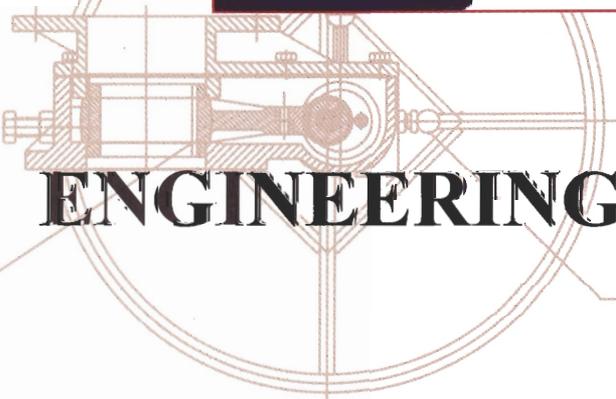
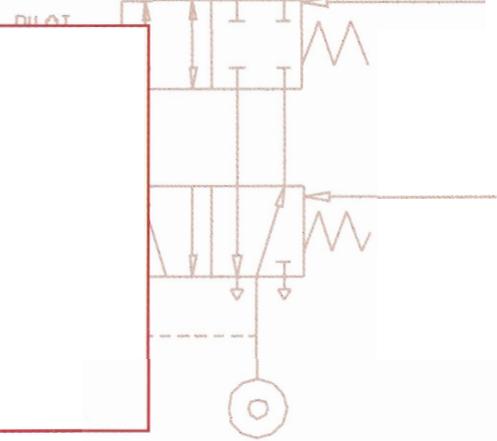
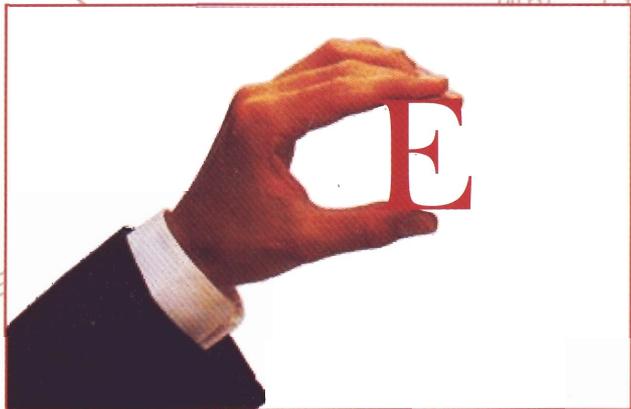
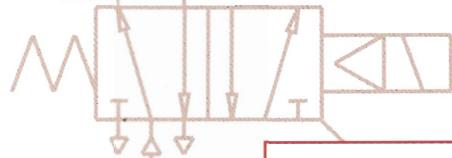
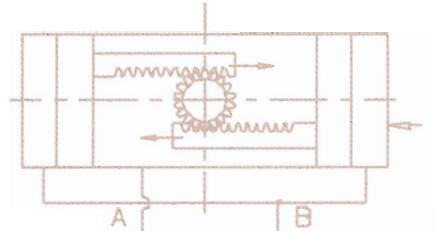
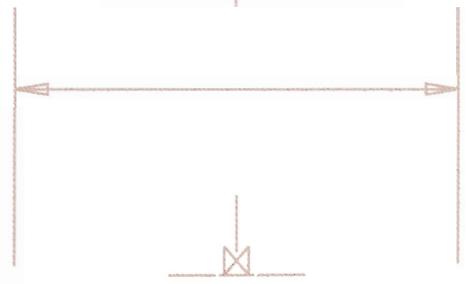
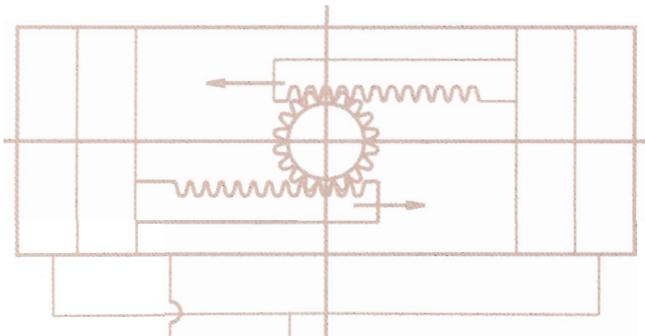


EL-O-MATIC (INDIA) PVT. LTD.

