- 6.2 Check that indicator when located on pinion will show correct indication.
- 6.3 To change indication, push out red and white buttons and reassemble in alternative position.
- 6.4 Locate indicator on pinion flats. Press firmly until location nibs fit into recess on pinion.

Actuator sizes 25, 30, 33, 35, 40, 42, 45, 50



- 6.5 Check which visual indication is required.
- 6.6 Locate indicator on pinion flats. Press firmly until location nibs fit into recess on pinion.

7 AIR SUPPLY AND INSTALLATION

7.1 Air Supply:

The Series 40R actuator is factory lubricated. For optimum operation, the use of filtered and lubricated air is recommended.

7.2 Air Supply Pressure:

Standard double-acting actuators require 2–8 bar supply air. Spring-return actuators require 2.5–7 bar supply air. Spring-return actuators can also be set up to operate on supply air pressures ranging from 2.5–5.5 bar by using fewer springs. See “Rebuilding Instructions”, Spring-Return Actuator, paragraph 1 on page 13 for proper number and location of springs for reduced supply air pressures.



WARNING: Air pressure greater than the maximum on the label must not be applied.

7.3 Air Supply Connections:

Double-Acting – Connect air supply lines to both BSPP ($\frac{1}{8}$ ” on size 05/10: $\frac{1}{4}$ ” on sizes 15–50) ports.

Spring-Return Models – Connect air supply line to the outboard BSPP ($\frac{1}{8}$ ” on size 05/10: $\frac{1}{4}$ ” on sizes 15–50) port.

For sizes 10–50, the ports are on the solenoid end cap. The solenoid end cap is the one on the left end of the actuator when looking at the nameplate. For 05 size only, the ports are on the solenoid block interface plate on back of actuator when looking at the nameplate. For size 05 spring-return it is on the back and near center of actuator.

7.4 Recommended Tubing Sizes:

In order to provide sufficient flow of supply air to the Series 40R actuator, the following tubing sizes are recommended:

Actuator Size	Runs Up To 1.5 m Long	Runs Over 1.5 m Long
05, 10, 15, 20, 25	$\frac{1}{8}$	$\frac{1}{4}$
30, 33, 35, 40, 42, 45	$\frac{1}{4}$	$\frac{3}{8}$
50	$\frac{1}{4}$	$\frac{1}{2}$

8 AIR CONSUMPTION

The following chart shows the amount of pressurized (5 bar) air consumed per stroke in litres. To determine the total amount of air consumed per complete cycle for double-acting actuators, simply add the volumes for both the opening and closing strokes together; for spring return units, the total volume of air consumed is the volume shown for the opening stroke.

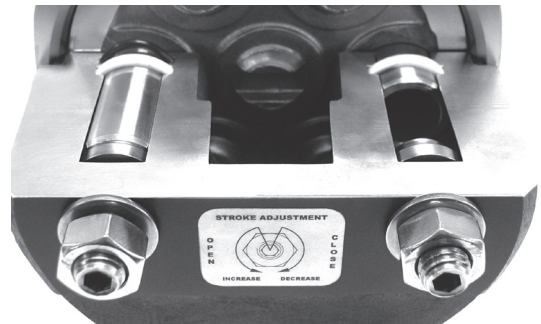
Actuator Size	Air consumption litres	
	Opening Stroke	Closing Stroke
05	0.05	0.05
10	0.17	0.22
15	0.35	0.39
20	0.69	0.74
25	1.22	1.31
30	1.86	2.05
33	3.39	4.79
35	3.93	5.54
40	7.73	8.19
42	12.0	13.89
45	13.51	20.0
50	23.87	30.5

spring-return actuators, closure is accomplished by means of springs contained within the end caps which force the pistons together when the supply air to the center chamber has been interrupted.

If rotation opposite to that described above is required, refer to the section on Installation for the proper procedure to reverse the rotation.

The accurate rotation of the actuator pinion is controlled through the adjustment of two hexagon headed bolts on the end cap. Each bolt will control either the open or closing stroke (based on how the actuator has been orientated on the valve). The adjustment of each bolt is shown on the end cap. Actuators are factory set to provide a 90° operation. If adjustment needs to be made the lock nut will need to be backed off, the adjustment screw rotated to provide correct positioning and the lock nut retightened. For size 10 to 35 turn screw clockwise to decrease rotation and counterclockwise to increase rotation. For size 40 to 50 the reverse applies. It is critical to retighten to ensure an effective seal of the washer.

Care should be taken to secure travel stop setting when tightening lock nut.



