TYPE P/R PNEUMATIC ACTUATOR

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

CONTENTS:

TYPE P/R PNEUMATIC ACTUATOR MANUAL

DESIGNATION	.....
Spring range	.....
Control input	.....
Actuator stroke	.....
Serial no. / production year	.....
.....	.....
Conformity marking	QC mark

1. GENERAL SAFETY PRINCIPLES

This manual establishes the requirements for the installation, operation and servicing and their safety requirements for type P/R actuators. The following principles shall be complied with to ensure operating safety:

- Type P/R actuators are designed for installation on valves;
- Prior to installation and operation, read this manual carefully.
- The actuator springs are preloaded and during operation, they are protected by design against full relaxation. If the cases are removed, follow the guidance on the warning plates and in this manual. !
- This product shall only be installed by qualified and authorised personnel, and the installation process shall be completed with acceptance on written record.
- The operating hazards are indicated with the character "**!**" in this document.

2. STANDARD OPERATING CONDITIONS

The actuator shall be operated in conditions that are within the engineering design of the product. To ensure problem-free operation throughout the entire operating life, the actuator and its fittings shall be protected against mechanical impact/shock and damage, and subjected to regular maintenance and periodic inspections. Additional operating conditions:

- Ambient temperature: -40°C to +80°C;
- Relative humidity (RH): 98% max.;
- Min./max. supply air pressure fluctuations: ±10%
- The supply air shall be free of all solids, oil and substances causing corrosion of steel, copper and alloys; it shall be dry so that its dew point is equal to temperature at least 10°C lower than the minimum operating temperature of the product. !

3. STORAGE AND TRANSPORT

The actuators shall be stored in dry and ventilated indoor storage locations with a maximum relative humidity of 80% RH. The indoor atmosphere must be free of aggressive vapours and gases. The actuators can be transported in any enclosed-body vehicle, with or without their packaging, secured against shifting and protected against strong shocks. !

Handle the actuators during their packaging, loading or unloading using flexible straps or belts, with either secured against touching the positioner.

4. INSTALLATION

The actuators are usually supplied complete with their corresponding valves.
If it is necessary to install the actuator on the valve, the locking nut is the mounting fastener.
The actuator stem is connected to the valve stem using the coupling (36, 37, 38). It is critical to adjust the stem-to-stem coupling as to obtain the rating value of the actuator stroke while ensuring approx. 0.5 mm of the distance of the plug thrust to the valve seat in the end positions of the actuator stems.
Connect the pneumatic control input lines (from a control unit or an operating panel) to the actuator.
The pneumatic input supply shall be plumbed using copper, acid-proof or plastic tubing. All pneumatic connections shall be perfectly tight at the joints. Verify the tightness of connections using a monitoring pressure gauge, after the compressed air under pressure equal to the supply pressure is applied to the actuator, followed by isolating the air supply with a stop valve.

VALVES WITH MOUNTED PNEUMATIC ACTUATORS ARE RECOMMENDED TO BE INSTALLED WITH THE ACTUATOR UPWARD AND THE MAXIMUM ANGLE FROM THE PLUMB LINE SHALL NOT EXCEED 30°.

In special cases, other installation orientation can be agreed upon with the manufacturer.

For a pneumatic control input supply line 7.5 m long, use □ 6 x 1 mm tubing. For longer lines, use □ 8 x 1 mm (OD x wall thickness) tubing. The pneumatic control input shall be connected to the upper diaphragm case on a regular-action type P actuator or to the lower diaphragm case on a reverse-action type R actuator. The connection is made using straight or elbow unions with threaded ends (1/4" NPT).

While installing a valve with a pneumatic or electro-pneumatic positioner, connect the pneumatic or current control input lines from the control unit or operating panel to the input port end / input terminal labelled "SIGNAL" (control input). The compressed air supply line with a pressure of 140; 250; 400 or 600 kPa (depending on the requirements), shall be connected via a filter regulator unit, to the positioner's input port end / input terminal labelled "SUPPLY" (supply input), respecting the recommendations for the line length and OD stated above.

5. COMMISSIONING

The actuator stem shall moves smoothly and without stuttering through the entire rated travel range.