(IN COLLABORATION WITH EL-O-MATIC B.V. OF HOLLAND)



ENGINEERING MANUAL

CONTENTS

SECTION 1

PRELIMINARY INFORMATION

- 1.1. How to use this manual
- 1.2. How to order spares

SECTION 2

ORDER, SUPPLY & SYSTEM DETAILS

- 2.1 Order details
- 2.2 Scope of supply
- 2.3 System drawings

SECTION 3

COMPONENT MANUALS

(Manuals for only those system components actually ordered, marked ' ' are included in this manual set)

3.1	ACTUATOR	ACT	□
3.2	PROCESS VALVE	VLV	□
3.3	SOLENOID VALVE	SOV	□
3.4	LIMIT SWITCH UNIT	LSB	□
3.5	POSITION TRANSMITTER & INDICATORS	PTR	□
3.6	I / P CONVERTOR	IPC	□
3.7	POSITIONER	POS	□
3.8	AIR TANK	ATK	□
3.9	MANUAL OVER-RIDE UNIT	MOR	□
3.10	OTHER PNEUMATIC ACCESSORIES	ACC	□
	AFR QEV FCV ALV NRV PNEU. LOCK EQV		
3.11	ELECTRONIC CONTROLS	ELC	□

PRECAUTION

READ THIS MANUAL THOROUGHLY BEFORE ATTEMPTING TO INSTALL OR SERVICE THIS EQUIPMENT.



PAY CAREFUL ATTENTION TO THE PRECAUTIONARY INSTRUCTIONS GIVEN AT VARIOUS PLACES IN THE USER MANUALS IN OUTLINE BOXES.

SECTION 1**PRELIMINARY INFORMATION****1.1 How to use this manual**

Section 1 of this manual contains instructions relating to how to use this manual, ordering spares.

Contact your nearest branch of our headquarters if you require :

- Service Assistance
- Spare parts
- Actuators or valve / actuator systems

Section 2 gives details which are specific to this order: Customer's order reference, our works reference, and scope of supply. Drawings of the valve / actuator systems supplied are also given in this section.

Section 3 contains separate manuals for each major component of the valve / actuator systems supplied under this order. Each user manual is complete with respect of the system component it covers. It includes detailed specifications, standard drawings, and instruction, disassembly, re-assembly, and trouble shooting.

1.2 How to order spares :

Spares for El-o-matic Actuators and valve actuator systems can be ordered through the El-o-matic Branch office nearest to you.

PLEASE FOLLOW PART NUMBERS AND PART NAMES ACCURATELY AS GIVEN IN THE USER MANUALS. OTHERWISE, IT CAN LEAD TO ERRORS AND / OR DELAYS IN EXECUTING ORDERS.

IMPORTANT : READ THIS MANUAL THOROUGHLY BEFORE INSTALLATION OR SERVICING
CONTENTS :

1. DESCRIPTION	7. AIR CONSUMPTION	13. P SERIES: ACTUATOR DIMENSIONS
2. SPECIFICATIONS	8. MAINTENANCE	14. P SERIES: CONSTRUCTION, PARTS AND MATERIALS
3. ORIENTATION	9. RECOMMENDED SPARES/REPAIR KIT	15. E SERIES: ACTUATOR DIMENSIONS
4. AIR SUPPLY	10. DISASSEMBLY	16. E SERIES: CONSTRUCTION PARTS, AND MATERIALS
5. OPERATION	11. REASSEMBLY	
6. MANUAL OPERATION	12. TROUBLE SHOOTING	

1. DESCRIPTION :

El-o-matic Pneumatic Actuators are pneumatic quarter turn (90°) actuators, Special versions are available for half turn (180°) applications. The design utilizes a double rack and single pinion. A unique patented features of the actuator is the application of a 3 point support for pistons. Three carbon filled Teflon guide bands are a balanced piston and the cylinder walls which eliminates wear and increases the actuator life.

The unit has an extended top shaft and a complete modular design which allows simple attachment to a variety of control accessories.

The bottom mounting pad of the actuator is as per ISO 5211. Thus it can be directly mounted on any valve which conforms to ISO 5211 flange configuration.

Details relating to dimensions, assemblies, part list, and materials are given in the drawings / data sheets in sections 13, 14, 15 and 16.

