



Worcester Controls Series F39 Pneumatic Actuator

Twin-piston, double rack-and-pinion



Experience In Motion



Worcester Controls

WCAIM2036
(Part 17430)

Series 39 Pneumatic Actuator

Installation, Operation and Maintenance Instructions

DESCRIPTION

Worcester Controls/McCANN Series 39 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. In double-acting units, both pistons are pressurized on both strokes of the actuator.

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 feature an integral solenoid control block which properly directs supply air to the actuator. On double-acting actuators, the solenoid control block provides independently adjustable speed control for both opening and closing strokes of the actuator. On spring-return actuators only the spring stroke is adjustable.

▲ WARNING: SERIES 39 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. See paragraph D.1.f.1.

Do not install 39S (spring-return) models with air connection in end cap or with integral solenoid vertical, if water spray or rainfall can occur in area. 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 120°F or below 40°F may occur. Do not store within 50 feet of any source of ozone.

IMPORTANT: INCLUDED IN ALL 39 ACTUATOR ACCESSORY AND REPAIR KITS IS A REBUILD/ACCESSORY ADDITION LABEL, WHICH IS TO BE MARKED WITH A PERMANENT MARKER AND THEN APPLIED TO THE ACTUATOR AFTER AN ACCESSORY KIT HAS BEEN INSTALLED OR AN ACTUATOR HAS BEEN REPAIRED.

INSTALLATION

NOTE: The Series 39 actuator is normally installed with its major axis parallel to the pipe line (this is mandatory when mounting actuator to 90° V1 Diverter/Three-Way (D44 and T44) valves and CPT valves). The actuator can be oriented above, beside or beneath the valve without affecting its operation.

Sizes 10-35 Rev. R6 actuators may come with an ISO locating ring, used for optional ISO mounting.

- Determine mode of operation desired (normally open or normally closed) of the valve.
- Determine desired quadrant for bracket attachment and direction of mounting of actuator (in-line or cross-line).
- Attach mounting bracket to actuator using four (4) cap screws and lockwashers provided in mounting kit. To avoid any damage to the Series 39 actuator body, ONLY the proper length screws

supplied with the mounting kit should be used. For small size top-mount style valves, attach bracket such that bracket nameplate will be to side of valve.

For mounting to 818/828 Series valves, insert ISO locating ring into groove on bottom of actuator before attaching to bracket.

NOTE: Ring can be permanently held in groove by applying Loctite to ring before inserting in groove.

NOTE: Size 0539, if furnished with factory solenoid, shall be "cross-line" mounted to ensure adequate clearance for air connections.

D. Attach bracket/actuator assembly to valve as follows:

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.

1. Valve models 45 (2½"-6"), 59 (2"-4"), 51/52 (½"-10"), 151/301 (3"-6"), 82/83 (½"-10"), 818/828 (2"-8"), 94 (½"-6"), 44 (¼"-2"), 59 (¼"-1½"), WK70/WK74 and H71 (½"-2"):

NOTE: For above listed valves, it is not necessary to remove any valve body bolts or remove valve from line in order to mount actuator.

- a. Rotate valve ball and stem to position necessary to achieve desired operation. If any valve information is marked on stop plate or handle, it will be necessary to transfer this information to the bracket nameplate.
- b. For ¼"-2" 44, ½"-2" WK70/WK74, ¼"-1½" 59, and ½"-1½" H71 series top-mount style valves, and ½"-2" 51/52, ½"-1½" 82/83 series valves with high-cycle stem packing as standard, remove handle nut, lockwasher, handle, separate stop plate (if any), retaining nut and stop pin(s). Add the two additional Belleville washers with their larger diameter sides touching each other. Add the self-locking nut to the stem and tighten while holding the stem flats with wrench. Tighten until Belleville washers are flat — the nut will "bottom" — and then back nut off ½ of a turn. The two additional Belleville washers and the self-locking nut are included in the mounting kit.

CAUTION: The self-locking stem nut requires a good amount of effort to tighten, and must fully flatten Belleville washers before backing off.

For 2" 59, H71, 82/83, and 2½" 45, 82/83 valves, and valves 3" and larger with square stem, remove handle assembly, retaining nut, stop and stop screws. Replace with valve stem spacer or, if valve has graphite stem packing, with two Belleville washers (except 8", 10" 82/83 and 10" 51/52), and replace retaining nut. NOTE: Belleville washers are installed with their larger diameter sides touching each other. Do not use stem spacer when Belleville washers are used. Using a wrench to prevent stem from turning, tighten retaining nut until stem

packing is fully compressed or Bellevilles, if used, are fully flattened, then back off nut ¼ turn. Excessive tightening causes higher torque and shorter seal life.