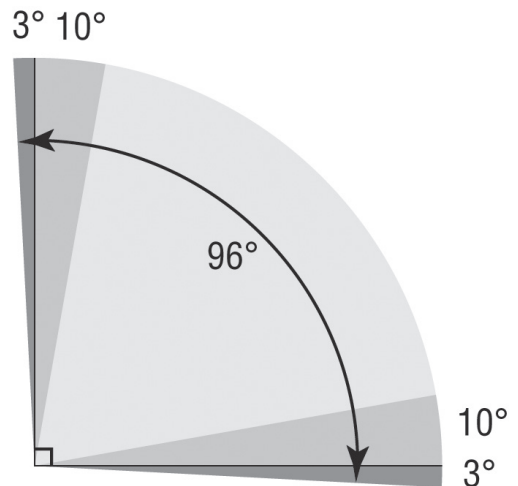
9 INSTALLATION OF ACCESSORIES

For details of installation of accessories refer to the installation instructions contained in respective accessory kit.

10 OPERATION

10.1 Basic Actuator

The Series 40R actuator drive shaft rotates through a full 90° segment with approximately 3° overtravel at each end of travel (limit stop version). Rotation is accomplished by feeding supply air into the center chamber, forcing the two opposing pistons apart, resulting in a counter-clockwise rotation of the drive shaft to the “open” position. For double-acting actuators, closure is obtained by feeding supply air into the end cap chambers, which forces the pistons together, resulting in a clockwise rotation of the drive pinion. For



10.2 Actuator With Solenoid

Double-Acting – Air is supplied to the one BSPP port on the bottom of the block. When the solenoid is energized, the spring-loaded plunger is withdrawn, allowing the supply air to shift the spool within the block, which opens the supply path to the center chamber of the actuator. Air from the end chambers of the actuator is allowed to pass through the block and exhaust to atmosphere.

When the solenoid is de-energized, the spring-loaded plunger blocks the flow of air to the center chamber of the actuator. The supply air now shifts the spool within the block to a position which opens the supply path to the end chambers of the actuator. Air from the center chamber of the actuator is allowed to pass through the block and exhaust to atmosphere.

The double-acting solenoid assembly is electrically fail-safe. That is, it will return to its de-energized position upon electrical failure and cycle the actuator to the closed position provided the air supply is not interrupted.

Spring-Return – Air is supplied to the one BSPP port on the bottom of the block. When the solenoid is energized, the spring-loaded plunger is withdrawn, which opens the supply path to the center chamber of the actuator. Air from the end chambers of the actuator is allowed to pass directly through the block and exhaust to atmosphere.

When the solenoid is de-energized, the spring-loaded plunger blocks the flow of air to the center chamber of the actuator. The springs in the end cap of the actuator, which were compressed on the opening stroke, now relax, forcing the air contained in the center chamber of the actuator to exhaust through its supply port in the solenoid block. The exhaust air passes through the block and the solenoid where it exhausts to atmosphere.

10.3 Standard Stroke Times

Standard stroke times of the Series 40R actuator are shown in the following table. Times shown are in seconds and represent average times under 50% load conditions with an air supply pressure of 5 bar. Times shown are per stroke for double acting actuators. For spring-return actuators, the opening stroke times may be slightly longer; stroke times for the closing (spring) stroke are dependent upon the number of springs used.

The figures shown below are meant as an indication of obtainable speeds only. Faster or slower speeds are obtainable, if required, by using additional control equipment.

Actuator Size	Stroke Time (sec.)
05	1
10	1
15	1
20	1
25	2–3
30	3–4
33	4–5
35	4–5
40	5–6
42	6–7
45	10–12
50	12–14

10.4. Manual Operation

In the event of air failure, the Series 40R actuator can be cycled manually. This is accomplished by applying a wrench to the exposed top shaft of the actuator and turning it in the desired direction.



WARNING: Care must be taken to ensure that the actuator is not operated automatically while manual operation is being performed.

11 MAINTENANCE



CAUTION: The actuator must be isolated both pneumatically and electrically before any maintenance activity is begun.

Periodic checks should be performed to make certain that all fasteners remain tight.

Actuator size	Fastener size	Torque
05	M5	4Nm
10	M6	9Nm
15	M6	9Nm
20	M8	19Nm
25	M8	19Nm
30	M10	35Nm
33	M10	35Nm
35	M12	49Nm
40	M12	49Nm
42	M16	98Nm
45	M16	98Nm
45	M20	216Nm

All actuators are supplied with sufficient lubrication for their normal working life. If required, recommended lubrication for all standard actuators is a Rocol Sapphire Lo-Temp 2 grease. Consult Flowserve for lubricants used for high or low temperature applications.

Depending upon the conditions under which the actuator must work, such as extended duty, non-compatible operating media or abnormal operating conditions, periodic replacement of internal seals is recommended. Repair kits containing all necessary seals can be obtained through any authorized Flowserve distributor.