180° actuators are available only in the 'P series. (Type PD and PE). Dimensions of 180° actuators correspond to those of 90° actuators. Torque ratings of 180° actuators are different.

2. SPECIFICATIONS :
P SERIES

1. Pressure range	: PD - 0.2 to 10 bar PE - 6 to 10 bar standard springs PE - 3 to 10 bar, reduced springs	5. Temperature	: -20° C to +80° C
2. Torque	: 23 to 4955 Nm, at 6 bar working pressure	6. Rotation	: Counter-clockwise to open, with port "A" pressurized. Spring return actuators air fail to close, clockwise
3. Media	: Air (dry or lubricated) non-corrosive gas or light hydraulic oil	7. Movement	: 91.5° from -0.5 CW to 91° CCW
4. Construction	: Suitable for indoor or outdoor Installation	8. Lubrication	: Factory lubricated for the normal life of the actuator.

Actuator size (PD or PE)		60	150	280	500	750	1100	2500	4000	Units
Bore		80	110	135	164	200	210	300	325	mm
Stroke		18.8	25.1	31.4	37.6	37.6	50.3	56.8	81.7	mm
Weight	PD	2.6	5.3	9.2	14.0	22.4	30.8	64.7	97.8	kg
	PE	3.0	6.4	11.6	19.2	33.4	41.5	97.9	143.0	kg
Operating time (standard)		1.2	2.3	3.4	4.2	4.8	6.0	7.0	12.0	sec.
Air Consumption (actual volume at 1 atmosphere)	Port A	0.27	0.60	1.50	1.90	3.20	4.20	8.00	13.50	Litres
	Port B	0.38	0.80	1.60	2.50	4.20	5.40	9.30	17.50	Litres

E SERIES

- 1. Pressure range : ED : 0.2 to 10 bar
 ES : 6 to 10 bar standard springs
 ES : 3 to 10 bar, reduced springs
- 2. Torque : 9 to 251 Nm, at 6 bar working pressure
- 3. Media : Air (dry or lubricated)
 non-corrosive gas or light hydraulic oil
- 4. Construction : Suitable for indoor or outdoor
 Installation
- 5. Temperature : -20° C to +80° C
- 6. Rotation : Counter-clockwise to open with port "A"
 pressurized.
 Spring return actuators air fail to close,
 clockwise
- 7. Movement : 91.5° from -0.5° CW to 91° CCW
- 8. Lubrication : Factory lubricated for the normal life
 of the actuator

Actuator size (ED or ES)		12	25	40	100	200	350	600	950	1600	Units
Bore		46	56	70	91	110	145	175	200	230	mm
Stroke		12.6	15.7	18.8	25.1	37.7	37.7	44.0	50.3	62.8	mm
Weight	ED	0.61	1.3	2.0	3.7	6.8	10.4	19.4	26.4	42.7	Kg
	ES	0.67	1.7	2.6	5.0	10.3	16.9	27.6	38.6	65.8	Kg
Operating time (Standard)		0.4	0.5	0.7	1.2	2.3	3.6	3.6	5.4	6.9	Sec
Air Consumption (Actual volume at 1 atmosphere)	Port A	0.05	0.10	0.16	0.35	0.80	1.80	2.90	4.70	7.30	Litres
	Port B	0.06	0.11	0.22	0.49	1.00	1.90	3.10	4.90	8.00	Litres

3. ORIENTATION :

The actuator is normally installed with its major axis parallel to the pipeline. The actuator can be oriented above, beside or beneath the valve without affecting its operation.

The unique full machined shaft and square drive mounting pattern allows reorientation of the actuator to accommodate installations where physical obstructions might otherwise be prohibitive.

All El-o-matic actuators feature a blow out proof shaft design. This means that the pistons must be removed before the shaft can be reoriented.

4. AIR SUPPLY :

El-o-matic actuators are factory lubricated. For optimum operation, the use of clean, dry air / gas is recommended. Lubricated air is not necessary.

Standard double acting actuators require 1 to 8 bar air supply pressure and spring return actuators 3 to 8 bar.

5. OPERATION :

The El-o-matic actuator drive shaft rotates through a full 90° (180° actuators are available on special order). Rotation is accomplished by feeding supply air into the center chamber (through port A) forcing the two opposing pistons outward, resulting in counter-clockwise rotation of the drive shaft to the 'Open' position.