NOTE: Large valves with V51 high-cycle stem packing option installed, identified by two Belleville washers installed and handle assembly, stop and stop screws removed, and 818/828 series valves, do not require stem area disassembly.

For 2"-8" 818/828 valves, remove handle assembly, locking plates and hardware, and stop screw (if any). Do not remove stop plate (2"-6" sizes) or spacer (8" size).

For ½"-2" 94 valves, remove handle (if any). Do not remove gland plate or gland bolts.

For 3"-6" 94 and 2"-8" E818/828 valves, remove handle assembly, stop, and spacer (if any). Do not remove gland plate or gland bolts.

- c. Center coupling on valve stem.
- d. Lower mounting bracket/actuator assembly over coupling and onto valve, making sure that male actuator shaft engages slot in coupling.
- e. Secure bracket to valve using cap screws and lockwashers, or bolts and nuts provided in mounting kit. Tighten securely. For small size top-mount style valves, bracket nameplate will be to side of valve.

Install set screws (if any) in coupling and tighten securely.
- f. Determine if mode of operation is as desired; if not:
 - 1) Double-Acting Actuators – Mount the actuator 90° from normal mounting (see paragraph D.1.f.3 for size 25 and larger actuators) OR if integral solenoid is present, remove the solenoid block and gasket, invert them (turn them upside-down) and remount them. (This is an either/or situation. If you do both, the direction of rotation of the actuator will not reverse.) On 05-20 sizes, the actuator may also be inverted, yielding the opposite mode.
 - 2) Spring-Return Actuators – 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" position.

For "FAIL-CLOSED" cross-line operation with 05-20 sizes, invert actuator and cross-line mount actuator to pipe line.

For "FAIL-OPEN" in-line operation with 05-20 sizes, invert actuator (**NOTE:** If in-line coupling is used, actuator does not need to be inverted). Rotate the valve ball and stem 90°, so coupling lines up with actuator shaft. Mount actuator in-line with the pipe line.

For “FAIL-OPEN” cross-line operation with 05–20 sizes, rotate the valve ball and stem 90°, so coupling lines up with actuator shaft. Mount actuator cross-line to pipe line.

- 3) On size 25 and larger double-acting and spring-return actuators, the output shaft is square. 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. Cross-line mounting, if desired, requires a special bracket, except for the 818/828 Series valves.
- g. Determine position indication. Buttons on position indicator are set up to show valve closed on in-line mounting, i.e., pistons together on actuator. If different indication is required:
 - 1) Check which visual indication is required.
 - 2) Check that indicator, when located on actuator shaft, will show correct indication.
 - 3) To change indication, push out (remove) red and white buttons and reassemble in opposite positions (this step is only necessary on 10–20 sizes).
 - 4) Locate indicator on actuator shaft flats. Press firmly until location nibs snap into recess on actuator shaft.

For sizes 10–50, the ports are on the solenoid end cap. The solenoid end cap is the one on the right end of the actuator when looking at the nameplate. If the air supply is connected to the left end cap, the unit will not operate. For 05 size only, the ports are on the solenoid block interface plate on back of actuator when looking at the nameplate. For sizes 10-50 spring-return, the proper NPT port is to the rear of actuator (away from the nameplate). For size 05 spring-return it is on the back and near center of actuator.

- b. With Integral Solenoid – Connect air supply line to the NPT (1/8" on four-way double-acting blocks, 1/4" on three-way spring-return blocks) port on the solenoid block.

4. Recommended Tubing Sizes:

In order to provide sufficient flow of supply air to the Series 39 actuator, the following tubing sizes are recommended:

Actuator Size	Runs Up To 4 Ft. Long	Runs Over 4 Ft. Long
05, 10, 15, 20, 25	1/8"	1/4"
30, 33, 35, 40, 42, 45	1/4"	3/8"
50	1/4"	1/2"

5. Air Consumption:

The following chart shows the amount of pressurized (80 psig) air consumed per stroke in cubic feet. 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	Stroke	
	Open	Close
0539	.01	.01
1039	.04	.05
1539	.08	.09
2039	.16	.17
2539	.28	.30
3039	.43	.47
3339	.65	1.10
3539	.90	1.27
4039	1.26	1.43
4239	1.73	3.25
4539	3.1	4.6
5039	5.5	7.0

AIR SUPPLY AND ELECTRICAL INSTALLATION

A. 1. Air Supply:

The Series 39 Actuator is factory lubricated. For optimum operation, the use of filtered and lubricated air is recommended.

