

Description of Operation

The Ultraflo Series 100 Pneumatic Actuators feature a double piston, rack and pinion mechanism designed to automate quarter-turn valves. In the Series 100 Double-Acting Actuator, pressure introduced through Port A (the left port when facing the ports) forces the pistons away from each other and causes the pinion to rotate in a counterclockwise direction. Pressure introduced through Port B (the right port when facing the ports) is directed through an internal passage to the opposite side of the pistons, which forces the pistons together and rotates the pinion in a clockwise direction. Normally, the clockwise rotation (pistons moving together) closes the attached valve, and the counterclockwise rotation (pistons moving apart) opens the attached valve.

In the Series 100 Spring-Return Actuators, spring cartridges have been added to push the pistons together by spring force in the event the compressed air pressure is lost. This spring force normally closes the attached valve. However, in the event that the valve is required to open under spring force, refer to the *fail open* portion of the **installation** section below.

Operating Fluid

The recommended operating medium is clean dry air at 40 - 140 psig (3 - 10 bar). An air-line lubricator is suggested for fast cycling applications, i.e. more than 10 cycles per minute. Other media such as hydraulic oil, water, or certain other gases may also be used in some instances, but the factory should be consulted for specific applications.

Operating Temperature

The recommended operating temperature range is -15°F to 200°F (-25°C to 95°C). Below 32°F (0°C) care must be taken to prevent condensed moisture from freezing in the air supply lines. Consider the use of an air dryer if the actuator is installed in cold climates. The air dryer must be capable of lowering the dew point of the air to a temperature lower than that of the surrounding environment.

Installation

Ultraflo Series 100 Actuators are designed to mount directly on the top plate of Ultraflo Valves. Before the actuator is mounted on a valve, it is a good practice to lubricate the output bore of the actuator with a thick grease. The grease will make it easier to remove the actuator from the valve stem, even after years of service.

Normally, the actuator is mounted with its long side parallel to the pipeline. A double acting actuator will normally rotate the valve stem clockwise to close, and counterclockwise to open. Spring return actuators will normally rotate the valve stem clockwise to close with the spring stroke, and counterclockwise to open with the air stroke. The normal operation of the spring cartridges is therefore *fail closed*.

Direction of operation may be changed to *fail open* by any one of several different methods. Refer to the Assembly Instructions and Exploded View in Figure 2 on page 6 for more details.

Method 1 - Note: This method works only with concentric disc valves such as the Ultraflo Series 300, 400, 500 and 600 or other valves that allow the disc to be swung through the seat. Turn the actuator so the long side is perpendicular to the pipeline. This will allow the spring cartridges to rotate the valve stem clockwise to open, and the air stroke to rotate the valve stem counterclockwise to close. This is the easiest method if there is sufficient room to mount the actuator.

Method 2 - Note: This method works only with concentric disc valves such as the Ultraflo Series 300, 400, 500 and 600 or other valves that allow the disc to be swung through the seat. Remove the end caps, spring cartridges and pistons from the actuator. See **Assembly** below for detailed instructions on reinstalling the travel stop cam on the pinion. Remove the pinion, rotate it 90°, and reinstall the pinion in the actuator. This will also allow the spring cartridges to rotate the valve stem clockwise to open, and the air stroke to rotate the valve stem counterclockwise to close. This is the second easiest method, and allows the actuator to be mounted with its long side parallel to the pipeline.

Method 3 - Note: This method works for all valves but must be used for offset disc valves where the disc may only turn clockwise to close. See **Assembly** below for detailed instructions on reinstalling the travel stop cam on the pinion. Remove the end caps, spring cartridges and pistons from the actuator. Rotate the pistons so that the racks turn the pinion counterclockwise as the pistons move toward each other. (With the air input ports of the actuator body facing you, the left hand piston rack should be on the side with the air ports.) This is the third easiest method, and allows the actuator to be mounted with its long side parallel to the pipeline, and clockwise to close rotation to be maintained.

The actuator is attached to the valve by means of the mounting bolts furnished in the mounting kit. Install the actuator on the valve making sure that the base of the actuator fits flat against the valve mounting flange. Use the bolts and washers from the kit to complete the installation. Torque the bolts in a diagonal pattern to assure equal loading of the studs.

The final step in the installation process is to check the travel stop settings, generally the open position. The travel stops are set for 90° of travel at the factory, however, each installation is different so they should be checked before putting the valve in service. The actuators are designed with a minimum of 5° over or under travel at each end of rotation. A screwdriver, an open end or box end wrench and a hex wrench, all of the appropriate size, are the only tools required to make the necessary adjustments.