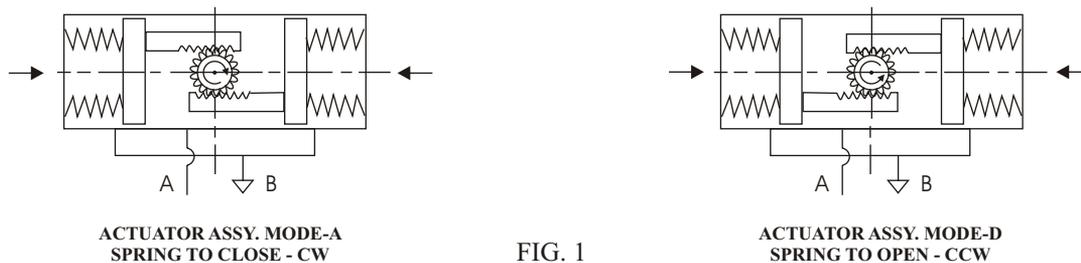


FIG. 1

For double-acting actuators, closure is obtained by feeding supply air into the end cap chambers (through port B) which forces the pistons inward, resulting in clock-wise rotation of the drive shaft.

For spring return actuators, closure is accomplished by means of springs contained in the end cap chambers, which force the pistons inward when the supply air to the center chamber (port A) is allowed to exhaust.

To reverse the stroke direction of the actuator, remove both the pistons, rotate them by 180° and re-install. This will reverse the direction of rotation of the output shaft. (see FIG.1).

6. MANUAL OPERATION :

In the event of air failure, the 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. This is not recommended on Model PD 500 and larger size of actuators. For these, El-o-matic offers, optional Manual Override gear units, with declutchable hand wheels. Manual wrench is not recommended for spring return actuators.

**CARE MUST BE TAKEN TO ENSURE THAT THE
ACTUATOR IS NOT OPERATED
AUTOMATICALLY
THROUGH AIR SUPPLY WHILE MANUAL
OPERATION IS BEING PERFORMED!**

Air must be allowed to exhaust from the actuator for manual operation. This may call for disconnecting air lines or providing three-way vent valves at inlet ports, depending on the pneumatic circuits.

7. AIR CONSUMPTION :

The charts showing the amount of air consumed per 90° of stroke in litres / stroke are given in specifications above.

8. MAINTENANCE :

**THE ACTUATOR MUST BE ISOLATED BOTH
PNEUMATICALLY AND ELECTRICALLY BEFORE
ANY MAINTENANCE IS CARRIED OUT!**

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

All actuators are supplied with sufficient lubrication for their normal working life. If required, recommended lubricant for all standard actuators is GREASE SERVOGEM 2. Consult El-o-matic 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 ordered from El-o-matic.

On spring return actuators, the springs may need replacement after extended duty, since springs may be subject to fatigue.

**SPRINGS SHOULD ALWAYS BE REPLACED IN
COMPLETE SETS ONLY !**

Spring kits are available from El-o-matic.

9. RECOMMENDED SPARES/REPAIR KIT :

All soft seals, bearings and non-reusable parts are included in the recommended spare part kit.

Each kit includes:

Guide band, piston	2 nos.
Guide band, housing	1 / 2 nos.
O-rings, piston	2 nos.
O-rings, endcap	2 nos.
O-rings, shaft	2 nos.
Guide bush, shaft	1 no.
Bearing band, shaft	1 no.
Washer, shaft	1 no.
Circlip, shaft	1 no.
Passage O- rings	2 / 4 nos.

The spare parts kit is identical for both the double-acting and the spring return models. For the spring return models, it is safe to have a set of spare springs for each different model in addition to the recommended spare parts kit. Keep in mind that, when necessary springs are to be replaced in complete set.

Racks are not recommended for replacement, instead, piston-rack assemblies should be replaced, if required.

10. DISASSEMBLY :

Before disassembling any actuator, be sure that the complete repair kit is available and that the kit has been checked for all parts.

1. Disconnect the air supply and electrical service to the actuator.
2. Remove the actuator from its mounting bracket.

DISASSEMBLY AND REASSEMBLY OF THE ACTUATOR MUST BE DONE IN CLEAN, DUST FREE ENVIRONMENTS!