6. PRODUCT OVERVIEW

6.1 Technical specifications:

The product is available in the following versions:

- regular-action (air input extends the stem): - type P;
- reverse-action (air input retracts the stem): - type R;
- regular-action, manual drive: - type PN;
- reverse-action, manual drive: - type RN

Table 1. Diaphragm effective area, stroke, and spring range of the actuator

Diaphragm effective area	Stroke	Spring range	Maximum air supply pressure
[cm^2]	[mm]	[kPa]	[kPa]
160	20	20...100 kPa; 40...120 kPa; 60...140 kPa — 3 springs used 40..200 kPa; 80...240 kPa; 120...280 kPa — 6 springs used	600
250			
400			
630	20; 38	20...100 kPa; 40...120 kPa; 60...140 kPa — 3 springs used 40..200 kPa; 80...240 kPa; 120...280 kPa — 6 springs used 180...380 kPa — 12 springs used	500
630 T			
1000	38; 50; 63		
1500	38; 50; 63; 80; 100		
1500 T			

- Operating temperature: - 40...+80°C
- Relative humidity (RH): max. 98%

6.2 Construction

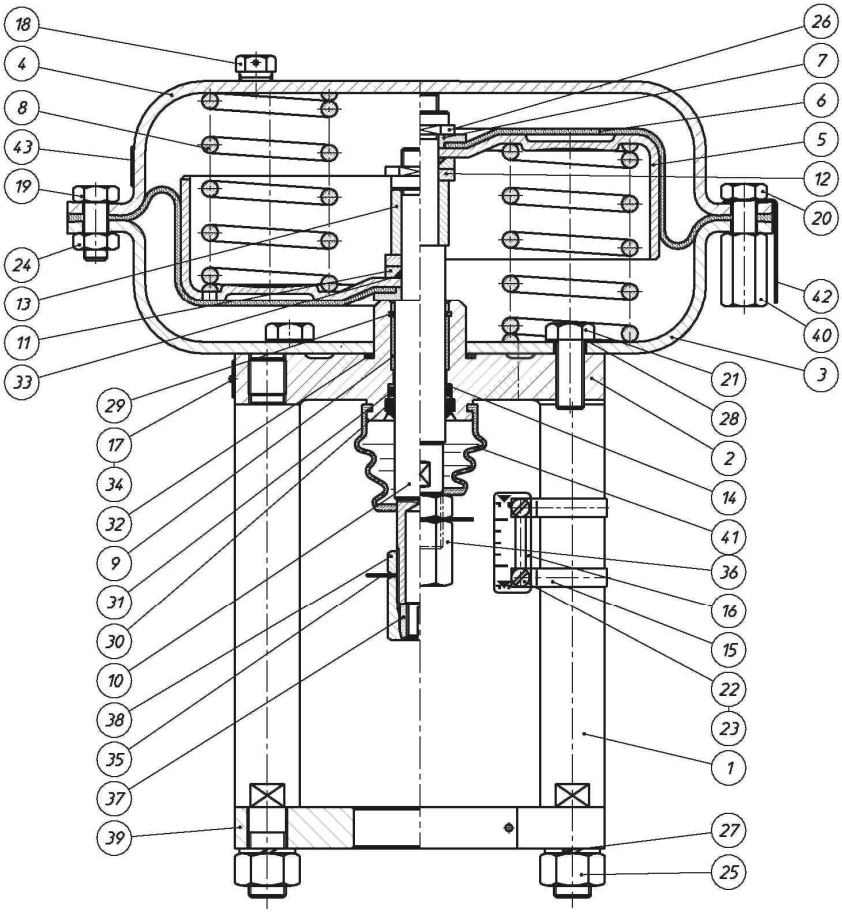

Fig. 1. Type P/R pneumatic actuator

Table 2. Parts list

#	Part name
1	Column
3	Lower diaphragm case
5	Diaphragm plate
7	Distance ring
9	Sliding sleeve
11	Spacer washer
13	Distance sleeve
15	Column clamp
17	Valve nameplate