- Remove the black position pointer to expose the wrench flats on the top of the pinion.
- Rotate the valve to the desired position. If an air supply is available, it may be used to stroke the actuator. If no air is available and the actuator has no springs, a wrench may be used.
CAUTION: Remove the air pressure before making the adjustments.
- Loosen the lock nut on the travel stop screw. It is not necessary to remove the nut completely. Using the hex wrench, turn the screw in or out until the desired travel stop position is reached. While holding the screw with the hex wrench, tighten the lock nut with the wrench.
- Replace the position indicator making certain the pointer is aligned with the position of the valve, open or closed.

Some valves or operating conditions dictate that the actuator have additional travel adjustment. For these conditions, the Series 100 actuator can be fitted with extended travel stops in the end caps. Consult the Ultraflo distributor in your area for this option.

Spring return actuators may be operated with only one air supply connected to Port A, since the spring cartridges will move the pistons when the air pressure is removed. This operation, however, will draw the surrounding atmosphere into the spring chambers through Port B. To prevent contamination from entering the spring chamber, a filter with a 40 micron (or finer) element should be installed in Port B.

Even better service may be obtained on spring return actuators by installing a four-way solenoid, covering both Port A and Port B. A four-way solenoid will fill the spring chambers with compressed air from the plant air supply with each stroke. The plant air supply is often cleaner than the surrounding atmosphere, especially in heavy industrial or chemical areas.

Maintenance

The rugged components and factory lubrication combine to ensure a long and trouble-free service life for Series 100 actuators. Dirt and rust are the most common cause for shortened service life, and they typically enter the actuator through the air supply line. Therefore, it is strongly recommended that an adequately sized filter with a 40 micron (or finer) element be installed adjacent to the inlet of the directional control valve. Airline lubricators are recommended for rapid cycling applications (10 cycles or more per hour.)

Routine maintenance of Series 100 actuators consists primarily of maintaining the air supply system by changing filter elements before they start by-passing and adding oil to lubricators before they run dry.

The second most common cause of shortened service life is misalignment between the valve and the actuator. This can cause premature failure due to excessive side loads on the bearings and gear teeth.

Troubleshooting

Table 1 shows several common symptoms and their remedies.

Symptom	Probable Cause	Check	Remedy
Loss of Power	Low air supply pressure, or damaged O-rings	Air supply pressure at actuator, leakage across O-rings	Boost air supply pressure, repair air supply line leaks, replace O-rings
Binding between valve and actuator	Misalignment of coupling	Alignment	Realign coupling
Valve "pops" out of seat and slams open	Valve torque too high, actuator sized too small, or insufficient air supply flow	Valve torque, actuator sizing calculations, size of air supply lines and/or solenoid valve	Repair valve, use proper size actuator, use larger air supply lines and/or solenoid valve with higher flow

Assembly

To identify component names and shapes, refer to the Exploded View of the actuator shown in Figure 2. The numbers in parentheses () refer to the numbers in Fig. 2 on page 6. Easiest assembly will result from lubricating all bearings and seals as they are installed. The lubricant should be a high pressure or extreme pressure petroleum grease with a lithium based thickener which meets the NLGI¹ grade 2. Grease which meets this specification should be available from any automotive supply store.

Pinion (3) - Install bearing rings (6 & 7) and o-rings (19 & 20) in their appropriate grooves. Insert the pinion through the large hole in the center of the body (1). With the pinion part of the way into the body, slide the cam (16) over the pinion, being careful to align the punch mark on the cam with the punch mark(s) on the pinion. For normal installation and rotation, align the single marks. For *fail open* operation described in *Method 2* above, align the single mark on the cam with the two marks on the pinion. For *fail open* operation described in *Method 3* above, align the single marks. Next, install the spacer (15) above the cam. Then insert the pinion through the hole at the top of the body and secure it with the washer (9) and retaining ring (8).

Travel Stop Screws (13) - Slip the o-ring (14) over the flat end of the screw until it is 5-7 threads from the end. Thread the screw into the hole flat end first. Repeat these steps for the second screw. Thread the lock nuts (12) onto the screws and tighten the nuts against the body. This will seal the threads for testing. It is not necessary to set the travel stops at this time as they may have to be re-set when the actuator is installed on the valve.

