

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

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

1. DESCRIPTION :

EL-O-MATIC Pneumatic Actuators are available for half turn (180°) applications. The design utilizes a double rack and single pinion. A unique patented feature 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/PS). Dimensions of 180° actuators correspond to those of 90° actuators. Torque ratings of 180° actuators are different.

2. SPECIFICATIONS :

- | | |
|--|--|
| <p>1. Pressure range for Half Turn 180° :</p> <p style="margin-left: 20px;">PD-0.2 to 6 barg
PE-6 bar standard springs
PE-3 to 6 bar, reduced springs</p> <p>2. Torque: For half turn (180°)</p> <p style="margin-left: 20px;">5 to 2477 Nm, at 6 bar working pressure</p> <p>3. Media: Air (dry or lubricated)
non-corrosive gas or light hydraulic oil</p> <p>4. Construction: Suitable for indoor or outdoor installation.</p> | <p>5. Temperature: -20° C to +80° C</p> <p>6. Rotation:</p> <p style="margin-left: 20px;">Counter-clockwise to open with port "A" pressurized.
Spring return actuators air fail to close, clockwise</p> <p>7. Movement :</p> <p style="margin-left: 20px;">For half turn (180°) : 183° from -1° CW to 182° CCW</p> <p>8. Lubrication: Factory lubricated for the normal life of the actuator</p> |
|--|--|

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

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 blowout 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 6 bar air supply pressure and spring return actuators 3 to 6 bar.

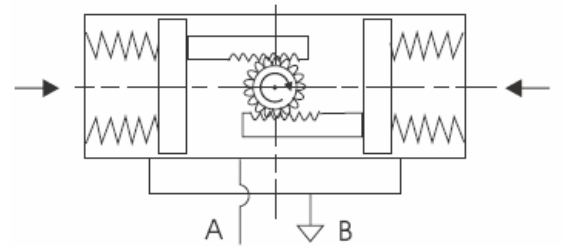
5. OPERATION :

The EL-O-MATIC actuator drive shaft rotates through a full 180°. 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 'On' position.

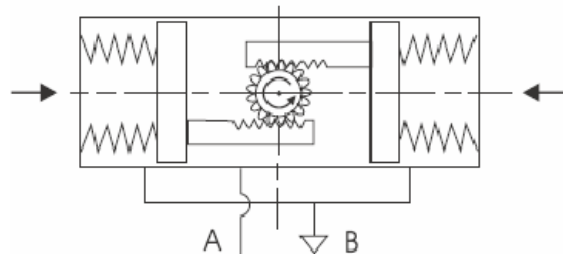
For double-acting actuators, closure is obtained by feeding supply air into the end cap chambers (through port B) which forces the pistons inward, resulting in clockwise rotation of the drive shaft.

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).



ACTUATOR ASSY. MODE-A
SPRING TO CLOSE - CW



ACTUATOR ASSY. MODE-D
SPRING TO OPEN - CCW

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 de-clutchable handwheels. 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 180° of stroke in liters /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 or equivalent. 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	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 end cap O-rings.

IF THE ACTUATOR IS A 'SPRING RETURN' MODE, UNIFORMLY LOOSEN ALL ENDCAPS SCREWS ON EACH ENDCAP, 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 END CAPS!

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 or equivalent. 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 (SERIES DA)**

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 a 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)

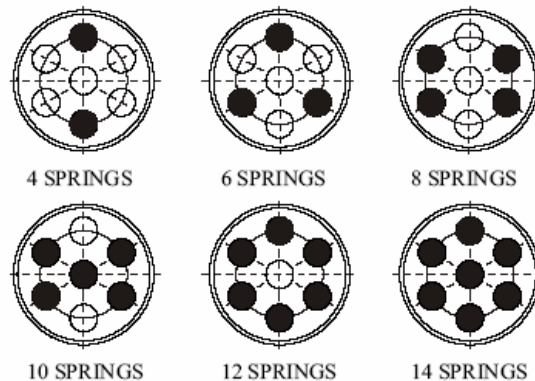
7. Once the pinion gear and pistons are properly engaged, ensure that smooth movement and 180° operation can occur without moving the pistons out of the actuator body. This is important.
8. Take care of seal O-rings while replacing the actuator endcaps.
9. Replace the washer over the top shaft extension.
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**

• **PE/PS 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 endcap, 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 end caps.
16. Place the end cap bolts through the retention holes of the end cap

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.