#	Part name
2	Bracket
4	Upper diaphragm case or manual drive unit
6	Diaphragm
8	Spring
10	Stem
12	Spacer washer
14	Thrust ring
16	Stroke indicator scale
18	Pipe plug

19	Bolt
21	Bolt
23	Nut
25	Nut
27	Spring washer
29	Retaining ring
31	O-ring
33	O-ring
35	Stroke indicator
37	Locking nut
39	Connecting plate
41	Stem protection
43	POLNA mark

20	Bolt
22	Screw
24	Nut
26	Special nut
28	Washer ring
30	Z-form scraper ring
32	O-ring
34	Round head grooved pin
36	Connecting nut
38	Low-profile locking nut
40	Tension nut
42	Warning plate

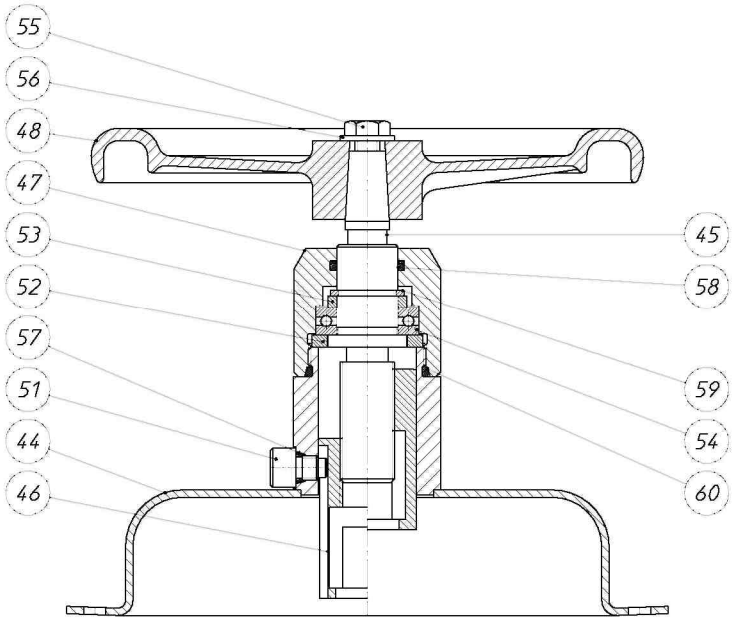

Fig. 3. Manual drive unit of type P/R pneumatic actuator

Table 3. Parts list

#	Part name
44	Upper diaphragm case
46	Carrier
48	Drive handwheel
52	Washer
54	Thrust bearing
56	Washer
58	Sealing ring
60	Sealing ring

#	Part name
45	Drive screw
47	Holder
51	Special screw
53	Thrust ring
55	Bolt
57	Sealing ring
59	Snap ring

6.3 Connection dimensions

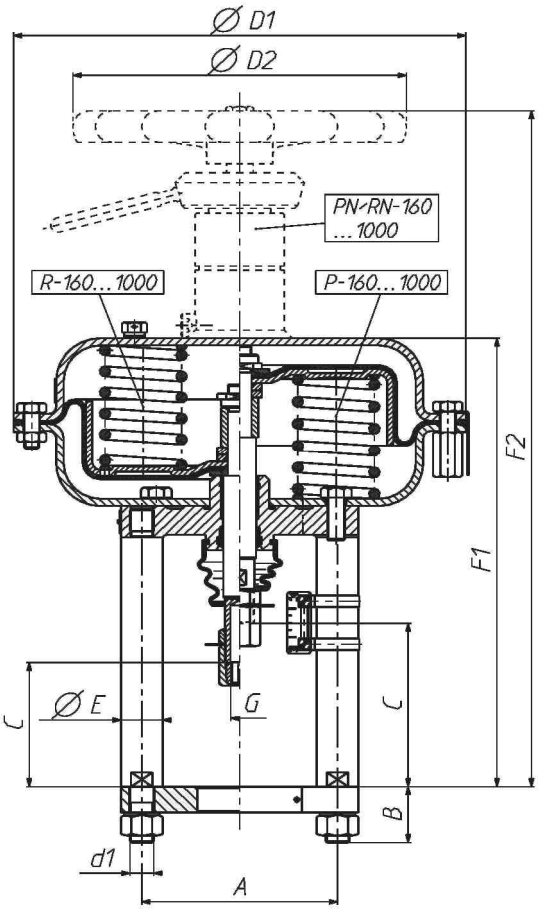

Fig. 4. Type P/R pneumatic actuator connection dimensions Table 4. Type P/R-160...1000 actuator weight and dimensions

