actuator description

The Model 33 "floating stem" spring-diaphragm actuator is a virtually frictionless mechanical device used to power Masoneilan rotating shaft valves, specifically, the 36000 Series Control Ball valve and 37000 Series MiniTork Butterfly valve. There are two case sizes: 70 sq. in. and 140 sq. in. The action of the actuators is direct, i.e. increasing air pressure extends the stem.

The nominal range of a spring-diaphragm actuator is the air pressure range in pounds per square inch (psi) for rated stroke under no load. The range of these actuators is designed for use with a 3-15 psi instrument signal and is shown in the table opposite. The range is determined by the spring rate and diaphragm effective area. The initial pressure or the pressure at which the actuator stem starts to move is normally set by an adjusting screw in conventional actuators. In the Model 33 actuator the initial is pre-set when the actuator is assembled and an adjustment is neither necessary nor possible. Maximum allowable supply pressure is 60 psi.

The Model 33 actuator consists of an upper and a lower diaphragm case housing a diaphragm, diaphragm plate, actuator stem and a bracket adapter which also serves as a stroke stop. The spring is pre-compressed during assembly by three tension bolts. A tag on each bolt reads "CAUTION, TENSION BOLT, REMOVE LAST". The actuator stem pivots at the upper end. It is fastened to a trunnion block which, in turn is fastened to the diaphragm plate with a cap screw.

The only change made in the actuators when using them on the MiniTork Butterfly valve and Control Ball valve is the spring and bracket adapter.

Connection to the valve is with a precision rod end bearing (grease lubricated). The air connection is ¼" NPT tap in the cover plate.

Actuator Size (Sq. In.)	Actuator O.D. (in.)	36000 Series Control Ball Valve		37000 Series MiniTork Butterfly Valve	
		Stroke (in.)	Range (psi)	Stroke (in.)	Range (psi)
70	13	2⅝	5-13	2¼	6-15
140	17½	2⅝	7½-14½	2¼	9-15