On spring-return actuators, the springs may need replacement after extended duty since springs may fatigue and break. SPRINGS SHOULD ALWAYS BE REPLACED IN COMPLETE SETS.

12 SPARE PARTS

The following are recommended spare parts which should be kept on hand for Series 40R pneumatic actuators:

Repair Kit(s) – Kits contain all necessary seals, bearings and instructions.

13 TROUBLESHOOTING



WARNING: BEFORE DISASSEMBLING ACTUATOR FOR ANY REASON, CONSULT REBUILDING INSTRUCTIONS CONTAINED IN FOLLOWING SECTION.

For solenoid controlled actuators:

- 13.1 If actuator does not function, check to ascertain:
 - 13.1.1 That valve is free to rotate.
 - 13.1.2 That actuator is the correct size.
 - 13.1.3 Any speed control screws are loose (if screws are tightened all the way, actuator will not operate).
 - 13.1.4 That correct voltage is supplied to solenoid.
 - 13.1.5 That sufficient air supply is available at inlet to control block. Inlet pressure to control block should be at least 2.5 bar for double-acting, 5 bar for spring-return (unless a reduced spring complement is installed (fewer springs)). When checking supply pressure, place gauge in line at control block inlet and monitor gauge for unexpected pressure drops.
- 13.2 If proper voltage and air pressure have been verified and valve is free, proceed as follows:
 - 13.2.1 Turn on signal voltage. Check solenoid for clicking sound.
 - 13.2.2 If no sound is detected, remove air pressure and turn off signal voltage.
 - Carefully unscrew solenoid and solenoid stem from block.
 - Reapply signal voltage and observe solenoid plunger. If it does not retract, replace solenoid.
 - 13.2.3 If solenoid functions, remove solenoid valve block and place on bench. Connect to reduced air supply (4 bar) and correct voltage. Switch signal voltage and check air flow. Air should flow out only one output port when solenoid is energized. The flow should occur only at the other port when de-energized. (Slight back pressure may be required to shift the valve spool. This may be generated by obstructing the outlet ports.)
 - 13.2.4 If control block and solenoid are operating correctly, proceed to Section 13.3.2 below.
 - 13.3 If the actuator functions but exhibits leakage, or power loss accompanied by leakage, proceed as follows:
 - 13.3.1 Check voltage. Voltage must be within 10% of the specified voltage (low voltage will cause leakage out of the back of the solenoid and burn out the coil).
 - 13.3.2 Check air supply. Be certain that no sharp air pressure drops occur as unit is cycled. Loss of air pressure can cause incomplete shifting of the spool valves used in all double-acting units, which results in bypass leakage and substantial actuator torque losses.
 - 13.4 If air supply and voltage are adequate, proceed as follows:
 - 13.4.1 If leak is at solenoid exhaust port, replace the solenoid.
 - 13.4.2 If leak occurs at exhaust ports in the block itself, the trouble will be in either the spool valves in the block, or at one of the piston seals of the actuator. A leaking piston seal will usually leak on either cycle.

On spring-return actuators, piston seal leakage will show at the breather port of the end cap, or for O5 size, the solenoid block interface plate.

The recommended procedure in the cases above is to replace the spool valve O-rings. If the leakage persists, rebuild the actuator using a factory-supplied repair kit.
 - 13.5 For actuators without the solenoid control block, or if block and solenoid are operating correctly, remove the actuator from the valve, disassemble (per Rebuilding Instructions) and check the following:
 - 13.5.1 Make sure that all internal porting is free and clear of any obstructions. End caps, guide rods and pistons are air transporting components.

! **NOTE:** The most common problem encountered on 40R actuators is the improper replacement of the piston guide rod assembly with the hole in it, relative to the nameplate on the body (see section 14.2.7 on page 12).

13.5.2 Make certain that the actuator has lubrication, and that there is no solidified grease between the pinion and the piston racks:

- If actuator has no lubrication, apply generous amount of grease. If actuator is prepared for high or low temperature operation, consult Flowserve for proper lubricants.
- If solidified grease between the pinion and the piston racks is present, clean, dry, re-grease and reassemble.

13.5.3 Verify that actuator pinion shaft and/or pistons are not bound. If bound, reassemble per Rebuilding Instructions.

13.5.4 If unit exhibits excessive amounts of backlash, check teeth on piston racks for wear. If worn, replace piston assemblies.

13.5.5 In spring-return actuators, check for misplaced or broken springs. If springs are broken, check body bore for scoring:

- If springs are broken, replace springs. **SPRINGS SHOULD ALWAYS BE REPLACED IN COMPLETE SETS.**
- If body bore is scored, replace it. Also, replace piston O rings (contained in repair kit).