2. Air Supply Pressure:

Standard double-acting actuators require 40–120 psig supply air. Spring-return actuators require 80–120 psig supply air. Spring-return actuators can also be set up to operate on supply air pressures ranging from 40–80 psig by using fewer springs. See “Rebuilding Instructions”, Spring-Return Actuator, paragraph 1 on page 9 for proper number and location of springs for reduced supply air pressures.

3. Air Supply Connections:

a. No Integral Solenoid:

Double-Acting (N Models) – Connect air supply lines to both NPT (1/8" on sizes 05–20, 1/4" on sizes 25–50) ports.

Spring-Return (SN Models) – Connect air supply line to the outboard NPT (1/8" on sizes 05–20, 1/4" on sizes 25–50) port.

B. Electrical Supply (models with integral solenoid only):

The solenoid coil wattage and required amperage are as follows:

General Purpose Solenoid			
Voltage	Holding Amps	Inrush Amps	Watts
24 VAC 50/60 Hz	.80	1.20	11
120 VAC 50/60 Hz	.15	.30	11
240 VAC 50/60 Hz	.08	.12	11
12 VDC	.70	—	11
24 VDC	.35	—	11

Watertight and Hazardous Location Solenoids			
Voltage	Holding Amps	Inrush Amps	Watts
24 VAC 50/60 Hz	.71	1.13	11
120 VAC 50/60 Hz	.14	.23	10
240 VAC 50/60 Hz	.07	.11	10
12 VDC	.81	—	10
24 VDC	.41	—	10

INSTALLATION OF ACCESSORIES

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

OPERATION

A. Basic Actuator – (N Model)

The Series 39 actuator drive shaft rotates through a full 90° segment with approximately 2° overtravel at each end of travel. 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 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.

B. Actuator With Factory-Supplied Solenoid

Double-Acting – Air is supplied to the one NPT 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.

Double-acting solenoid assemblies have two independently adjustable speed control screws which can be used to adjust the speed of operation for the opening and/or closing stroke. If the speed control screws are too tight, the unit will fail to operate. NOTE: Speed control screws are shipped from the factory in the full open position.

Spring-Return – Air is supplied to the one NPT 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.

When using a spring-return solenoid assembly, only the speed of the spring stroke is adjustable. This is accomplished by tightening the set screw contained in the exhaust nut (shipped separately in envelope) which mounts directly to the end of the solenoid.

C. Standard Stroke Times

Standard stroke times of the Series 39 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 80 psig. 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.)
0539	1
1039	1
1539	1
2039	1
2539	2-3
3039	3-4
3339	4-5
3539	4-5
4039	5-6
4239	6-7
4539	10-12
5039	12-14

D. Manual Operation

In the event of air failure, the Series 39 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.

If a routine cycle check is to be performed on a double-acting actuator equipped with the proper Worcester/McCANNNA solenoid control block, the actuator can be cycled manually by shifting the spool valve within the block. This can be done by pushing the piston nearest the outside surface of the control block towards the center of the block with a pen or pencil. Care must be taken to hold the spool valve in the desired position until the actuator has cycled. Provided the air supply is still on, the actuator will cycle to its original position as soon as the manually applied pressure on the spool valve is released.

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. Care should be taken when tightening the end cap retaining bolts since these fasteners are METRIC. All other fasteners are UNIFIED IMPERIAL.

All actuators are supplied with sufficient lubrication for their normal working life. If required, recommended lubrication for all standard actuators is a #1 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 Worcester/McCANNNA 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. Spring kits are available through any authorized Worcester/McCANNNA distributor.

SPARE PARTS

The following are recommended spare parts which should be kept on hand for Series 39 pneumatic actuators:

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

Spring Kit(s) – For Spring-Return Actuators.

TROUBLESHOOTING

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

- I. For solenoid controlled actuators (with Worcester/McCANNNA solenoid control block):
 - A. If actuator does not function, check to ascertain:
 1. That valve is free to rotate. This can be done as described above in Manual Operation.
 2. That actuator is the correct size.
 3. That speed control screws are loose (if screws are tightened all the way, actuator will not operate).
 4. That correct voltage is supplied to solenoid.
 5. That sufficient air supply is available at inlet to control block. Inlet pressure to control block should be at least 40 psig for double-acting, 80 psig for spring-return (unless a reduced spring complement is installed (fewer springs)). When checking supply pressure, place gage in line at control block inlet and monitor gage for unexpected pressure drops.
 - B. If proper voltage and air pressure have been verified and valve is free, proceed as follows:
 1. Turn on signal voltage. Check solenoid for clicking sound.
 2. If no sound is detected, remove air pressure and turn off signal voltage.
 - a. Carefully unscrew solenoid and solenoid stem from block.
 - b. Reapply signal voltage and observe solenoid plunger. If it does not retract, replace solenoid.