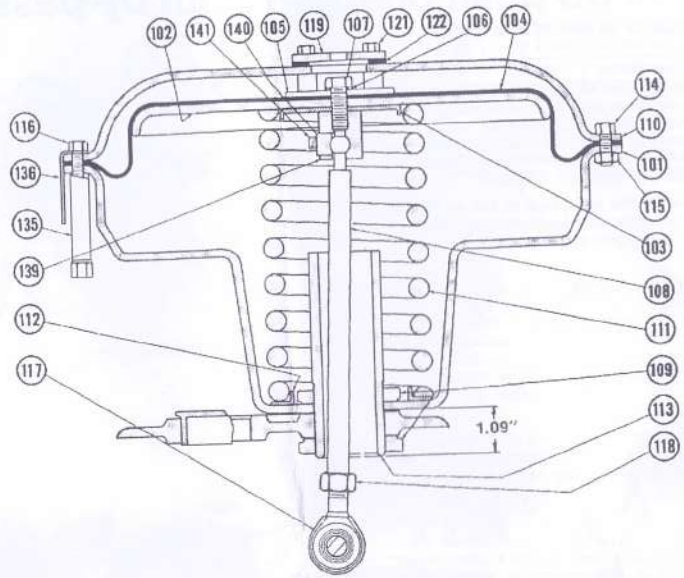
actuator maintenance

Disassembly

1. Disconnect air lines. Unscrew clamp nut (109) and remove actuator from bracket.
2. Remove cap screws (121) and lift cover plate (119) and gasket (122) from case (110). If a Model 7700 positioner is installed on actuator, unscrew four mounting screws (121) and remove positioner by turning it counterclockwise until the feedback spring stud (13) disengages from cap screw (107).
3. Remove rod end bearing (117) and nut (118) from the actuator stem. Caution: The rod end bearing *must* be removed at this point. If not removed, the spring will still be partially compressed when the three tension bolts are removed. The load will be transferred to cap screw (107) posing a potential danger to maintenance personnel. Remove all nuts (115) and cap screws (114) except the three tension bolts. Note: REMOVE THE THREE TENSION BOLTS LAST.
4. Unscrew tension bolts (116) evenly to relieve the spring compression. Remove upper diaphragm case (110) diaphragm-stem-trunnion block subassembly, spring (111), and spring guide (112).
5. Unscrew cap screw (107) and separate seal washer (106), travel stop (105), diaphragm (104), diaphragm plate (102), spring guide (103) and trunnion block (139). Separate actuator stem from the trunnion block by removing Nyloc screw (141) and bearing (140). Note: Do not remove bracket adapter (113) unless necessary as it acts as a lower travel stop and its position is set at the factory. If disassembled, position it in the lower diaphragm case using dimension A, firmly locking clamp nut (109) to inside of case (101).
6. Clean all parts thoroughly before reassembling. Note: Lightly lubricate the trunnion block and end of the actuator stem with Molykote G or a light film of grease. Also grease the rod end bearing (117).

Reassembly

1. Screw bracket adapter (113) with clamp nut into lower diaphragm case, establish dimension A (1.09") and tighten clamp nut firmly.
2. Fasten actuator stem (108) to trunnion block, replace bearing (140) and tighten Nyloc screw (141) until snug, i.e. until the actuator stem can move, but without backlash.
3. Assemble trunnion block (139) spring guide (103), diaphragm plate (102), new diaphragm (104), travel stop (105), and seal washer (106), and fasten together with cap screw (107).
4. Position spring guide (112), spring (111) and diaphragm assembly on the lower diaphragm case. Replace upper diaphragm case (110) and tighten the three tension bolts (116) to compress the spring. Replace cap screws (114) and nuts (115).
5. Replace nut (118) and rod end bearing (117) on actuator rod (108).
6. Replace gasket (122), cover plate (119) and cap screws (121). If replacing the 7700 positioner, refer to instructions on pages 6 and 7.



Model 33 Spring-Diaphragm Actuator

Recommended spare part numbers

Actuator Size (sq. in.)	Diaphragm Reference No. 104	Sealing Washer Reference No. 106	Gasket Reference No. 122
70	021107-020-686	971508-007-694	009191-688-680
140	021114-020-686	971508-007-694	009191-688-680

PARTS REFERENCE

Ref. No.	Part Name	Computer Abbrev.	Ref. No.	Part Name	Computer Abbrev.	Ref. No.	Part Name	Computer Abbrev.
101	Lower Diaphragm Case	L D CSE	110	Upper Diaphragm Case	U D CSE	119	Cover Plate	CVR PLT
102	Diaphragm Plate	DPH PLT	111	Actuator Spring	ACT SPR	121	Cap Screw	CAP SCR
103	Spring Guide	SPR GDE	112	Spring Seat	SPRSEAT	•122	Gasket	GASKET
•104	Diaphragm	DIAPHRM	113	Bracket Adapter	BKT ADP	135	Tension Nut	TSN NUT
105	Travel Stop	TVL STP	114	Cap Screw	CAP SCR	136	Warning Plate	WRN PLT
•106	Sealing Washer	DYN WSH	115	Nut	NUT	139	Trunnion Block	TRUNBLK
107	Cap Screw	CAP SCR	116	Tension Bolt	TSN BLT	140	Trunnion Block Plug	T B PLG
108	Actuator Stem	ACT ROD	117	Rod End Bearing	R E BRG	141	Cap Screw	CAP SCR
109	Adapter Nut	ADP NUT	118	Nut	NUT			

• Recommended spare parts

maintenance —
Model 7700 positioner – without by-pass

Refer to back page for positioner with by-pass

Installation

The integrally top-mounted Model 7700 pneumatic positioner has been designed specifically for use with the floating stem actuator. The simple feedback mechanism is internally connected to cap screw (107). External exposed linkage has been eliminated giving this positioner reliable, positive, accurate feedback.

A plate is located on the front face of the positioner giving the supply pressure and signal pressure. The two gauges indicate instrument signal and output pressure to the actuator.

Use ¼" O.D. tubing or equivalent for all air lines. If supply air line exceeds 25 ft. in length, use ⅜" O.D. tubing. ¼" NPT ports are provided in the positioner manifold block for supply and signal pressure connections. Supply air is piped to the port in the back of the block. Set supply pressure to the value indicated on the serial plate. Pipe instrument output to the port marked "SIGNAL".