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 center 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, re-grease 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.

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

➤ **ACTUATOR SYSTEM:**

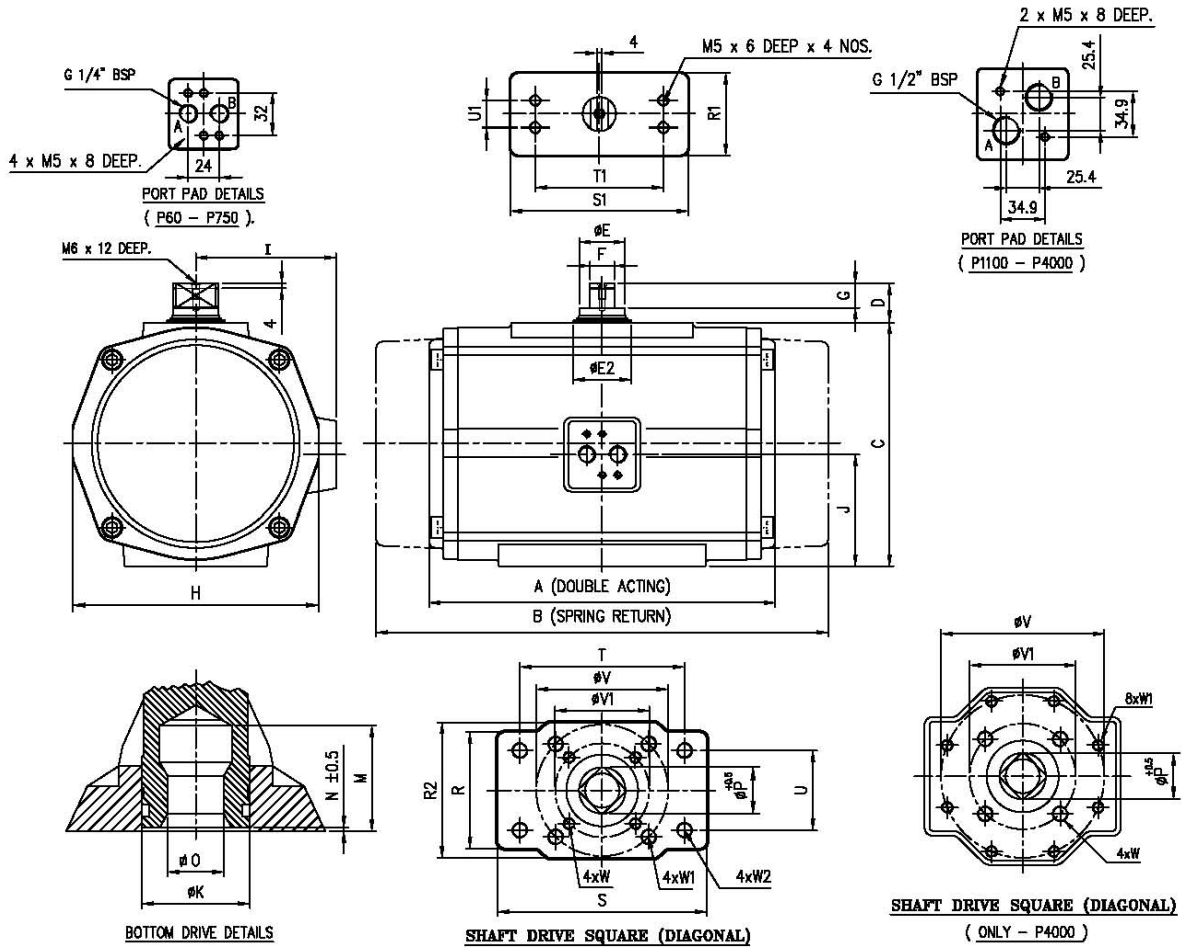
IMPORTANT: READ THESE GUIDELINIES BEFORE ATTEMPTING ANY REPAIRS

SL. NO.	FAULT	PROBABLE CAUSE	REMEDIAL ACTION
A.	FOR SOLENOID OPERATED ACTUATORS		
1.	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>