3. If solenoid functions, remove solenoid valve block and place on bench. Connect to reduced air supply (50 psig) 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.)
 4. If control block and solenoid are operating correctly, proceed to Section II below.
- C. If the actuator functions but exhibits leakage, or power loss accompanied by leakage, proceed as follows:
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).
 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.
 3. If air supply and voltage are adequate, proceed as follows:
 - a. If leak is at solenoid exhaust port, replace the solenoid.
 - b. 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 0539, 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.
- II. For actuators without the Worcester/McCANNA 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:

- A. 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 39 actuators is the improper replacement of the piston guide rod assembly with the hole in it, relative to the nameplate on the body (see Step 6 on page 8).*

- B. Make certain that the actuator has lubrication, and that there is no solidified grease between the pinion and the piston racks.

1. If actuator has no lubrication, apply generous amount of a #1 grease. If actuator is prepared for high or low temperature operation, consult Flowserve for proper lubricants.
 2. If solidified grease between the pinion and the piston racks is present, clean, dry, regrease and reassemble.
- C. Verify that actuator pinion shaft and/or pistons are not bound. If bound, reassemble per Rebuilding Instructions.
- D. If unit exhibits excessive amounts of backlash, check teeth on piston racks for wear. If worn, replace piston assemblies.
- E. In spring-return actuators, check for misplaced or broken springs. If springs are broken, check body bore for scoring.
 1. If springs are broken, replace springs. **SPRINGS SHOULD ALWAYS BE REPLACED IN COMPLETE SETS.**
 2. If body bore is scored, replace it. Also, replace piston O-rings (contained in repair kit).
- F. 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.

REBUILDING INSTRUCTIONS

NOTE: *For identification of all numbered parts discussed below, consult exploded view of actuator.*

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

ACTUATOR DISASSEMBLY

1. Disconnect the air supply and electrical service to the actuator.
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 "Miser" valve, the two top valve body bolts must be removed. For all the valves listed in Installation Section D, the actuator bracket can be removed without loosening or removing any valve body bolts.**

3. Remove the actuator bracket (and actuator positioner) from the actuator to begin repair. (Note mounting of removed bracket and positioner for easy reassembly.)
4. It is not necessary to remove solenoid control block (7A) or (7B) (if so equipped) to rebuild actuator. However, if it becomes necessary to remove the block, begin by removing the solenoid block bolts (8E). Use care to retain the solenoid block gasket (9).

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

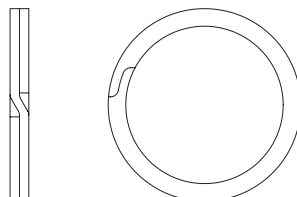
- For sizes 10–50, each end cap (5A and 5B) is aligned onto the body (1) over a “foolproof pin”. This ensures that the end caps can only be assembled to their respective end of the actuator. Remove all four metric screws (5C) from, and remove, both end caps. For Rev. R1 and R3 through R6 actuators, remove the two bearings (6A) and O-rings (15A and 15B) from each end cap. Note that for Rev. R2 models with top-hat style (6C) 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.

CAUTION: 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.

- The two piston guide rod (4) assemblies can now be removed from each end of the body and disassembled by removing the piston set screws (12). Do not interchange piston guide rods (4) and their respective piston (3). For sizes 10–20 Rev. R6, each guide rod and piston may be press fitted together (do not use set screws) and cannot be disassembled. (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).
- The shaft (2A) on Rev. R2 and sizes 05–20 Rev. R3 through R6 models 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: For sizes 40 and 42 Rev. R3 through R6 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.

The Rev. R1 model, all sizes and the Rev. R3 through R6 models, sizes 25 through 42, have an anti-ejection ring (15J). The anti-ejection ring on Rev. 1, sizes 45–50 consists of a flat washer with a shaft clip. All others are a one-piece spiral wound ring. This ring does not have to be removed and may or may not be included in repair kits.

For Rev. R1 models, remove shaft clip (15F) (not a reusable part!) (see Note above) and the stainless steel washer from the shaft. Then remove the top shaft bearing (15G) and the bottom shaft bearing (15H) by carefully prying them away from the body.

CAUTION: Both of these bearings may have a projecting “nib” which locates the bearings to the actuator body. Be careful not to break off these nibs inside the body when removing the top and bottom bearings. Note: Top bearing is marked “Top”. Bottom bearing has a larger ID than the top bearing.