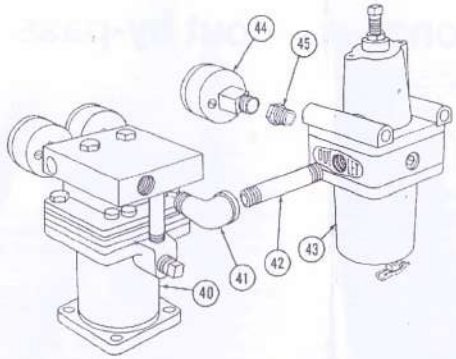
If a Model 77-4 air filter regulator was ordered with the valve, it is shipped with gauge and piping unassembled in the box. Pipe the regulator to the positioner as shown.

Operation

The 7700 positioner works on the force balance principle: an input force produced by the controller air signal, acting on a double diaphragm assembly (22) is balanced by the opposite force generated by the feedback spring (18). The feedback spring tension varies with the up or down movement of the actuator diaphragm plate to which it is connected. The double diaphragm assembly operates a unique spool and sleeve pilot valve (25 & 3) which throttles output pressure to the actuator diaphragm, increasing or exhausting pressure as needed. The bottom or exhaust end of the pilot valve rests on the double diaphragm assembly. Output air is exhausted only after the pilot valve seats (shutting off air to the actuator) and the double diaphragm assembly moves down an additional amount to open the exhaust port.

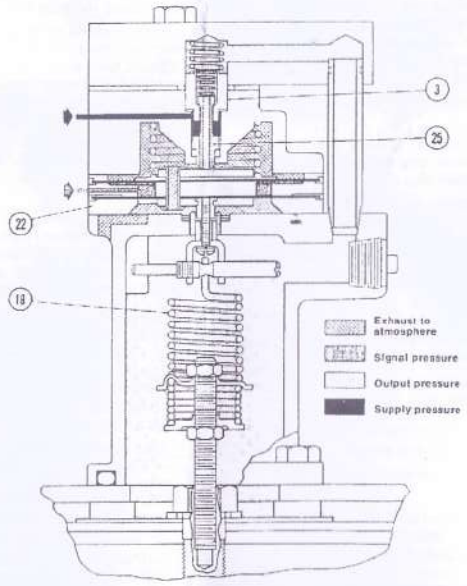
The only air leakage during steady state operation is the small clearance between spool and sleeve, resulting in very low air consumption.

The schematic shows the positioner action: pilot output increases when air signal increases. An increase in instrument signal makes the double diaphragm assembly (upper diaphragm has twice the area of lower diaphragm) move up, pushing the spool (25) up. Supply air flows by the spool increasing output and extending the actuator stem. On decreasing signal, the upward force of the double diaphragm assembly is reduced, allowing the spool to close. Further movement opens the exhaust port of the spool allowing air to escape and the actuator stem moves up. When the signal is constant, the entire force balance mechanism stabilizes to maintain the desired valve position.



Assembly of Airset to Positioner

Ref. No.	Part Name	Part Number
40	Positioner	Model 7700
41	Street Elbow	971583-002-400
42	Nipple	972503-010-400
43	Air Set	Model 77-4
44	Gauge (0-60 psi)	435100-068-888
45	Bushing	971591-001-400



Schematic of Operation

maintenance — Model 7700 positioner – without by-pass

Refer to back page for positioner with by-pass

Disassembly

1. Disconnect air lines, 77-4 air filter-regulator and associated piping.
2. Remove cap screws (121) and turn positioner counterclockwise until stud (13) disengages cap screw (107). Remove O-ring (17).
3. Remove cap screws (1) and lift manifold block (29) off block (23). Remove spring (2), gasket (5) (containing 3 O-rings), O-ring (4), sleeve (3), shim(s) (26) and O-ring (24). Note: Count the number of shims removed. Install the same number when reassembling.
4. Unscrew pipe plug (10). Insert a screwdriver into the ¼" NPT port and back out the feedback spring pin (12). Remove pin and feedback spring subassembly. Note: Do not disassemble feedback spring sub-assembly unless a span adjustment is required (see Adjustments).
5. Remove screw (11), lock washer (9), spring bracket (21) and spacer (8).
6. Remove cap screws (1) and separate block (23) from the body (19). Remove screws and separate double diaphragm assembly (22) from block.
7. Examine all parts for damage or wear and clean thoroughly. Replace all O-rings (including the small O-ring in the double diaphragm assembly) and all damaged parts. Apply a light coat of silicone grease to all O-rings before assembling the positioner.