SL. 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>Pressurize 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 (in case 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>

SL. 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.	ACTUATORS CONTROLLED WITH POSITIONERS (Additional checks)		
5.	Actuator not functioning on increasing signal pressure	<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>Feedback mechanism not functioning / broken</p> <p>Excessive play in feedback mechanism</p> <p>Wrong span and zero adjustment</p> <p>Wrong selection of feedback cam profile</p>	<p>Check positioner feedback linkage and ensure positive feedback.</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>

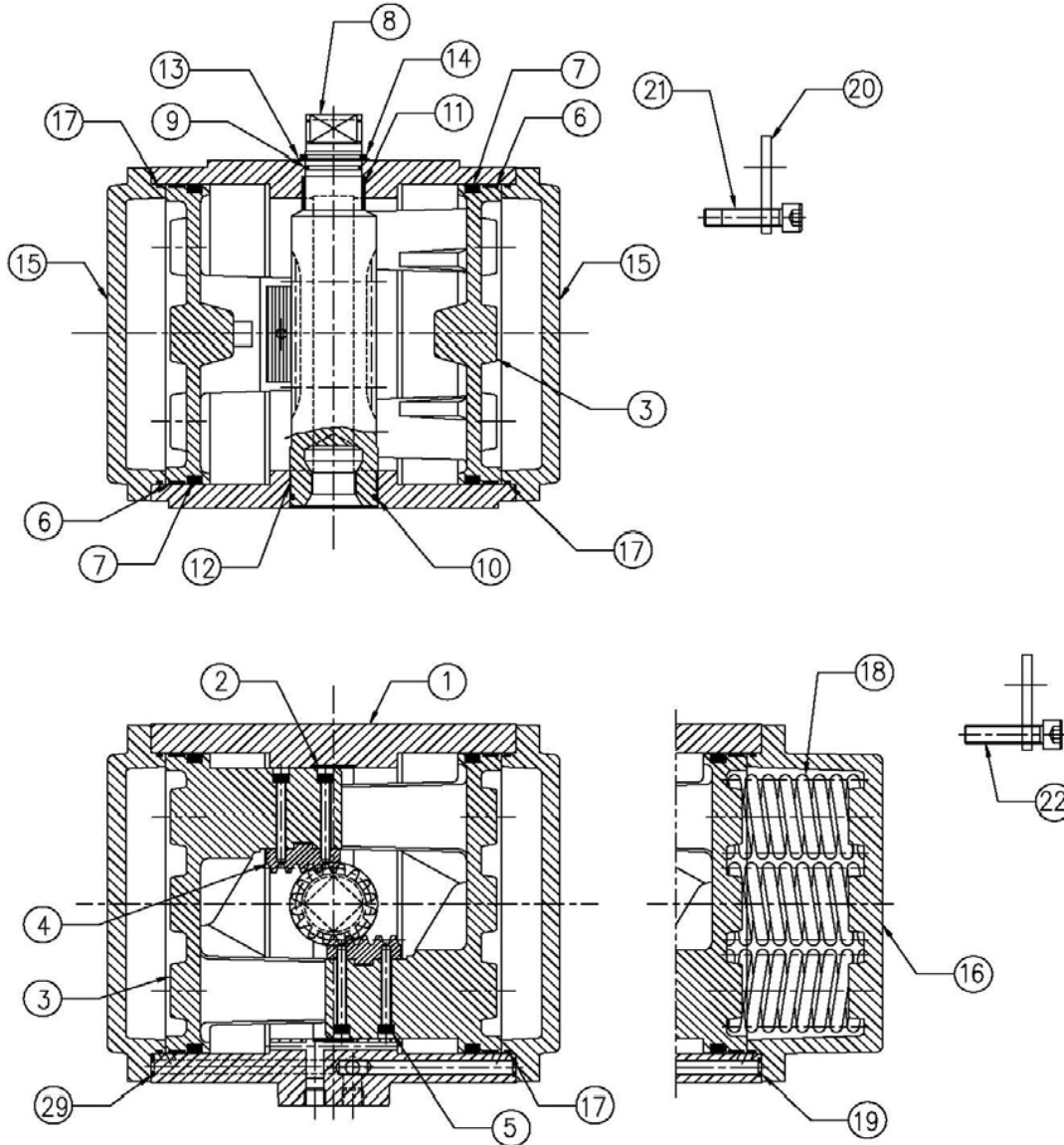
13. P SERIES : ACTUATOR DIMENSIONS (APPLICABLE FOR 180°)