Actuator size	A	B	B_1	C		D_1	D_2	d_1	E	F_1	F_2	G	Weight	
				P; PN	R; RN								P; R	PN; RN
	[mm]												[kg]	
160	110	31	18	110	84	210	225	M12	22	288	450	M12x1.25	9	13.5
250				112	86	240	225			306	468		10	14.5
400	132	39	20	116		305		M16	28	312	474		16	20.5
630			22	134		375	305			402	564		30	37
1000	216	50		210	127	477	450	M24	42	585	825	M16x1.5	74	100

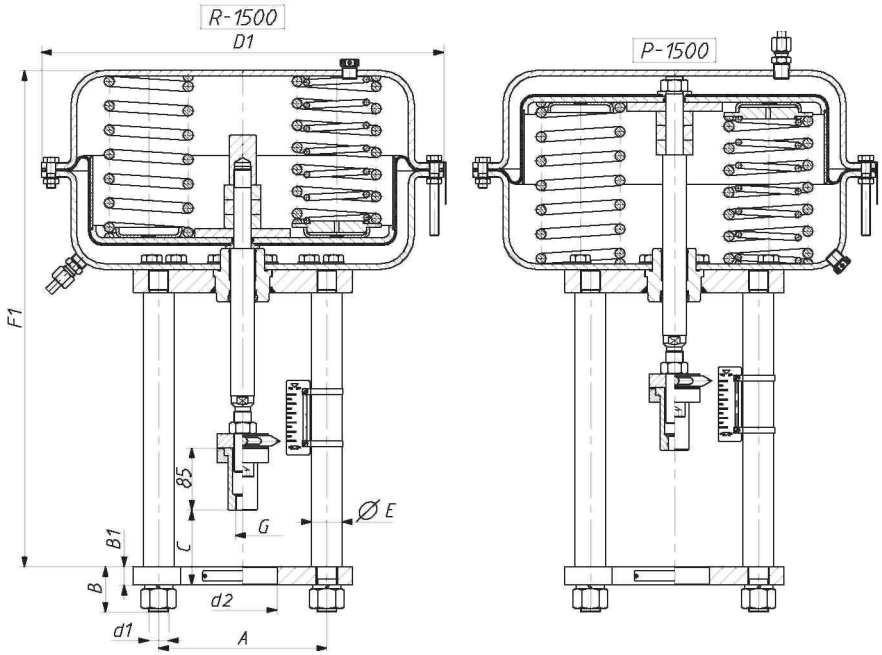

Fig. 5. Type P/R 1500 pneumatic actuator connection dimensions

Table 5. Type P/R-1500 actuator weight and dimensions

Actuator size	A	B	B_1	d_2	D_1	d_1	E	F_1	G	Weight P; R
	[mm]									[kg]
1500	230	62	18	57.15	550	M27	42	679	M16x1.5 M20x1.5 M24x1.5	95
			22	84.15						
			25	70						
				95.25						

Actuator size	Actuator stroke	C	
		P	R
	[mm]		
1500	38	142	102
	50	154	
	63	167	
	80	184	
	100	204	

6.4 Principle of operation

The operation of the pneumatic actuator consists in processing a pneumatic input (compressed air with a nominal control air pressure range of 20...100 kPa; 40...200 kPa or another range specific to the positioner in use) into linear motion which translates the moving parts of the actuator.

The main parts of the actuator are:
- the cast bracket (2), the column (1), the lower and upper cases (3 and 4) bolted together using fasteners (19, 20, 24, 40);
- the movement assembly inside the actuator comprises of the diaphragm (6), the Diaphragm plate (5), the stem (10), the distance sleeves (11, 12), and the valve stem fasteners (36, 37, 38), and the stroke indicator;
- the springs (8).