Reassembly

1. Replace the small O-ring (and spring (7) in a split range positioner) and assemble double diaphragm assembly (22) to block (23).
2. Replace O-ring (24), shims(s) (26) and sleeve (3) in the block. Position gasket (5) with its 3 O-rings on the top of the block. Insert two cap screws (1) in block (23). Place spring (2) on the sleeve.
3. Position manifold block (29) on block (23) and fasten with two cap screws (1).
4. Replace O-ring (4) on the output pipe (6). Slip manifold, block and diaphragm assembly over output pipe (6) and fasten to the body (19) with two cap screws (1).
5. Assemble spacer (8), spring bracket (21), lock washer (9) and screw (11). Note: Be sure that the threaded hole of the spring bracket (21) is furthest from the access port in the body.
6. Position feedback spring assembly in the body and replace feedback spring pin (12). Replace pipe plug (10). Replace O-ring (17).

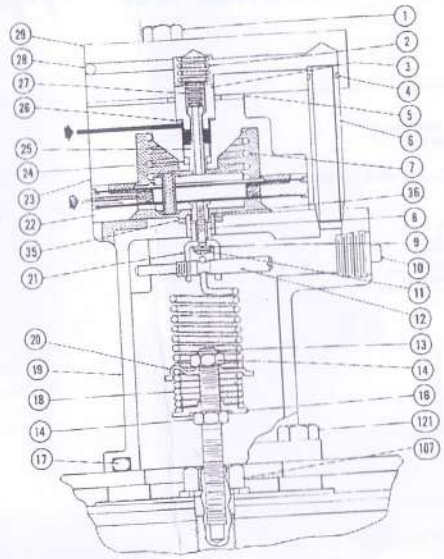
Adjustments

Zero: The zero adjustment locates the base point of the span, i.e. it determines that the actuator stem (valve) will start to move when the signal pressure is 3 psi (3-15 or 3-9 signal) or 9 psi (9-15 signal).

1. Locate the positioner directly over the hole in the top of the actuator and turn until the threads of the stud (13) engage cap screw (107). Turn positioner onto the actuator the number of turns shown in the table opposite and tighten four cap screws (121). For convenience, have the gauges facing in the same direction as the travel indicator on the valve.
2. Connect air lines, apply supply pressure and set initial signal pressure. The indicator plate of the valve should indicate full open or closed.
3. If the valve starts to move before initial signal pressure is reached, remove air lines and cap screws (121) and turn positioner clockwise. Note: A 360° turn of the positioner equals approximately 0.2 psi change in signal pressure on the MiniTork valve (2¼" stroke) or a 0.17 psi change on the Control Ball valve (2⅝" stroke).
4. If the valve starts to move at a signal pressure above the initial pressure, turn the positioner counterclockwise.
5. Adjust signal pressure first to mid-range and then to full range. When maximum signal pressure is reached (15 psi), the valve should be full open or closed. If not, a slight adjustment (span) of the feedback spring is required.

Span: The span of the 7700 positioner is set at the factory with a pre-calibrated feedback spring subassembly (see table opposite for color code identification of feedback spring assemblies for various signal ranges). No adjustment of the spring should be attempted until the positioner has been tested on the valve and a zero adjustment made.

1. Remove feedback spring subassembly from positioner body (19) as outlined under DISASSEMBLY. Caution. Do not adjust the spring rate while the feedback spring is in the positioner body or damage to the pin (12) and diaphragm (36) may result.
2. Check the color code of the spring. If correct, adjust the spring rate by loosening jam nut (14) and locking disk (16) and turning adjustment disk (20). If signal span is too short for rated stroke, decrease the number of active coils. If signal span is too long for rated stroke, increase the number of active coils. Each active coil represents approximately 1 psi of signal span.
3. Reassemble positioner, install on the valve and repeat the zero procedure.