BALL VALVES AND PLUG 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

3. Remove solenoid valve by unscrewing the mounting screws. Take care to retain the solenoid valve O-rings.
4. Each endcap is fitted into the body with a set of end cap bolts. Remove all endcap bolts from both endcaps by loosening them evenly and a little at a time. After the screws are removed, gently pry off each endcap being careful not to damage the endcap O-rings.

IF THE ACTUATOR IS A 'SPRING RETURN' MODE, UNIFORMLY LOOSEN ALL END CAPS . SCREWS ON EACH END CAP TWO TO THREE TURNS AT A TIME, IN SEQUENCE, TO RELIEVE PRE-LOAD OF THE SPRINGS. ON ALL ACTUATORS WITH SPRINGS, USE CAUTION WHEN REMOVING ENDCAPS !

5. The two pistons can now be removed by rotating the actuator shaft, driving the piston assembly outward until the gear rack and pinion have disengaged.
6. Remove and discard circlip and the washer from the shaft.
7. Remove the shaft through the bottom of the body.
8. All repair kit O-rings, guide bands and bearings may now be installed, if all the actuator surfaces are clean and free of grit and scratches. If the inside wall of the body is scored, the actuator will leak after Rebuilding. New 'unscored' parts should be obtained from the factory. Light tracing, barely detectable to touch is acceptable.
9. Lubricate the standard actuator thoroughly with grease Servogem 2. Apply a light film of grease to all O-rings.

10. If converting over to a 'high temperature' actuator, or rebuilding an existing one, consult El-o-matic for proper high temperature silicone or graphite base grease.

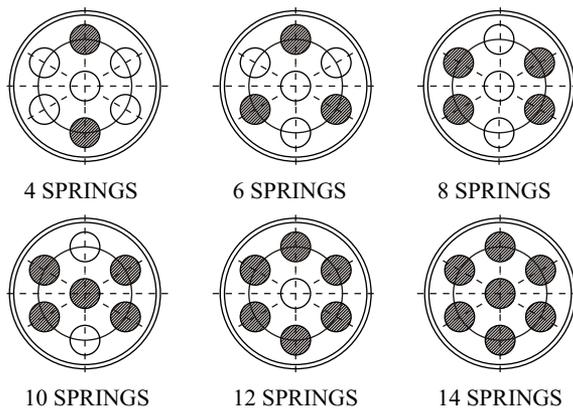
11. REASSEMBLY :**DOUBLE ACTING ACTUATOR**

1. Replace the top and bottom shaft bearings.
2. Replace the shaft in the body through the bottom of each actuator body. The bottom hole in the actuator body is larger inside diameter than the top hole in the body.
3. Very carefully align the shaft square to the body.
4. Align the pinion gear so that the teeth on the center gear will 'pick-up' the piston assembly's rack teeth, when turning the top extension of the center gear clockwise (CW).
5. To ensure proper meshing of the teeth, rotate the center gear 45° (or two teeth) counter clockwise (CCW) from its normal position with the piston assemblies located at the body ends. Normal position is that position which provides the proper output shaft orientation required.
6. With the piston assemblies in the body, gently push each piston into the body. Turn the top shaft extension clockwise (CW). At the proper point of engagement between the center gear and piston assemblies, both piston assemblies will move toward the center of the body when turning top shaft extension of the actuator clockwise (CW).
7. Once the pinion gear and pistons are properly engaged, ensure that smooth movement and 90° operation can occur without moving the pistons out of the actuator body. This is important.
8. Take care of seal O-rings while replacing the actuator endcaps.
9. Replace the washer over the top shaft extension.
10. Install the NEW circlip into its mating groove on the top shaft extension. (The removed shaft clip is not to be re-used). When properly installed, the shaft clip should rotate freely within the groove.

SPRING RETURN ACTUATOR:
P SERIES (Model SR)

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

When less than the standard number of seven springs are used in each end cap, these springs should be positioned in balanced configuration (refer FIG. 2 below)



● = SPRING.