13.5.6 If actuator is free, valve is free and control block (if used) is shifting air properly, reassemble the actuator and retest. If unit still fails to operate, consult Flowserve.

14 REBUILDING INSTRUCTIONS

! **NOTE:** For identification of all numbered parts discussed below, consult exploded view of actuator (see pages 14/15)

After actuator has been repaired, mark rebuild label accordingly and apply to actuator.

14.1 Actuator disassembly

14.1.1 Disconnect the air supply and electrical service to the actuator.

14.1.2 Remove the actuator and its mounting bracket from the valve. If the actuator uses a positioner, loosen the set screws in the coupling between the valve and actuator. (See Caution note below.)



CAUTION: Ball valves can trap pressurized media in the cavity. Isolate the piping system in which the actuator/valve assembly is mounted and relieve any pressure on the valve. To remove the actuator bracket from a three-

piece non-top-mount style valve, the two top valve body bolts must be removed.

14.1.3 Remove the actuator bracket (and actuator positioner) from the actuator to begin repair. (Note mounting of removed bracket and positioner for easy reassembly.)

14.1.4 It is not necessary to remove solenoid control block (if so equipped) to rebuild actuator. However, if it becomes necessary to remove the block, begin by removing the solenoid block bolts. Use care to retain the solenoid block gasket.

For 05 size only, also remove the solenoid block interface plate (20) and the interface gasket (19) by removing the three screws (21).

For sizes 10 to 35 it is not necessary to remove the limit stop bolts from the end cap.



CAUTION: For sizes 40 to 50 the limit stop bolts will need to be removed to facilitate disassembly. On these sizes remove the air inlet end cap. Then remove the limit stop lock nuts and unscrew the limit stop bolts through the guide rods. This should be done in conjunction with the instructions below.

14.1.5 For sizes 10–50, each end cap (5A and 5B) is aligned onto the body (1) over a “foolproof pin”. This ensures that the end caps can only be assembled to their respective end of the actuator. Remove all four metric screws (5C) from, and remove, both end caps, remove the two bearings (6) and O-rings (15A and 15B) from each end cap. **Note** that for models with top-hat style bearings, the bearings and particularly the retaining washers (16) in each end cap should not be disturbed during O-ring seal replacement, as they are not included in the rebuilding kit. For size 05, remove all four metric screws (5C) from both end caps (5). Remove O-ring (15A) from each end cap.



WARNING: Spring return actuators contain energized springs. The following section must be followed to ensure safe disassembly of the actuator.

If the actuator is a spring-return model, first remove two end cap screws diagonally opposite each other, then lubricate the threads and under the head. Replace the screws and repeat the procedure for the other two screws. Do this for each end cap as this will aid reassembly. Now uniformly loosen all four end cap screws on each end cap two to three turns at a time, in sequence, to relieve preload of the springs. On larger actuators with springs use caution when removing end caps. End cap screws are long enough to allow springs to relieve before disengaging.

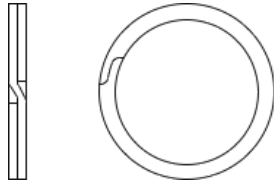
After the screws are removed, gently pry off each end cap, being careful not to damage the end cap O-Rings.

14.1.6 The two piston guide rod (4) assemblies can now be removed from each end of the body. Do not disassemble the piston from the guide rod. (To assist reassembly, mark the body with a line on the side from which the guide rod using the thru-hole is removed). Remove all O-rings (15B and 15C) and bearings (6B) from pistons (3). For size 05, the two pistons (3) can now be removed from each end of the body. Remove O-rings (15C) from pistons (3).

14.1.7 The shaft (2A) can only be removed after the piston assemblies are taken out. Remove the position indicator (17) (if any), the shaft clip (15F) (not a reusable part!) (see Note below) and the stainless steel washer from the top of shaft. Then remove the shaft through the larger opening in the bottom of the body. The top bearing (15G) and the O-ring (15D) can now be removed. Remove the two stainless steel washers (10–35 sizes only) and thrust bearing (10) from the top of the shaft, the O-ring (15E), and the bearing (15H) (10–42 sizes only) from the bottom end.

! **NOTE:** On later models only a single stainless steel washer is used and thrust bearing (10) is not used.

! **NOTE:** Some actuators may be using a spiral-ring type shaft clip as shown at right.



To remove this clip, engage the lower end of the ring with a flat blade screwdriver. Using another flat blade screwdriver push the top end of the clip in the opposite direction. As the clip I.D. expands, lift the clip from the shaft. The installation of a new clip would be the above steps in reverse and ensuring that the edges of the clip are properly seated in the shaft groove.