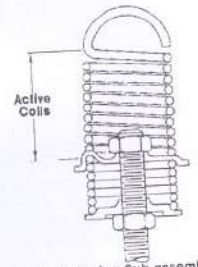


PARTS REFERENCE

Ref. No.	Part Name	Computer Abbrev.	Ref. No.	Part Name	Computer Abbrev.	Ref. No.	Part Name	Computer Abbrev.
1	Cap Screw	CAP SCR	13	Stud	STUD	26	Shim	SHIM
2	Spring	SPRING	14	Jam Nut	JAM NUT	*27	Spring	SPRING
*3	Sleeve	SLEEVE	16	Locking Disk	LCK DSK	§28	Ball	BALL
*4	O-ring	O RING	*17	O-ring	O RING	29	Manifold Block	MFD BLK
*5	Gasket	GASKET	18	Feedback Spring	F B SPR	30	Emblem	EMBLEM
6	Output Pipe	OUT PIP	19	Positioner Body	PSN BDY	31	Output Gauge	OUT GGE
†7	Bias Spring	BIASSPR	20	Adjustment Disk	ADJ DSK	32	Instrument Gauge	INS GGE
8	Spacer	SPACER	21	Spring Bracket	SPR BKT	33	Decal (signal)	DECAL
9	Lockwasher	LCK WSH	*22	Positioner Diaphragm S/A	PSN DPH	34	Serial Plate (Decal)	SRL PLT
10	Pipe Plug	PIP PLG	23	Positioner Block	PSN BLK	‡35	Washer	WASHER
11	Screw	HED SCR	*24	O-ring	O RING	‡36	Diaphragm	DIAPHRM
*12	Pin (Feedback Spring)	PIN	*25	Spool	SPOOL			

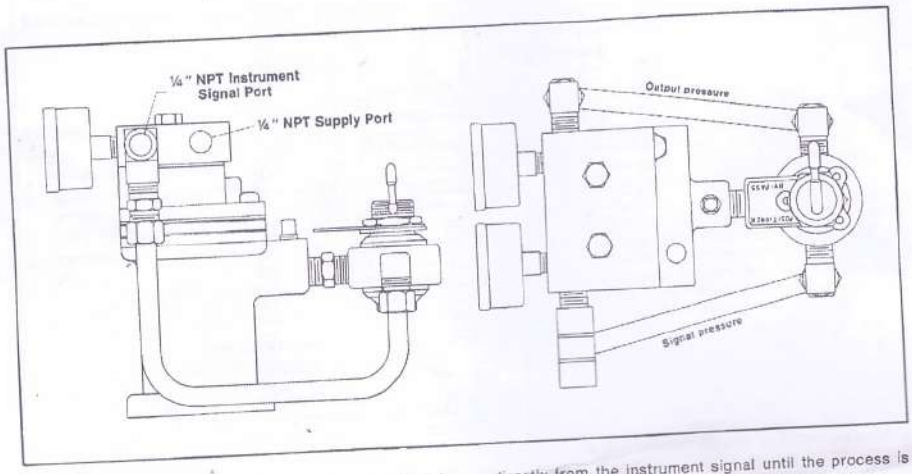
* Recommended spare parts
§ Contained in Part No. 29
‡ Contained in positioner body (19).
† Supplied only for split range
* Supplied as a complete subassembly, includes sleeve (3) spring (27) and spool (25).

Valve	Stroke (in.)	Instrument Signal Range (psi)	Approximate number of Positioner Stud turns for Initial Setting	Feedback Spring Color Code	Bias Spring Color Code
37000 Series "MiniTork" Butterfly Valve	2¼	3-15 3-9 9-15	12½ 12½ 15	Red Blue Green	— Blue Green
36000 Series Control Ball Valve	2⅝	3-15 3-9 9-15	12½ 12½ 16	White Black Yellow	— Blue Green



Feedback Spring Sub-assembly

Model 7700 positioner with by-pass



The by-pass for the Model 7700 positioner is shipped completely piped as shown and ready for operation. Simply connect the instrument signal and supply air lines to the ¼" NPT ports shown in the above drawings.