Pistons (2) - Install the bearing pad (10) on the back of the rack and the o-ring (19) and guide ring (11) in their appropriate piston grooves. The o-ring goes in the groove nearest the rack. With the ports on the actuator body toward you, turn the pinion so that the slot is approximately 45° to the right of perpendicular with the long side of the body. Grasp the pistons in the spring pockets so that the piston in the right hand has the bearing pad toward you and the piston in the left hand has the bearing pad away from you. Slide the pistons into the body so that they both engage the teeth on the pinion at the same time. Apply enough steady force to compress the o-ring into the body bore. At this point, you may continue pushing or use a wrench on the top of the pinion to pull the pistons into

¹ National Lubricating Grease Institute

the body. Check three things now. Did the pinion turn clockwise as the pistons moved toward the center of the body? Is the slot in the top of the pinion within a few degrees of perpendicular to the long side of the body? Are the pistons the same distance in from the end of the body? (Check this carefully because it is very critical.) If the answer to all three questions is yes, proceed to install the end caps. If the answer to any one question is no, use a wrench on the pinion to drive the pistons out of the body and repeat the insertion process. It is not necessary to remove the pistons from the body unless the answer to the first question is no. It is only necessary to disengage the piston rack from the pinion.

NOTE: The procedure described here is the "standard" method. For fail open actuators, refer to the *Method 2* or *Method 3* above.

End Caps (4) - Install the o-ring (20) in the groove. Attach the end cap to the body with the 4 bolts (17) and washers (18) making certain that the straight part of the o-ring groove is toward the bottom of the body. The air pressure will not flow to the outboard side of the pistons if the straight part of the o-ring groove is at the top.

Position Indicator (23) - Install the position indicator pointer on the top of the pinion and secure it with the flat head screw (24). Normally, the long axis of the pointer will be parallel to the groove in the pinion. If the actuator is installed across the pipe line, as described in Method 1 above, the indicator should be turned so that it is in line with the butterfly valve disc or port in the ball or plug valve.

Final Assembly and Testing

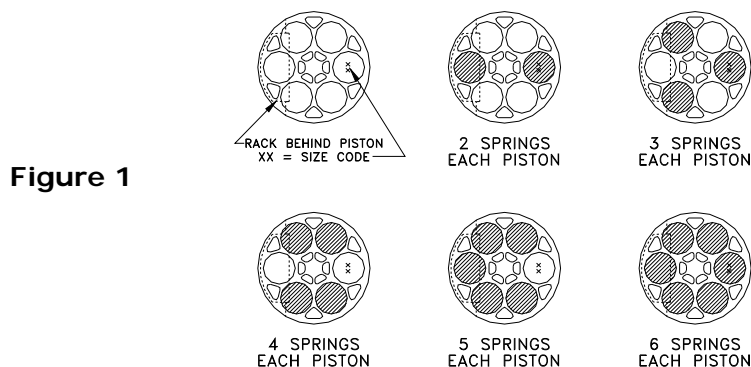
Connect the compressed air supply to the actuator input ports. Cycle the actuator fully open and fully closed to check for proper travel and absence of air leaks. If compressed air is applied to Port A and the actuator reaches the end of travel, there should be no air flow out of Port B, and vice versa. There should be no air flow between the end caps and the body, through the travel stops, or out the top or the bottom of the pinion. A solution of soap and water applied to the sealing points can indicate leaks that are too small to be audible.

Disassembly

Disconnect the compressed air from the actuator. If the actuator is installed on a valve, remove it and take it to a clean work area, if possible. Remove the indicator pointer. Remove both end caps by loosening the hex head end cap bolts. Remove both pistons by rotating the pinion counterclockwise until the piston heads are protruding from the body. Pull the pistons out. Take off the pinion retaining ring and acetal washer, then remove the pinion from the body. The pinion bearings and o-rings may then be removed.

Adding Spring Cartridges

Move the pinion to the fully closed (0°) position. Remove the end caps and insert the desired number of spring cartridges into the end cap pockets, up to a maximum of six cartridges per end cap. See preferred placement of the spring cartridges below.



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Align the end cap with the body so the spring cartridges fit into the piston pockets. Attach the end caps to the body with the hex head end cap bolts. Tighten the bolts gradually in a diagonal sequence. Proceed to Final Assembly and Testing.