The diaphragm separates the void between the cases, forming two chambers: the pressure chamber and the non-pressure (spring-actuated) chamber. Applying a pneumatic control input to the pressure chamber translates the actuator stem in one of the two directions, depending on the actuator's version of action (P or R).

7. SERVICING, MAINTENANCE & REPAIRS

Caution:
The actuator springs are pre-tensioned. Therefore, when disassembling the actuator, release the tension nuts (40) last, as shown on the warning plate (42).
Before every disassembly operation, verify that all compressed air and electrical power supply lines have been isolated.

In-operation servicing of the actuator is to maintain the appropriate level of tightness of the cases and the actuator stem; also, visually inspect and verify that the actuator stem moves smoothly.
Compulsory documented periodic inspections ensure long-lasting and safe operation of the actuator.
For continuous-duty actuators, the periodic inspection shall be done every 6 months or more frequently. For non-continuous duty actuators, the periodical inspection shall be done every 12 months or more frequently.
During each inspection, the actuator shall have its maintenance done and be repaired as required. Whenever required, the following servicing shall be done during each maintenance or repair:
- replace the pneumatic actuator diaphragm;
- replace the pneumatic actuator seals (for type R).

7.1 Diaphragm replacement

7.1.1 Pneumatic actuator action version:

CLOSING action with rising air pressure (type P)

a) Disconnect the control air supply line from the actuator;
b) Remove the actuator's upper diaphragm case (4) or the actuator manual drive unit, and remember to release the tension nuts (40) last, as shown on the warning plates (42); !
c) Remove the special nut (26) from the actuator stem and remove the distance ring (7);
d) Replace the diaphragm (6) and re-assemble the actuator in the reverse order of disassembly;
e) Reconnect the control air supply line to the actuator.

7.1.2 Pneumatic actuator action version:

OPENING action with rising air pressure (type R)

a) Disconnect the control air supply line from the actuator;
b) Remove the actuator's upper diaphragm case (4) or the actuator manual drive unit, and remember to release the tension nuts (40) last, as shown on the warning plates (42); !
c) Remove the springs (8);
d) Remove the special nut (26) from the actuator stem and remove the diaphragm plate (5) together with the distance sleeve (13) and the washer (12);
e) Replace the diaphragm and re-assemble the actuator in the reverse order of disassembly;
f) Reconnect the control air supply line to the actuator.

7.2 Stem seal replacement in type R pneumatic actuator

Perform the following procedure to replace the actuator seal (the O-ring (31); the Z-form scraper ring (30)):
a) Remove the stem coupling to detach the valve stem from the actuator stem by releasing the coupling nut (36) (for type P/R-160...1000) or removing two Allen socket head bolts which secure the upper and lower valve-to-actuator stem couplings (for type P/R-1500).
b) Release the actuator locking nut and remove the actuator from the actuated unit;
c) Release the counternut (38) and remove the remaining parts from the actuator stem;
d) Remove the actuator's upper diaphragm case or the manual drive unit and remove the springs, as shown in Section 7.1.2 b & c; !

e) Remove the stem together with the diaphragm and the diaphragm plate from the bracket bonnet chamber;
f) Replace the O-ring and scraper rings if worn out;
g) Re-assemble the actuator parts in the reverse order of disassembly;
h) Place the actuator on the valve and complete the reassembly by installing the remaining parts which have been removed during the disassembly process.

7.3 Modifying the valve action and control air range

7.3.1 Modifying the pneumatic actuator action

The reversible design of type P/R type pneumatic diaphragm actuators facilitates reversing the action of the valve operated by the actuator from the CLOSING action with rising air pressure to OPENING action with rising air pressure, and vice versa.

This requires modifying the actuator action. The procedure:

a) Remove the valve stem and actuator stem coupling assembly;
b) Remove the upper diaphragm case or the drive unit of the actuator and remember to release the tension nuts last, as shown on the warning plate.

Further steps of the procedure will depend on the action version of the actuator prior to the modification.