Under normal operating conditions with the toggle set at "POSITIONER", the controller signal pressure (always connected directly to the double diaphragm assembly (22) of the positioner), is blocked at the toggle valve. Positioner output passes through the toggle valve and into the positioner body (19) and actuator. Setting the toggle at "BY-PASS" blocks the positioner output and allows the instrument signal to pass through the toggle valve directly to the actuator. Thus, in the event of a positioner malfunction, the valve may be operated directly from the instrument signal until the process is shut down for equipment maintenance.

The construction of the Model 7700 positioner with by-pass differs only slightly from the basic positioner shown on Page 7. The output pipe (6) and O-ring (4) of the standard positioner are removed and a ⅛" NPT pipe plug is installed in top of the positioner body (19). The manifold block (29) is replaced by a block which channels output air to a side ¼" NPT port. A connection is then made from the output port to the toggle valve to the ¼" NPT port at the back of the positioner body. The procedures for disassembly, reassembly and adjustments are the same as those of the standard Model 7700 positioner.

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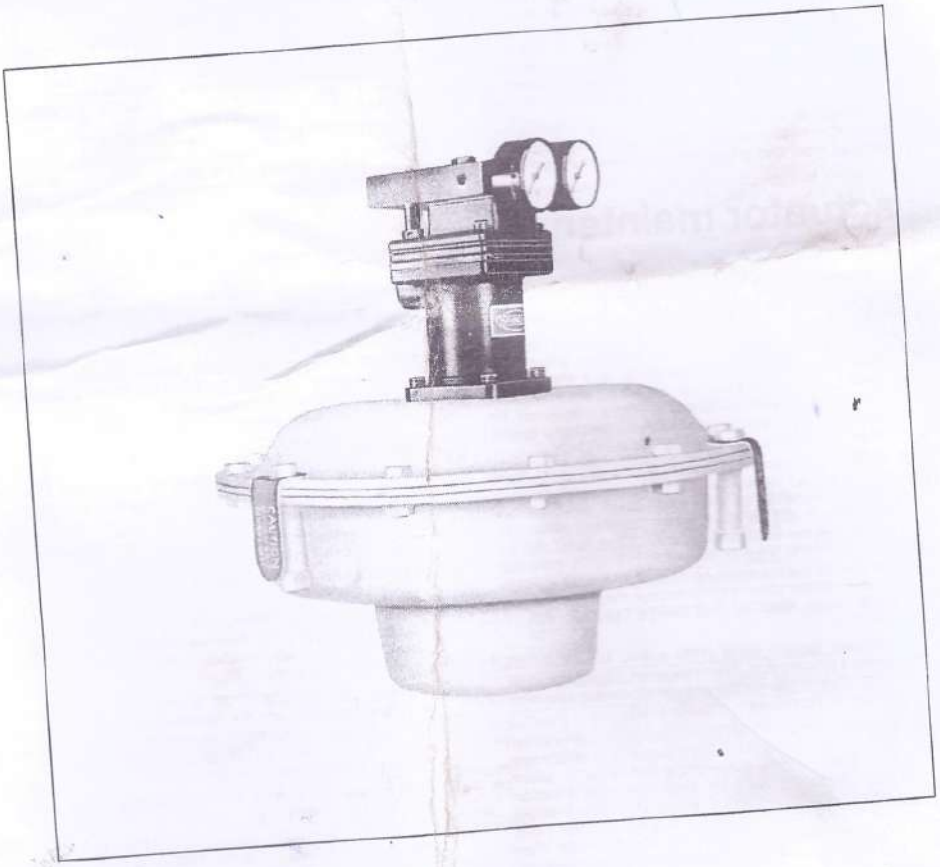
Instruction No. 6019E

Masoneilan
Model 33 Spring-Diaphragm Actuator
Model 7700 Pneumatic Positioner
Instructions



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Instruction No. 6019E