DIM	P60	P150	P280	P500	P750	P1100	P2500	P4000
A	155	186	232	271	285	340	380	502
B	184	217	312	352	388	478	570	835
C	101	135	160	190	234	247	356	380
D	20	20	20	30	30	30	30	30
ØE	16	22	26	36	36	45	55	64
ØE2	23	30	35	45	45	55	65	80
F	10	14	14	19	19	30	36	36
G	12	12	12	19	19	10	10	10
H	103	138	168	192	239	250	344	372
I	58	75	89	109	134	135	183	200
J	43	53	69	95	116	125	178	190
K	28	38	48	56	56	75	85	120
M	27	27	31	38	38	51	66	77
N	1.0	1.0	1.5	1.5	2.0	2.5	3.0	1.5
O'max	14.11	19.13	22.13	27.13	27.13	36.16	46.16	55.19
O'min	14.00	19.00	22.00	27.00	27.00	36.00	46.00	55.00
P	18.1	25.2	28.2	36.2	36.2	48.2	60.2	72.2

DIM	P60	P150	P280	P500	P750	P1100	P2500	P4000
R	60	80	101	111	140	140	170	170
R1	51	60	71	81	100	120	160	160
R2	70	100	-	-	-	-	-	262
S	111	130	141	161	210	210	290	290
S1	111	130	141	141	160	210	245	245
T	-	-	-	-	-	-	234.6	-
T1	80	80	80	130	130	130	130	130
U	-	-	-	-	-	-	97.2	-
U1	30	30	30	30	30	30	30	30
ØV	70	102	102	125	125	140	165	254
ØV1	50	70	70	102	102	-	-	165
W	M6x9	M8x13	M8x13	M10x16	M10x16	-	-	M20x30
W1	M8x13	M10x16	M10x16	M12x16	M12x16	M16x17.5	M20x30	M16x25
W2	-	-	-	-	-	-	M16x25	-
WEIGHT								
PD	2.6	5.3	9.2	14.0	22.4	30.8	64.7	97.8
PE	3.0	6.4	11.6	19.2	33.4	41.5	97.9	143

14. P SERIES: CONSTRUCTION, PARTS AND MATERIALS



DOUBLE ACTING ACTUATOR - PD

SPRING RETURN ACTUATOR - PE

PART. NO.	DESCRIPTION	QTY.	MATERIAL
1	BODY (HOUSING)	1	ALUMINIUM ALLOY
2 *	GUIDE BAND (HOUSING)	2	PTFE CARBON FILLED
3	PISTON	2	ALUMINIUM ALLOY
4	GEAR RACK	2	STEEL
5	BOLT RACK	2	HTS
6 *	GUIDE BAND (PISTON)	2	PTFE CARBON FILLED
7 *	O-RING PISTON.	2	NITRILE RUBBER
8	DRIVE SHAFT	1	STEEL
9 *	O-RING SHAFT TOP.	1	NITRILE RUBBER
10 *	O-RING SHAFT BOTTOM.	1	NITRILE RUBBER
11 *	BEARING BUSH	1	DELIN

* = RFPAIR KIT ITEMS

PART. NO.	DESCRIPTION	QTY.	MATERIAL
12 *	BEARING BAND	1	NILATRON GS.
13 *	THRUST WASHER	1	DELIN
14 *	SPRING CLIP	1	SPRING STEEL
15	END CAP PD	2	ALUMINIUM ALLOY
16	END CAP PE	2	ALUMINIUM ALLOY
17 *	O-RING END CAP	2	NITRILE RUBBER
18	SPRING	14	STEEL
19 *	O-RING PASSAGE	2/4	NITRILE RUBBER
20 **	LIFTING LUG	2	STEEL
21	END CAP BOLT PD	8/20	STAINLESS STEEL
22	END CAP BOLT PE	8/20	STAINLESS STEEL