Next, slide the shaft out through the bottom of the body and remove the top O-Ring (15D) and the bottom O-Ring (15E) from the body.

ACTUATOR REASSEMBLY

- 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.
- All rebuilding kit O-Rings and bearings may now be installed. Lubricate the standard actuator thoroughly with a #1 grease. Apply a light film of grease to all O-Rings.
- If converting over to a “high-temperature” actuator, or rebuilding an existing one, lubricate thoroughly with Dow Corning #7 or other equivalent high temperature silicone or graphite base grease.
- Some Rev. R2 actuators, sizes 10–35, use flanged bearings in the end caps. They resemble a “top hat” (6C), and are installed with the brim of the hat facing out, and are retained by “star washers” (16). These bearings and star washers should not be removed for O-Ring seal replacement. On sizes 10 and 15 only, there is one star washer, or retainer, per bearing. On sizes 20–35, there are two star washers per bearing. They are installed one on top of the other, with the “points” of the “star” overlapping each other (as opposed to being on top of each other). All the washers must be pressed in firmly and straight. The points of the star are bent slightly. When installed, they bear back, away from the hole.

For sizes 10–50 Rev. R1 and 10–42 Rev. R3 through R6 actuators, replace the two split-ring style bearings (6A) and one guide rod O-ring (15B) in each end cap.

Replace the split-ring style bearing (6B) 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.

5. 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: For sizes 40 and 42 Rev. R3 through R6, 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. NOTE: For sizes 10–35 Rev. R6 and size 05 actuators, top bearing (15G) is flat and the same as, and interchangeable with, thrust bearing (10). Replace the shaft through the larger opening in the bottom of the body.

For Rev. R3 through R6, sizes 25 through 42 actuators, replace anti-ejection ring (15J) in its groove on the shaft (2B), if removed.

For Rev. R1 Models:

Locate the shaft O-Rings into the actuator body. O-ring (15D) is the top O-ring while (15E) is the bottom O-Ring.

Replace the top bearing (15G) and bottom bearing (15H).

If the anti-ejection ring (15J) was removed, replace it in its groove on the shaft (2B). Check that the ring is properly seated in its groove.

Replace the shaft in the body through the larger opening in the bottom of the actuator body.

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 39 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.

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

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.)

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.)

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).

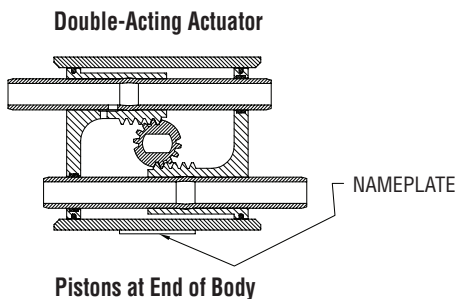
10. Once the shaft and pistons are properly engaged, ensure that smooth movement and 90 degree operation can occur without moving the pistons out of the actuator body. This is important!
11. Install O-Ring (15A) into and replace the actuator end caps, (5 or 5A and 5B), noting that the “foolproof” pin between the body and end cap mates properly (10–50 sizes only). For spring-return actuators, see spring installation section on page 10 before installing end caps.

NOTES: 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 fall and get pinched.

On Rev. R1 and earlier actuators, be sure O-Ring is installed in groove on end cap.

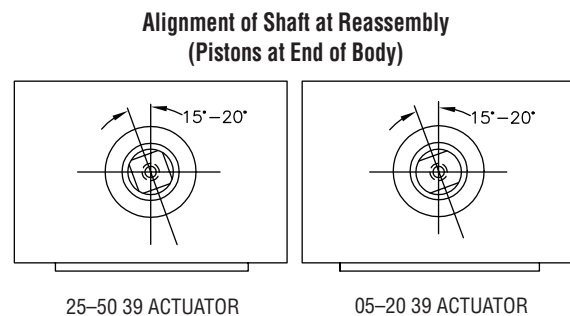
12. Replace the stainless steel washer over the top shaft extension.

Figure 1



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.

Figure 2



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

13. **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 7 for installation of spiral-ring type shaft clip (which newer rebuilding kits will contain).

14. If solenoid control block was removed:

For size 05 only, place interface gasket (19) onto solenoid block interface plate (20) and attach securely to body with three screws (21). Do not apply any grease to gasket.

Place gasket (9) on solenoid control block (7A) or (7B) (if used) and attach block securely to end cap, or for size 05, the solenoid block interface plate, to obtain a seal at gasket. NOTE: If fiber gasket is used, work a generous amount of assembly grease or petroleum jelly into the gasket prior to assembly (wipe off excess grease). If a rubber gasket is used, do not apply any grease, it must be installed dry.