FIG. 2

PE SERIES ACTUATOR

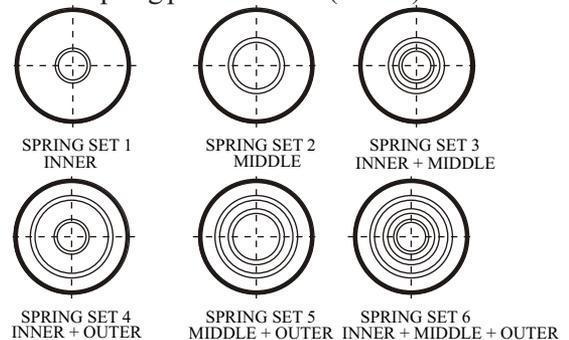
12. If a spring return actuator is being repaired due to a failed spring, replace ALL the springs in this actuator, as well as any other parts which may have been damaged.
13. When replacing the springs, place the actuator body on a clean, flat surface. Position it so that it stands on one end. Ensure that the pistons are stroked fully inward toward the center of the actuator. This may be done by rotating the actuator shaft with a wrench.
14. Place the springs on the piston face, engaging them with the bosses cast into the piston.
15. Place the endcap over the springs. Align them with the corresponding bosses on the endcap.
16. Place the endcap bolts through the retention holes of the endcaps.

IF CONVERTING A DOUBLE ACTING UNIT TO SPRING RETURN, BE SURE TO USE NEW END CAPS.

17. Engage the bolts with the tapped holes in the actuator body by forcing down slightly on the cap. Tighten each bolt in SMALL and EQUAL turns.

E SERIES (Model ES).

18. When replacing ES springs in a spring return actuator, ensure that the springs are replaced in their identical positions in the spring pack from where they were removed.
19. If a spring return actuator is being repaired due to a failed spring, replace ALL springs in this actuator as well as any other parts which may have been damaged.
20. To change springs, open the endcaps, remove nut cover, locknut, washer and O-ring.
21. Remove the spring retaining socket bolt using a hexagon wrench.
22. Remove and (if necessary) replace springs as indicated by the spring return torque chart. Be sure that all springs are located correctly in the end cap and the spring pack retainer. (FIG. 3)



○ = SPRING.

ES SERIES ACTUATOR

FIG. 3

23. Repeat steps 20 to 22 for the other spring pack.
24. Re-assemble in reverse order. (FIG. 1)

CAUTION !

When spring return actuators are used in a highly corrosive atmosphere, or when installed in the open, there are chances of corrosive media or water entering during suction through the silencer / breather provided on the spring chamber port (Port 'B'). This may lead to corrosion to springs or excessive wear and early failure to piston sealing ring.

To avoid such problems customers are advised to use BREATHER BLOCK. Breather block avoids suction of atmospheric air into spring chamber (Port 'B'). During spring stroke it allows air from centre chamber (Port 'A') to fill the spring chamber and then exhaust to atmosphere.

12. TROUBLE SHOOTING :

ACTUATOR

For identification of all numbered parts refer to drawing numbers in sections 14 and 16.

! AN ACTUATOR SHOULD NEVER BE REMOVED FROM THE SERVICE (PROCESS VALVE UNDER PRESSURE)

Make sure that all internal port passages are clear and free of any obstructions.

Make sure that the actuator is lubricated, and that there is no solidified grease between the pinion and the piston racks.

1. If the actuator has no lubrication, apply generous amounts of grease. If the actuator is for high or low temperature operation, consult El-o-matic for proper lubricant.
2. If solidified grease between the pinion and the piston racks is present, clean, dry, regrease and reassemble.
3. Verify that the actuator pinion shaft and / or pistons are bound. If bound, reassemble following the rebuilding Instructions.
4. If the actuator exhibits excessive amounts of backlash, check teeth in piston racks for wear. If worn, replace piston gear rack assembly.
5. In spring return actuators, check for misplaced or broken springs. If springs are broken, check the body bore for Scoring.

