

Mi-805 EN

Service and operating instruction

Valve positioner



Type SP405

Type SPE405



Introduction

This operating manual is intended for the operating, maintenance and supervisory personnel.

This operating manual also describes components, equipment and ancillary units which are not or only partially included in the scope of supply.

The operating personnel must have read, understood and must comply with this operating manual.

We keep the right to do any technical changes which are necessary to improve the product without prior notice.

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1 Pneumatic positioner type SP405

1.1 General

SP405 is a pneumatic valve positioner for an input signal of 20-100 kPa (3-15 psi). The easily exchangeable cam disc is available in various types for different valve characteristics, opening angles, as well as for split range 20-60 or 60-100 kPa (3-9 or 9-15 psi) (→ Tab.4-1)

The positioner is mainly designed to fit the SOMAS range of valves and actuators but can easily be adapted to other valve types with a rotation of 60°-90°.

A yellow indicator under the transparent cover indicates the opening angle of the valve. The indicator shows open valve when parallel to the pipeline. Different valve openings are indicated in the cover. The covers of the valve positioner and the I/P-converter are sealed with O-rings. Evacuation of the excess air inside the positioner is done through a preloaded diaphragm in the housing. (A separate flush-proof evacuation diaphragm is fitted on the underside of the housing).

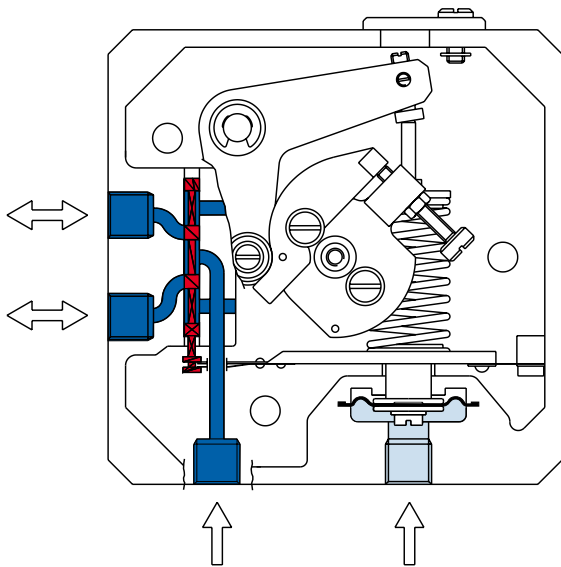


Fig.1-1 Pneumatic positioner type SP405



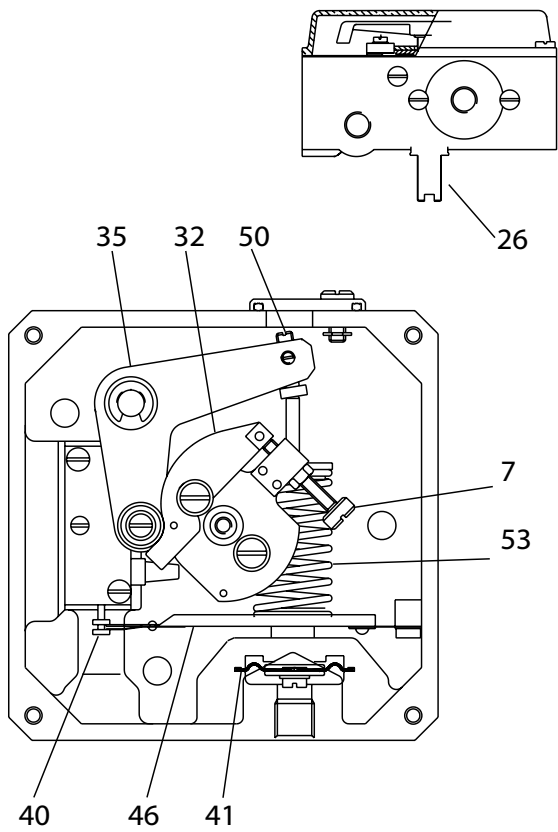
1.2 Function

A pneumatic control signal (0.2-1.0 bar) acts on the diaphragm (→ Fig.1-2/41) and via the balance arm (→ Fig.1-2/46) the slide (→ Fig.1-2/40) at the pilot valve is controlled. When the control signal increases, the pilot valve distributes supply air to one side of the piston while the other side is vented.

The cam disc (→ Fig.1-2/32), which is infinitely variable to the shaft (→ Fig.1-2/26), transmits the rotary motion of the actuator to the feedback arm (→ Fig.1-2/35).