Removing Spring Cartridges

Disconnect the compressed air from the actuator. An actuator with spring cartridges installed and no compressed air connected will move to the spring fail position. This may be either fully closed (0°) or fully open (90°). In either case, when the spring fail position is reached, remove the end caps by gradually loosening the hex head end cap bolts in a diagonal sequence. Remove the spring cartridges. Replace the end caps and tighten the bolts gradually in a diagonal sequence. **CAUTION:** Do Not Allow a Single Bolt to Hold the Fully Compressed Springs.

Proceed to Final Assembly and Testing.

General Pneumatic System Recommendations

To maintain maximum efficiency with the Series 100 actuator, as well as many other pneumatic devices, the following suggestions are offered:

- ⊙ Air supply lines should be run in accordance with a Standard Piping Practice, and should not have exaggerated loops which may trap condensate.
- ⊙ All pipe ends should be thoroughly cleaned and deburred after cutting to ensure that the pipeline is clear of cuttings.
- ⊙ Where air pipelines are subjected to extremes of temperature, the system should be fitted with air drying equipment.
- ⊙ If pipelines are hydraulically tested, the lines should be "blown down" with high pressure air to clear all water prior to connecting the lines to the actuator.
- ⊙ Where a system is dependent on air filter equipment, the air filters should be in positions that allow easy access for maintenance and/or draining.
- ⊙ Where pneumatic valve positioners or pneumatic controllers are installed in a valve actuator assembly, oil mist lubricated air should not be used unless the manufacturer states specifically that the positioner or controller is compatible with lubricated air. In general, lubricated air is not recommended for a positioner.
- ⊙ Where pipe fitting sealants or tapes are used, they should be applied to the male threads only. When applied to female threads, excess compound or tape can be transmitted into the actuator control lines and cause malfunctions in downstream equipment.

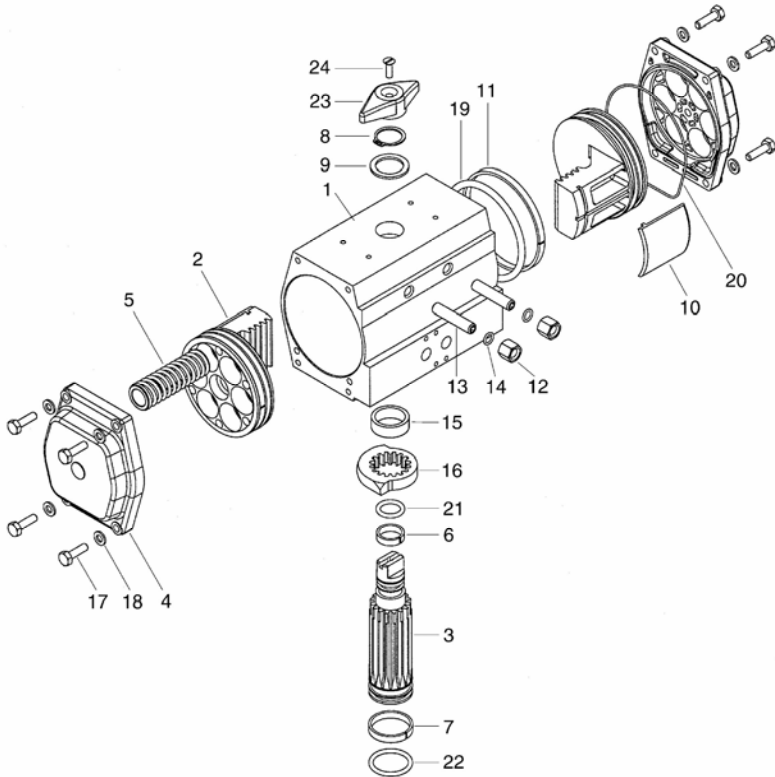


Figure 2

Item No	Qty.	Description
1	1	Body
2	2	Piston
3	1	Pinion
4	2	End Cap
5	12 max.	Spring Cartridge
6	1	Upper Pinion Bearing
7	1	Lower Pinion Bearing
8	1	Retaining Ring
9	1	Washer, Acetal
10	2	Bearing Pad, Acetal
11	2	Guide Ring, Acetal
12	2	Lock Nut

Item No	Qty.	Description
13	2	Travel Stop Screw
14	2	O-ring, Travel Stop
15	1	Spacer, Int. Travel Stop
16	1	Cam Internal Travel Stop
17	8	Hex Head Cap Screw
18	8	Washer, Stainless Steel
19	2	O-ring, Piston
20	2	O-ring, End Cap
21	1	O-ring, Upper Pinion
22	1	O-ring, Lower Pinion
23	1	Position Indicator Pointer
24	1	Flat Head Screw

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