Converting P action to R action:

c) Remove the special nut of the actuator stem;
d) Remove the diaphragm together with the diaphragm plate, the washer, and the distance sleeve, while keeping the stem secure to prevent its detachment to the outside of the bracket bonnet chamber;
e) Remove the springs from the lower diaphragm case;
f) Reverse the diaphragm with the parts removed as above by 180° and reinstall the diaphragm on the actuator stem;
g) Secure the special nut onto the actuator stem, while compressing the parts removed as above;
h) Place the springs on the diaphragm plate so that engage the guide bosses and the spring ends are equidistant from the stem centreline;
i) Place the upper diaphragm case or the manual drive actuator on the springs and first begin tightening the tension nuts alternately to produce equal compression of the springs; continue until the upper and lower diaphragm cases meet. Reinstall the remaining bolts and secure both cases together by tightening the bolt nuts.

Converting R action to P action:

j) Remove the springs from the diaphragm plate;
k) Remove the special nut from the actuator stem;
l) Remove the diaphragm together with the diaphragm plate, the washer, and the distance sleeve, while keeping the stem secure to prevent its detachment to the outside of the bracket bonnet chamber;
m) Place the springs in their marked locations on the lower diaphragm case;
n) Reverse the diaphragm with the parts removed as above by 180° and install it on the actuator stem so that the ø 6 hole at the bottom and the groove on the edge of the diaphragm plate are aligned with one of the holes along the diaphragm perimeter;
o) Place the diaphragm assembly on the springs so that the latter engage the guide bosses on the diaphragm plate. Verify that the springs are in the correct locations: bend away the diaphragm (at the groove on the edge of the diaphragm plate) enough to show □ 6 hole in the bottom of the diaphragm plate; a spring should be visible through the hole;
p) Secure the special nut onto the actuator stem, while compressing the parts removed as above;
r) Place the upper diaphragm case on the stem face plane and first begin tightening the tension nuts alternately to produce equal compression of the springs; continue until the upper and lower diaphragm cases meet. Reinstall the remaining bolts and secure both cases together by tightening the bolt nuts.

!

7.3.2 Modifying the control air range (spring range) in the pneumatic actuators

The design of the actuator facilitates setting different operating ranges by adding/removing a suitable number of springs or modifying the spring pre-tension with suitable spacers installed:

5.0 mm high – 2 pcs. (for a 20 mm stroke);
9.5 mm high – 2 pcs. (for a 38/80 mm stroke);
12.5 mm high – 2 pcs. (for a 50 mm stroke);
15.5 mm high – 2 pcs. (for a 63 mm stroke) – applies to the 1000 & 1500 actuators.

For the rated ranges, these parts are installed on the actuator stem, from the inward side of the diaphragm plate. The spring pre-tension is increased by installing one or two spacers on the outward side of the diaphragm plate, depending on the desired range.
The selection of parts and their assembly are specified in Table 6.
The spring pre-tension is modified by relocating the 5 mm distance sleeves for the 20 mm stroke, the 9.5 mm distance sleeves for the 38/80 mm stroke, the 12.5 mm distance sleeves for the 50 mm stroke, and the 15.5 mm distance sleeves for the 63 mm stroke. For the rated ranges, these parts are installed on the actuator stem, from the inward side of the diaphragm plate. The spring pre-tension is increased by installing 1 or 2 spacers on the outward side of the diaphragm plate, depending on the desired range. For the 80 mm stroke, additional 4.5 mm thick spring plates are installed. For the 100 mm stroke, the springs are replaced while the spacer bush height is not changed.

The selection of parts is specified in Table 6; the installation procedure is shown in the actuator's assembly drawing.

Table 6.