Sizes 25 through 42, have an anti-ejection ring (15J). The anti-ejection ring does not have to be removed and may or may not be included in repair kits.

14.2 Actuator reassembly

14.2.1 Be sure the actuator surfaces are clean and free of grit and scratches. If the inside walls of the body are scored, or the guide rod surfaces are scratched, the actuator will leak after rebuilding. New parts should be obtained from the factory. Light tracking, barely detectable to touch, is acceptable.

14.2.2 All rebuilding kit O-Rings and bearings may now be installed. Lubricate the standard actuator thoroughly with grease. Apply a light film of grease to all O-Rings.

14.2.3 If converting over to a “high-temperature” actuator, or rebuilding an existing one, lubricate thoroughly with high temperature silicone or graphite based grease.

! **NOTE:** Some older style actuators, sizes 10–35, use flanged bearings in the end caps. They resemble a “top hat”, and are installed with the brim of the hat facing out, and are retained by “star washers”. These bearings and star washers should not be removed for O-Ring seal replacement.

For sizes 10–50 replace the two split-ring style bearings (6) and one guide rod O-ring (15B) in each end cap.

Replace the split-ring style bearing (6) and guide rod O-ring(s) (15B) into I.D. groove(s) in each piston (3). Install O-Rings (15C) onto pistons.

For size 05 actuators, install O-rings (15C) onto the pistons.

14.2.4 Replace O-ring (15E) and bearing (15H) (10–42 sizes only) on the bottom of shaft. On the top of the shaft add the two stainless steel washers (10–35 sizes only) with the thrust bearing (10) between them. **NOTE:** On later models only a single stainless steel washer is used and thrust bearing (10) is not used. Locate the top bearing (15G) and O-ring (15D) into the body. Insert the shaft through the larger opening in the bottom of the body.

14.2.5 Replace the stainless steel washer over the top shaft extension.

- 14.2.6 For sizes 10–50, very carefully align the piston guide rod assemblies inside the body. Keep the pistons square to the body. (This is very important in the 30, 40R actuator where steel set screws can cause internal body damage if the piston assemblies “cock” inside the actuator body).

IMPORTANT: One piston guide rod assembly has a through hole drilled in it. It can be easily located by looking down the ends of both guide rods. This piston assembly must be reassembled, with its respective guide rod, opposite the nameplate on the body, as it was removed.

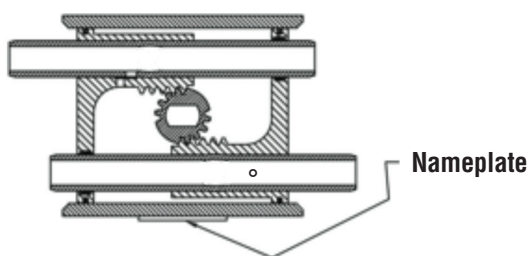


Figure 1
Pistons at End of Body

IMPORTANT: Note the relative location of the shaft teeth and the piston assembly’s rack teeth. The above figure is viewed when looking at the top of the actuator.

For size 05, align the pistons inside the body. Keep the pistons square to the body.

VERY IMPORTANT: Install the NEW shaft clip (15F) into its mating groove on the top shaft extension. (The removed shaft clip is not to be reused).

Place the numbered side up on the shaft clip and be certain the clip is fully seated in its groove. See Note at bottom of page 10 for installation of spiral-ring type shaft clip (which newer rebuilding kits will contain).

- 14.2.7 Align the shaft so that the teeth on the shaft will “pick-up” the piston assembly’s rack teeth when turning the top extension of the shaft clockwise (CW). (See Figure 1).

IMPORTANT: Proper 90° rotation can only be ensured if the shaft teeth begin to mesh with the piston assembly’s teeth at the “proper tooth” between these meshing gear pairs. (See Figure 1).

- 14.2.8 To ensure proper meshing of teeth, move the shaft 15 to 20 degrees counter-clockwise (CCW) from its normal position when the piston assemblies are located at the body ends. (See Figure 2.) NOTE: The “normal position” of the shaft on the 05–20 sizes is when the top flats are parallel to the main axis of the actuator body. On the 25– 50 sizes the teeth of the shaft will be on the left side of the actuator when viewed from the ends of actuator. (See Figure 1).

- 14.2.9 With the piston assemblies in the body, gently push each piston into the body. Turn the top shaft extension clockwise (CW). Do not allow the pistons to “cock”.

At the proper point of engagement between the shaft and piston assemblies, both piston assemblies will move toward the center of the body when turning the top shaft extension of the actuator clockwise (CW).