15. Replace position indicator (17) (if any). See Section D.1.g for proper installation and to determine position indication.

16. Mark Rebuild/Accessory Addition Label, if included in repair kit, and apply to actuator.

SPRING-RETURN ACTUATOR

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.

Sizes 10–35 Rev. R2 through R6 and Sizes 40 and 42 Rev. R3 through R6

70 psi - 8 springs - 4 per end cap.	Remove center spring.
60 psi - 8 springs - 4 per end cap.	Remove center spring.
50 psi - 6 springs - 3 per end cap.	Use three on a diagonal.
40 psi - 4 springs - 2 per end cap.	Use two in opposite corners.

Sizes 10–50 Rev. R1 (Except Size 42)

70 psi - 22 springs - 11 per end cap.	Remove required number of springs starting in the center.
60 psi - 18 springs - 9 per end cap.	Remaining springs should be evenly spaced as possible.
50 psi - 16 springs - 8 per end cap.	
40 psi - 12 springs - 6 per end cap.	

The size 05 spring-return actuator operating at 80 psi has four springs (two per end cap). For air supplies of 70, 60 or 50, remove inner spring of each end cap.

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.

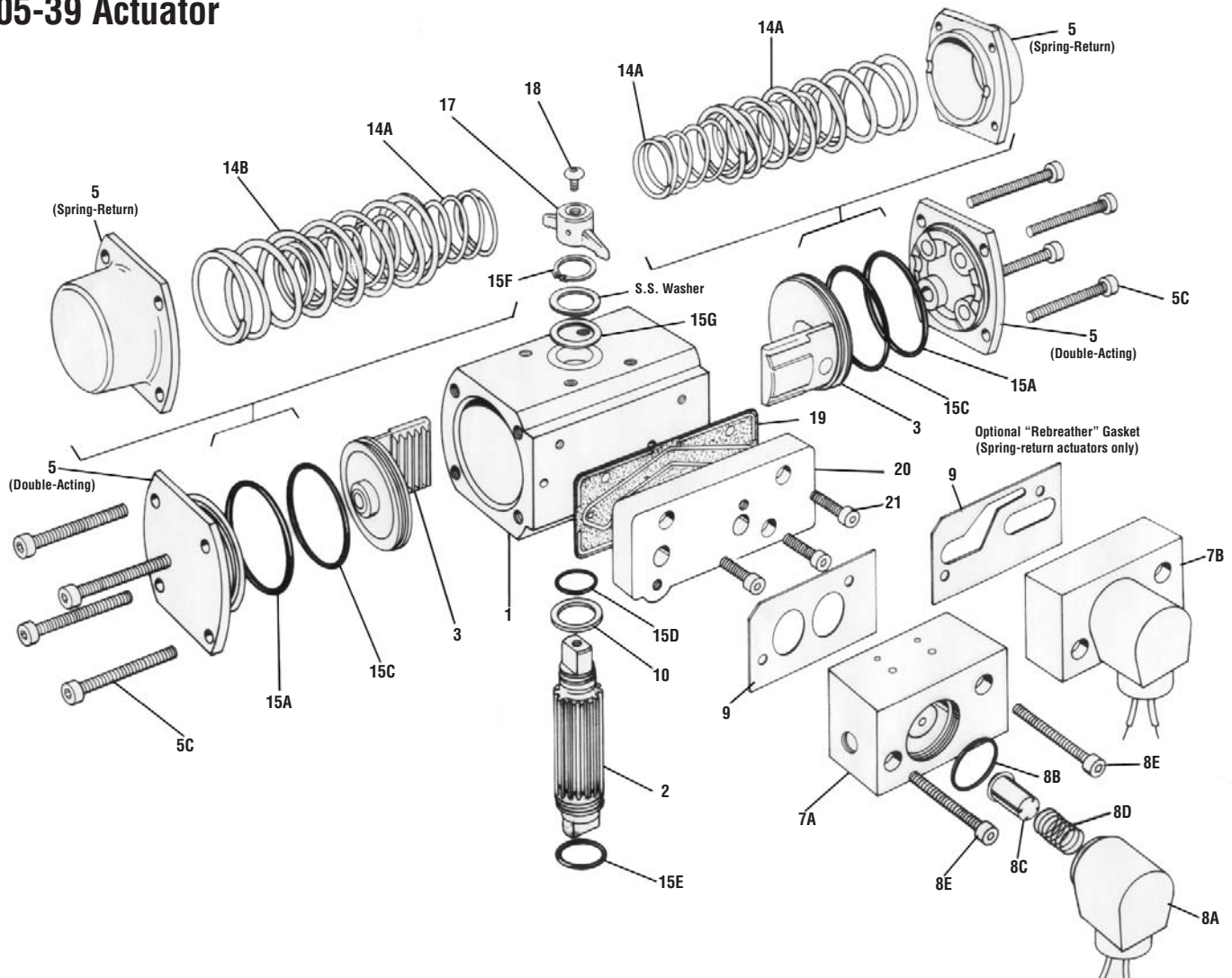
2. If a spring-return actuator is being repaired due to a failed spring, REPLACE all the springs in this actuator, as well as any other parts which may have been damaged.