Actuator size	Stroke [mm]	Spring range [kPa]													
		1		2		3		4		5		6		7	
		20 - 100		40 - 200		40 - 120		80 - 240		60 - 140		120 - 280		180 - 380	
		no. of springs	extra tens. [mm]	no. of springs	extra tens. [mm]	no. of springs	extra tens. [mm]	no. of springs	extra tens. [mm]	no. of springs	extra tens. [mm]	no. of springs	extra tens. [mm]	no. of springs	extra tens. [mm]
160	20	3		6		3	5	6	5	3	5+5	6	5+5		
250	20	3		6		3	5	6	5	3	5+5	6	5+5		
400	20	3		6		3	5	6	5	3	5+5	6	5+5		
630	20	3		6		3	5	6	5	3	5+5	6	5+5	12	5+5
	38	3		6		3	9.5	6	9.5	3	9.5+9.5	6	9.5+9.5	12	9.5+9.5
630 T	20	6		12		6	5	12	5	6	5+5	12	5+5	24	5+5
	38	6		12		6	9.5	12	9.5	6	9.5+9.5	12	9.5+9.5	24	9.5+9.5
1000	38	3		6		3	9.5	6	9.5	3	9.5+9.5	6	9.5+9.5	12	9.5+9.5
	50	3		6		3	12.5	6	12.5	3	12.5+12.5	6	12.5+12.5	12	12.5+12.5
	63	3		6		3	15.5	6	15.5	3	15.5+15.5	6	15.5+15.5	12	15.5+15.5
1500	38	3		6		3	9.5	6	9.5	3	9.5+9.5	6	9.5+9.5	12	9.5+9.5
	50	3		6		3	12.5	6	12.5	3	12.5+12.5	6	12.5+12.5	12	12.5+12.5
	63	3		6		3	15.5	6	15.5	3	15.5+15.5	6	15.5+15.5	12	15.5+15.5
	80	3		6		3	9.5	6	9.5	3	9.5+9.5	6	9.5+9.5	12	9.5+9.5
1500 T	38	6		12		6	9.5	12	9.5	6	9.5+9.5	12	9.5+9.5	24	9.5+9.5
	50	6		12		6	12.5	12	12.5	6	12.5+12.5	12	12.5+12.5	24	12.5+12.5
	63	6		12		6	15.5	12	15.5	6	15.5+15.5	12	15.5+15.5	24	15.5+15.5
	80	6		12		6	9.5	12	9.5	6	9.5+9.5	12	9.5+9.5	24	9.5+9.5

All spacers are included in the actuator's construction.
Order additional springs directly from the manufacturer.

Procedure for the control air range modification:

a) Complete the steps in Section 7.1 (a) and (b);
b) Remove the special nut from the actuator stem; remove the diaphragm together with the diaphragm plate, the washer, and the distance sleeve, while keeping the stem secure to prevent its detachment to the outside of the bracket bonnet chamber;
c) Relocate and install the spacers appropriately and add (or remove) the springs as required and shown in Table 1;
d) Reinstall the special nut, reassemble the casing, and readjust the actuator.

8. ACTUATOR TROUBLESHOOTING LIST

Table 7.

#	Symptoms	Causes	Remedy
1	Large hysteresis	- excessive friction resistance	- check, clean, and lubricate the friction parts: the stem guide (10) and sliding sleeve (9) surfaces; - replace the components if worn
2	No proper stroke	- stem surface dirty or damaged; - failed diaphragm; - valve-to-actuator stem coupling out of adjustment	- check the condition of the stem (10) and repair or replace as required; - check the diaphragm (6) and replace as required; - check the stem coupling assembly (35, 36, 37, 38) and reset the stroke as required.
3	No external tightness	- incorrect installation torque of the cases and diaphragm; - wear (failure) of sealing parts;	- locate the leaks; - re-tighten the threaded fasteners (19, 20, 24, 40); - replace the diaphragm and/or washer rings (28); replace the seals
4	Actuator stuck	- seizure of the stem in the sliding sleeve; - failed diaphragm; - broken spring(s)	- replace the sliding sleeve (9); clean and buff out the stem (10); - replace the diaphragm (6); - replace the failed springs (8)

CAUTION!

Operating abnormalities caused by poor action of electric actuators, positioners, filter regulator units, solenoid valves or other fittings installed on the control valve shall be remedied in conformity with the applicable OEM manuals.

9. LIST OF SPARE PARTS

Table 8.

#	Part name
8	Spring
9	Sliding sleeve
30	Scraper ring

#	Part name
6	Diaphragm
31	Sealing ring
32	Sealing ring

NOTE!