- 14.2.10 Once the shaft and pistons are properly engaged, ensure that smooth movement and 90 degree operation can occur without moving the pistons out of the actuator body. This is important!



CAUTION: For sizes 40 to 50 limit stop variant, the limit stop end cap must be assembled first. Once assembled, feed the limit stop bolts through the guide rods and screw into the end cap. Add the sealing washer, backing washer and lock nut and then attach the air inlet end cap. This should be done in conjunction with the instructions below.

- 14.2.11 Install O-Ring (15A) into and replace the actuator end caps, (5 or 5A and 5B), noting that the “foolproof” pin between the body and end cap mates properly (10–50 sizes only).



NOTE: For spring return actuators, see spring installation section on page 13 before installing end caps.



NOTE: When installing the end cap O-Rings, use a small amount of a general purpose lubricant, such as petroleum jelly, to hold them in place for ease of assembly and to avoid having them drop down and get pinched.

On Rev. R2 and earlier actuators, be sure O-Ring is installed in groove on end cap.

- 14.2.12 Replace position indicator (17). See Section 6.

15 SPRING-RETURN ACTUATOR

- 15.1 When replacing springs in a spring-return actuator, ensure that the springs are replaced in their identical position in the end cap from where they were removed.

IMPORTANT: When less than the standard number of springs are used in each end cap, these springs should be positioned according to the air supply figures below.

The values listed below are for standard and less than the standard air pressure as required per the ordering code.



- NOTE:** Maximum operating pressure does not change.

- 15.2 If a spring-return actuator is being repaired due to a failed spring, REPLACE all the springs in this actuator, as well as any other parts which may have been damaged.

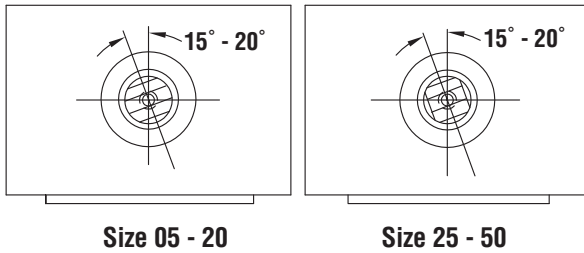


Figure 2
Alignment of Shaft at Reassembly

IMPORTANT: Align gear teeth on the shaft as per Figure 1.

Series 40R Sizes 10 - 42	
4.5 bar - 8 springs - 4 per end cap.	Remove center spring.
4.0 bar - 8 springs - 4 per end cap.	Remove center spring.
3.5 bar - 6 springs - 3 per end cap.	Use three on a diagonal.
3.0 bar - 4 springs - 2 per end cap.	Use two in opposite corners.
Series 40 Sizes 45 - 50	
4.5 bar - 20 springs - 10 per end cap.	Remove required number of springs starting in the center. Remaining springs should be evenly spaced as possible.
4.0 bar - 20 springs - 10 per end cap.	
3.5 bar - 16 springs - 8 per end cap.	
3.0 bar - 12 springs - 6 per end cap.	

The size 05 spring-return actuator operating at 5.5 bar has four springs (two per end cap). For air supplies of 4.5, 4.0 or 3.0, remove inner spring of each end cap.