ACTUATOR SYSTEM

IMPORTANT: READ THESE GUIDELINES BEFORE ATTEMPTING ANY REPAIRS

SR. NO.	FAULT	PROBABLE CAUSE	REMEDIAL ACTION
A. 1.	FOR SOLENOID OPERATED ACTUATORS : Actuator does not function.	<p>Valve jammed / seized.</p> <p>Excessive friction in valve gland.</p> <p>Solenoid valve not operating / Functioning</p> <p>Air supply not reaching actuator</p> <p>Insufficient air supply pressure</p> <p>Manual Override engaged in manual mode (where MO is mounted)</p> <p>Equalizing valve open (if provided - only for system with MO).</p> <p>Speed control valve (regulating valve) fully closed (for system with speed control valve)</p> <p>Actuator undersize for the given application.</p>	<p>Check valve operation through Wrench / Manual Override (MO), if provided otherwise, remove actuator and check valve for smooth operation.</p> <p>Check gland packing, loosen gland if required.</p> <p>Check solenoid coil and ensure that specified supply voltage is applied to coil.</p> <p>Check solenoid valve operation (listen for “click” sound).</p> <p>Replace coil / valve if not functioning.</p> <p>Check pneumatic line and connections.</p> <p>Check air after regulator setting (use local pressure. gauge for checking supply pressure).</p> <p>Check air supply pressure and ensure specified air supply pressure.</p> <p>Declutch manual override and disengage handwheel.</p> <p>Check equalizing valve and close valve fully before giving air supply.</p> <p>Check position of speed control valve. Ensure that valve is kept partially opened.</p> <p>Cross check valve torque requirements. Select correct size of actuator.</p>

SR. NO.	FAULT	PROBABLE CAUSE	REMEDIAL ACTION
2.	Actuator functions but exhibits lack of power	<p>Leakage in pneumatic line.</p> <p>Leakage across pistons or between ports A & B (can happen only due to prolonged operation over a period of time)</p> <p>Low air supply pressure.</p> <p>Severe misalignment between actuator and valve</p>	<p>Check all pneumatic connections and tighten properly. Use Teflon tape / thread sealants on threads.</p> <p>Pressurise port A/B and check for leakage from the others. Change sealing parts if required</p> <p>Check supply pressure and ensure correct air supply pressure.</p> <p>Check linkage. loosen mounting bolts and align actuator correctly for friction free rotation.</p>
3.	Full stroke of actuator not achieved	<p>Excessive friction in gland packing</p> <p>Excessive clearance / play in adaptor / linkage</p> <p>Mounting bolts loose or wrongly Oriented</p> <p>Limit stops on actuator (if provided, not set correctly)</p> <p>Limit stops on MO (incase of systems with MO) not set properly.</p> <p>Obstruction in valve or linkage.</p> <p>Excessive spring torque (in case of spring return actuators). Low air supply pressure.</p>	<p>Check gland and loosen if required.</p> <p>Change adaptor.</p> <p>Align correctly and tighten bolts.</p> <p>Check and reset limit stop screws to achieve required stroke.</p> <p>Check limit stop settings on MO and readjust if required to achieve full rotation.</p> <p>Check for mechanical obstructions if any and remove</p> <p>Check air supply pressure and ensure specified supply pressure. Check spring selection.</p>

SR. NO.	FAULT	PROBABLE CAUSE	REMEDIAL ACTION
4.	Noise inside actuator	<p>Improper clearance between rack and pinion. Broken or loosened rack bolts.</p> <p>Insufficient lubrication . (due to prolonged use at high ambient temperatures.)</p> <p>Metal to metal contact due to worn out sealing / guiding elements.</p>	<p>Open actuator and check tightness of rack bolts. If loose tighten properly. If worn out replace racks /shaft.</p> <p>Open actuator, clean and lubricate with specified lubricant/grease.</p> <p>Replace guide bands / sealing elements.</p>
B. 5.	<p>ACTUATORS CONTROLLED WITH POSITIONERS (Additional checks)</p> <p>Actuator not functioning on increasing signal pressure</p>	<p>Leakage in signal line signal not reaching Positioner.</p> <p>Insufficient supply air pressure</p> <p>Faulty Positioner / seized spool valve</p>	<p>Check signal line fittings and tighten properly. Check for blockage in signal line.</p> <p>Check and ensure specified air supply pressure</p> <p>Check and repair (See Positioner instruction manual) or replace Positioner</p>
6.	Incorrect positioning	<p>Feed back mechanism not functioning / broken</p> <p>Excessive play in feed back mechanism</p> <p>Wrong span and zero adjustment.</p> <p>Wrong selection of feed back cam profile</p>	<p>Check Positioner feed back linkage ensure positive feed back.</p> <p>Check linkage and connect properly. Tighten grub screws provided on adaptor.</p> <p>Check span and readjust to obtain specified span. Correct zero Adjustment.</p> <p>Check selected cam profile and ensure that the required profile only selected.</p>