Ordering Code	4	5	6	7	()
Supply Pressure	40	50	60	70	80
Actuator Size and Current Rev.	End of Spring Torque (In-Lbs)				
10 R6	35	55	75	75	95
15 R6	74	105	145	145	185
20 R6	125	195	265	265	335
25 R6	210	330	450	450	575
30 R6	340	535	730	730	920
33 R6	680	1070	1460	1460	1850
35 R6	850	1330	1815	1815	2300
40 R1	1500	1950	2200	2750	3000
40 R6	1500	2240	2980	2980	3740
42 R6	2390	3800	4890	4890	6370
45 R1	4000	5500	6300	7800	8400
50 R1	6500	8500	9500	12200	13500

Ordering Code	1	1	1	()
Supply Pressure (psi)	50	60	70	80
05	32	32	32	41

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!
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 "foolproof" pin in the end cap, which aligns with a hole in the body.)
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 permanently cast into the Rev. R1 (all sizes) and the Rev. R3 through R6 (sizes 25 through 42) actuator piston face. 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.
6. In a similar manner, as written in the previous steps, replace the springs in the other end of the actuator body.

05-39 Actuator



ITEM	QTY	DESCRIPTION
1	1	Body
2	1	Shaft
3	2	Pistons
5	2	End Caps
5C	8	End Cap Screws (Metric)
7A	1	Solenoid Block (Double-Acting)
7B	1	Solenoid Block (Spring-Return)
8A	1	Solenoid
8B	1	Solenoid O-Ring
8C	1	Solenoid Plunger
8D	1	Solenoid Spring
8E	2	Solenoid Block Bolts
9	1	Solenoid Block Gasket
10	1	Thrust Bearing
11	1	Nameplate (Not Shown)
14A	2	Inner Springs (See Table Page 9)
14B	2	Outer Springs (See Table Page 9)

ITEM	QTY	DESCRIPTION
15A	2	End Cap O-Rings
15C	2	Piston O-Rings
15D	1	Top Shaft O-Ring
15E	1	Bottom 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)