Genuine spare parts from the valve manufacturer are recommended. Failure to comply will release the manufacturer from all liability for the product.

10. OPERATING SAFETY CONDITIONS

The following principles shall be complied with to ensure operating safety:

- The valve can be removed from the pipeline or the parts in contact with the medium can be removed only after it has been positively verified that these parts are no longer under the medium's pressure.
- The actuator springs are preloaded and during operation, they are protected by design against full relaxation. If springs are replaced, the tension nuts (as shown on the warning plates) must be released last.
- If the service is at high temperature, hot valve parts are a risk of burns; provide protections where feasible to do so.
- Only qualified personnel may assemble/disassemble the valve.
- Other operating hazards are indicated with the character "!" in this document.
- For valves with a bellows bonnet, never attempt to rotate the valve stem inside of the bonnet body as the bellows can fail.

11. PRODUCT DISPOSAL

When the service life of the product ends, it shall be dismantled and its parts must be separated by material, into metal parts (non-ferrous metals, acid-resistant and carbon steel grades), rubber parts (diaphragms and seals) and plastic parts (flat seals and packing, electrical components, plugs/blinds). The recycling of these materials shall conform to the waste management regulations applicable. The product does not contain materials the disposal of which is harmful for the environment.

12. ADDITIONAL REQUIREMENTS FROM THE PRODUCT OPERATION IN EXPLOSIVE ATMOSPHERES PER DIRECTIVE 94/9/EC (ATEX)

12.1. Design requirements

Type P/R pneumatic actuators are designed in compliance with the requirements for equipment operated in explosive atmospheres, Group II, Category 2, per PN-EN 13463-1:2002, with specific consideration of the following:

- operation in compliance with the technical specifications established by the manufacturer and high level of protection is ensured;
- operation in areas where explosive atmospheres are likely to be formed mixtures of air with gases, mists, vapours or dust-air mixtures;
- explosion protection measures are applied to provide high level of protection, even in conditions of frequent disturbance or failure.

12.2 Application requirements

Type P/R pneumatic actuators manufactured with the  marking are approved for operation in the following Ex zones defined in PN-EN 1127-1:1997:

(a) Zone 1 for gases / vapours, which includes locations where explosive atmosphere may sometimes be present during normal operation; the Zone may include (but is not limited to):

- direct vicinity of Zone 0;
- direct vicinity of locations supplied with materials, and/or where materials are handled for filling or evacuation;
- direct vicinity of damage-sensitive equipment and insufficiently protected seals.

!

(b) Zone 2 for gases / vapours, which includes locations where no explosive atmosphere is present during normal operation or if present, its duration is short. This Zone may include (and is not limited to) the vicinity of Zone 0 and 1.
(c) Zone 21 for dust, which includes locations in which explosive atmospheres in the form of a flammable dust cloud in the air may sometimes be present during normal operation and may include (and is not limited to) locations in the direct vicinity of facilities where the dust is loaded/unloaded and locations where dust layers are present which, during standard operation, may form flammable mixtures with air, within explosive concentration limits.
(d) Zone 22 for dust including, locations in which explosive atmosphere in a form of flammable dust cloud in the air is not present during normal operation or if present, its duration is short. This Zone may include (and is not limited to) locations in the direct vicinity of facilities where dust may accumulate or be released.
(e) If an explosive atmosphere comprises acetylene, carbon disulphide, hydrogen, hydrogen sulphide or ethyl oxide, the actuator non-pressure (spring-actuated) chamber shall be connected using piping open to a non-explosive atmosphere to eliminate the risk of explosion caused by mechanically generated sparks, e.g. if a spring breaks.
(f) if an actuator is used to supply natural gas as a pneumatic control input, connect the actuator non-pressure chamber using piping open to a non-explosive atmosphere to eliminate the risk of explosion caused by mechanically generated sparks, e.g. if a spring breaks.

12.3. Repair and maintenance requirements

During inspection, repairs and maintenance in explosive atmospheres, ensure the safety conditions for the work tools and the Zones specified in EN 1127-7 Annex A in which the tools can be used.

NOTES:

NOTES:

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