** = SIZE ABOVE P 1100

15. TORQUE CHART (P – SERIES)

a) Spring Return Actuator (Half Turn – 180°)

Actuator Type	No. of Springs	Air Pressure														Spring Stroke (Nm)	
		3		3.5		4		4.5		5		5.5		6		E	F
		C	D	C	D	C	D	C	D	C	D	C	D	C	D		
PE-60	8	9	4	12	6	15	9	18	12	21	15	24	18	27	21	13	7
	10	-	-	10	3	13	6	16	9	19	12	22	15	25	18	16	9
	12	-	-	-	-	11	3	14	5	17	8	20	11	23	14	19	11
	14	-	-	-	-	-	-	12	2	15	5	18	8	21	11	22	12
PE-150	8	24	12	32	19	39	27	46	34	54	41	61	49	68	56	29	17
	10	20	4	27	12	34	19	42	26	49	34	56	41	64	48	36	21
	12	-	-	22	4	30	11	37	19	44	26	52	33	59	40	44	25
	14	-	-	-	-	25	3	32	11	40	18	47	25	54	33	51	30
PE-280	8	43	9	57	23	71	37	85	51	99	65	112	78	126	92	67	34
	10	-	-	48	5	61	19	75	33	89	47	103	60	117	74	84	43
	12	-	-	-	-	-	-	66	15	80	29	93	42	107	56	101	51
	14	-	-	-	-	-	-	-	-	70	11	84	24	98	38	118	60
PE-500	8	-	-	112	31	136	56	160	80	185	105	209	129	-	-	128	51
	10	-	-	-	-	122	22	146	46	171	70	195	95	219	119	160	64
	12	-	-	-	-	-	-	-	-	156	36	181	61	205	85	192	77
	14	-	-	-	-	-	-	-	-	-	-	167	26	191	51	224	89
PE-750	8	134	29	170	66	206	102	242	138	279	175	-	-	-	-	173	72
	10	-	-	150	20	186	56	222	92	259	128	295	165	331	201	216	91
	12	-	-	-	-	-	-	202	46	239	82	275	119	311	155	259	109
	14	-	-	-	-	-	-	-	-	218	36	255	72	291	109	302	127
PE-1100	8	190	74	244	128	297	181	351	235	404	288	458	342	-	-	226	113
	10	-	-	212	68	266	121	319	175	373	228	426	282	480	335	282	141
	12	-	-	-	-	234	61	288	114	341	168	395	221	448	275	339	170
	14	-	-	-	-	-	-	257	54	310	107	364	161	417	214	395	198
PS-2500	8	485	271	608	395	732	518	855	641	-	-	-	-	-	-	427	218
	10	425	157	548	281	671	404	794	527	918	651	1041	774	1164	897	534	273
	12	364	43	487	167	611	290	734	413	857	537	981	660	1104	783	641	327
	14	-	-	427	53	550	176	673	299	797	423	920	546	1043	669	747	382
PS-4000	8	738	287	946	495	1155	703	1363	911	1571	1120	1779	1328	-	-	881	441
	10	-	-	824	260	1032	468	1240	676	1449	884	1657	1093	1865	1301	1101	551
	12	-	-	-	-	910	233	1118	441	1326	649	1534	857	1742	1065	1322	662
	14	-	-	-	-	-	-	995	205	1203	414	1412	622	1620	830	1542	772

Tolerance = Spring torque $\pm 10\%$
 Air torque $\pm 10\%$

b) Double Acting Actuator (Half Turn – 180°)

Actuator Type	Torque in Nm							
	SUPPLY PRESSURE (Bar)							
	2	3	3.5	4	4.5	5	5.5	6
PD60	11	17	20	23	26	29	32	35
PD150	29	43	50	58	65	73	80	87
PD280	54	81	95	109	123	137	150	164
PD500	95	144	168	193	217	242	266	290
PD750	142	214	250	287	323	359	395	432
PD1100	209	316	369	423	476	530	583	637
PD2500	481	728	851	974	1098	1221	1344	1468
PD4000	812	1228	1436	1645	1853	2061	2269	2477
Tolerance = Air torque ±5 %								