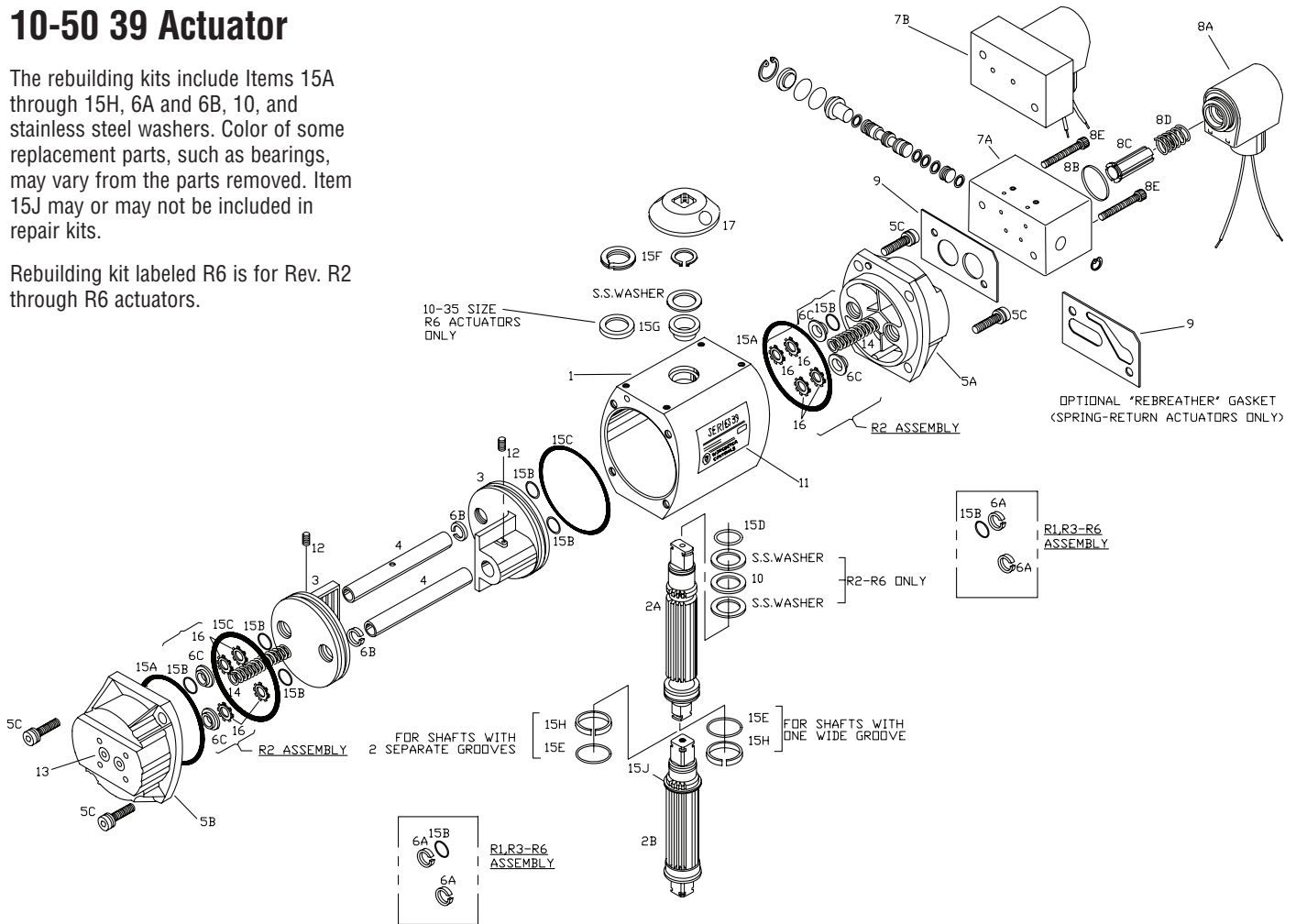
To order proper parts, please specify the actuator size, model and revision number. Use the standard nomenclature listed above.

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.

10-50 39 Actuator

The rebuilding kits include Items 15A through 15H, 6A and 6B, 10, and stainless steel washers. Color of some replacement parts, such as bearings, may vary from the parts removed. Item 15J may or may not be included in repair kits.

Rebuilding kit labeled R6 is for Rev. R2 through R6 actuators.



ITEM	QTY	DESCRIPTION	ITEM	QTY	DESCRIPTION
1	1	Body	14	Varies	Springs - See Table, Page 10
2A	1	Shaft(10-2039)	15A	2	End Cap O-Rings
2B	1	Shaft (25-5039)	15B	6 or 12	Guide Rod O-Rings (See Note Below)
3	2	Pistons	15C	2	Piston O-Rings
4	2	Guide Rods	15D	1	Top Shaft O-Ring
5A	1	Solenoid Block (Inlet) End Cap	15E	1	Bottom Shaft O-Ring
5B	1	Limit Switch End Cap	15F	1	Shaft Clip
5C	8	End Cap Screws (Metric)	15G	1	Top Pinion Bearing
*6	-	Bearings (Guide Rod)	15H	1	Bottom Pinion Bearing
6C	4	End Cap Bearing (Top-Hat Style)	15J	1	Anti-Ejection Ring (R1 and Sizes 25-42 R3-R6)
6A	4	End Cap Bearing (Split-Ring Style)	16	4 or 8	Bearing Retainer (R2 Only)
6B	2	Piston Bearing (Split-Ring Style)	17	1	Position Indicator
7A	1	Solenoid Block (Double-Acting)			
7B	1	Solenoid Block (Spring-Return)			
8A	1	Solenoid			
8B	1	Solenoid O-Ring			
8C	1	Solenoid Plunger			
8D	1	Solenoid Spring			
8E	2	Solenoid Block Bolts			
9	1	Solenoid Block Gasket			
10	1	Thrust bearing (R6 RK Only)			
11	1	Nameplate			
12	2	Piston Set Screws			
13	2	Pipe Plugs			

NOTE: Size 15 Rev. R6 rebuilding kits include twelve Guide Rod O-rings. The six larger diameter O-rings are for Rev. R3 through R6 actuators.

*End cap bearings (6C) illustrated are for Rev. R2 actuators only. All other revision end caps use split-ring style (6A), same as piston bearing (6B). Only split-ring style bearings are included in R6 rebuilding kits, and normally all styles of bearings do not need replacement during a rebuild.

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

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