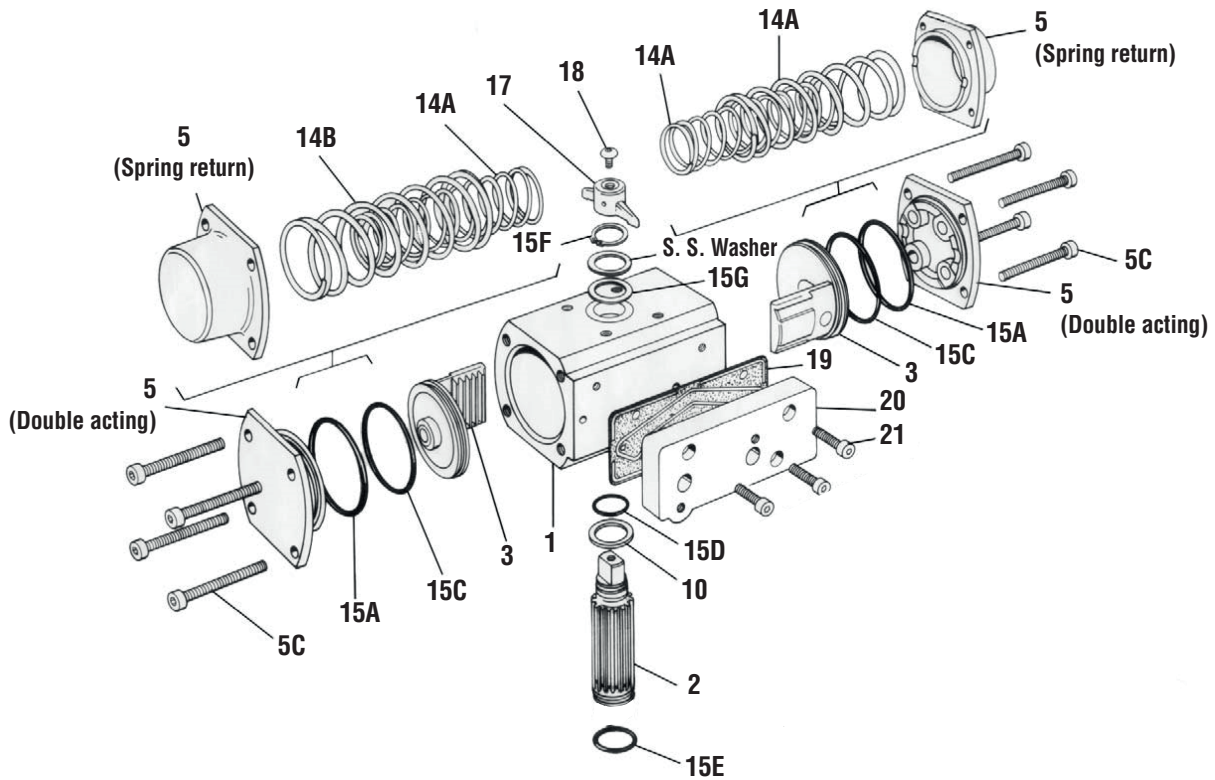
- 15.3 When replacing the springs in a spring-return actuator, place the springs in the end cap pocket after thoroughly lubricating each spring. Be generous with lubricant!
- 15.4 With the springs pointing up and the end cap on a solid surface, place the actuator body over the springs and the proper end cap. (Each end cap can only be mounted to just one end of the actuator body, as there is a “fool-proof” pin in the end cap, which aligns with a hole in the body).
- 15.5 Force the body down and begin by engaging two end cap screws (5C) by hand through the end cap. Take each end cap screw up in SMALL and EQUAL turns. Once the end cap is temporarily secured to the body, turn the actuator over to its normal position and uniformly take up the four end cap screws. Uniformly load all the springs to prevent any spring from buckling.

IMPORTANT: Locating nibs are cast into the piston face on sizes 25 to 50. The actuator springs must fit over these locating nibs on the piston face. Care in following the above instructions will ensure the proper alignment of the spring in the actuator body — proper contact with the piston face and end cap.

- 15.6 In a similar manner, as written in the previous steps, replace the springs in the other end of the actuator body.

! **NOTE:** On sizes 40 to 50 limit stop, only encapsulated springs (pre-compressed) can be used with this design.

16 Size 05 Exploded view/parts/materials



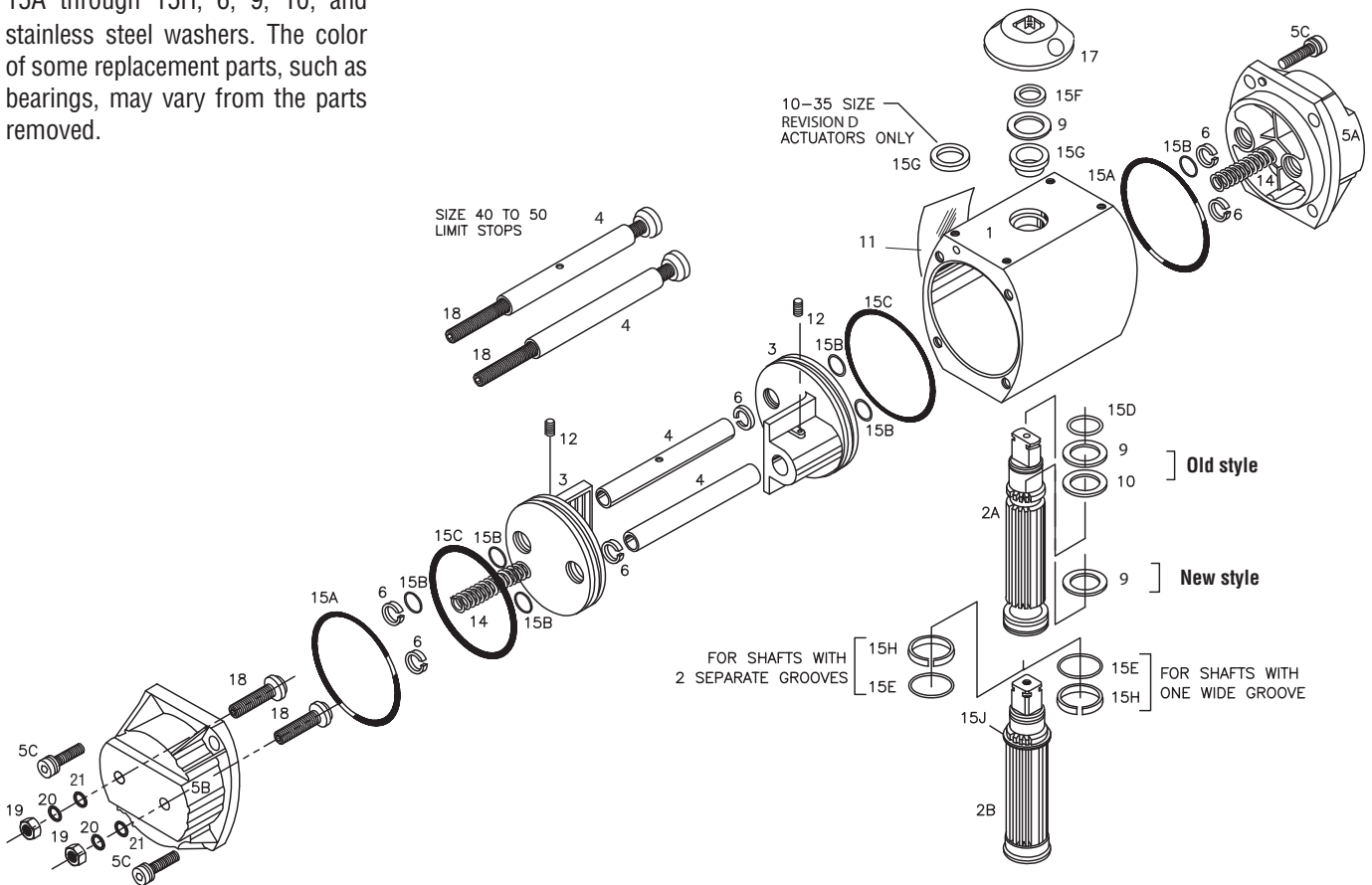
Item	Qty.	Description
1	1	Body
2	1	Shaft
3	2	Pistons
4	2	Guide Rods
5	2	End Caps
5A	1	Solenoid Block (Inlet) End Cap
5B	1	Limit Switch End Cap
5C	8	End Cap Screws (Metric)
10	1	Thrust Bearing
11	1	Nameplate (Not Shown)
12	2	Piston Set Screws
13	2	Pipe Plugs

Item	Qty.	Description
14A	2	Inner Springs (See Table Page 13)
14B	2	Outer Springs (See Table Page 13)
15A	2	End Cap O-Rings
15C	2	Piston O-Rings
15D	1	Top Shaft O-Ring
15F	1	Shaft Clip
15G	1	Top Pinion Bearing
17	1	Position Indicator
18	1	Indicator Mounting Screw
19	1	Interface Gasket
20	1	Solenoid Block Interface Plate
21	3	Plate Mounting Screws (Metric)

To order proper parts, please specify the actuator size, model and revision number. Use the standard nomenclature listed above. The rebuilding kits include Items 15A, 15C through 15G, 10, 19 and stainless steel washer. Color of some replacement parts, such as bearings, may vary from the parts removed.

17 Size 10-50 Exploded view/parts/materials

The rebuilding kit includes items 15A through 15H, 6, 9, 10, and stainless steel washers. The color of some replacement parts, such as bearings, may vary from the parts removed.



Item	Qty.	Description
1	1	Body
2A	1	Shaft, Size 10 to 20
2B	1	Shaft, Size 25 to 50
3	2	Pistons
4	2	Guide Rods
5A	1	Inlet End Cap
5B	1	Limit Stop End Cap
5C	8	End Cap Screws (Metric)
6	6	End Cap/Piston Bearing
9	1	Thrust Washer, Stainless Steel
10	9	Thrust bearing
11	1	Nameplate
12	2	Piston Set Screws
14	10	Spring

Item	Qty.	Description
15A	2	End Cap O-Rings
15B	6	Guide Rod O-Rings
15C	2	Piston O-Rings
15D	1	Top Shaft O-Ring
15E	1	Bottom Shaft O-Ring
15F	1	Spiral Retaining Ring
15G	1	Top Pinion Bearing
15H	1	Bottom Pinion Bearing
15J	1	Anti-Ejection Ring
17	1	Position Indicator
18	2	Limit Stop screws
19	2	Limit Stop Nuts
20	2	Backing Washers (sizes 25 to 50 only)
21	2	Sealing Washers

NOTE: To order proper parts, please specify the actuator size, model and revision number. Use the standard nomenclature listed above.



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