The feedback arm acts on a compression spring (→ Fig.1-2/53) against the balance arm and when there is a balance between the force from the diaphragm (→ Fig.1-2/41) and the force from the feedback spring, a new balanced position is established. Range adjustment is done with the adjustment screw (→ Fig.1-2/7).

The zero point can be adjusted from the outside by the zero point screw (→ Fig.1-2/50). (→ Chap.3.1)



- | | | | | | |
|----|------------------|----|--------------|----|--------------------|
| 7 | Adjustment screw | 35 | Feedback arm | 46 | Balance arm |
| 26 | Shaft | 40 | Slide | 50 | Zero point screw |
| 32 | Cam disc | 41 | Diaphragm | 53 | Compression spring |

Fig.1-2 Function of the pneumatic positioner type SP405



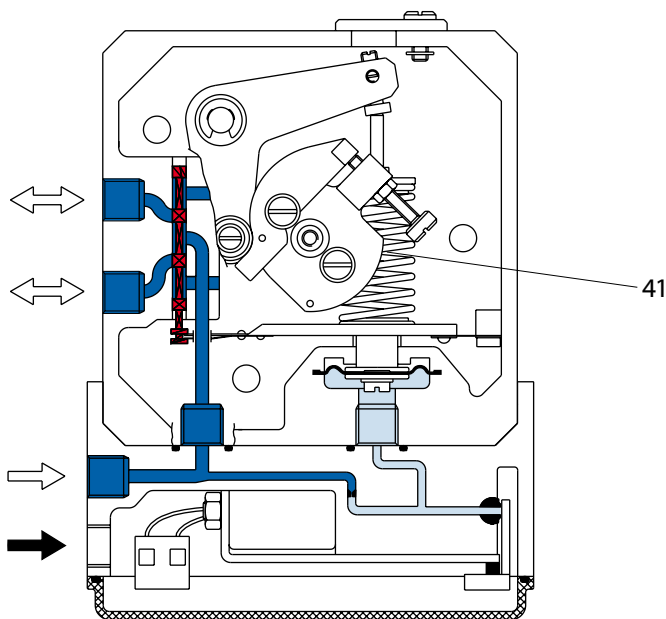
2 Electropneumatic positioner type SPE405

2.1 General

The electropneumatic valve positioner type SPE405 is built on a concept where the pneumatic version type SP405 is completed with an I/P-converter.

This I/P-converter is located in a separate housing, attached to the pneumatic version SP405.

Zero point and range adjustments are done on the pneumatic side (→ Chap.3.1).



41 Diaphragm

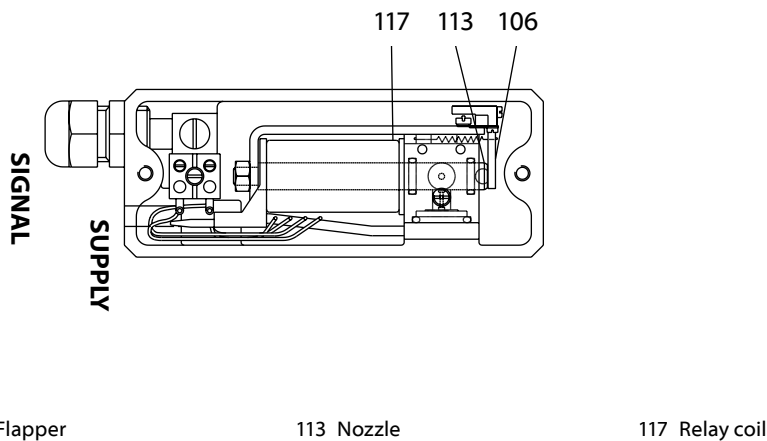
Fig.2-1 Electropneumatic positioner type SPE405



2.2 Function

The function of the SPE405 is identical to that of the SP405. The difference is that the pneumatic input signal comes from the attached I/P-converter.

The function of the I/P-converter is as follows: When the electric input signal increases or decreases the magnetic force of the coil (→ Fig.2-2/117) is influenced, which in turn affects the position of the flapper (→ Fig.2-2/106) against the nozzle (→ Fig.2-2/113). This function controls the internal pressure system of the I/P-converter, which in turn will affect the pneumatic signal into the valve positioner (SP405). At increasing current signal/input signal the flapper moves closer to the nozzle and the air pressure acting on the diaphragm (→ Fig.2-1/41) increases. Adjustment of range and zero is performed in the same way as for the SP405.



106 Flapper

113 Nozzle

117 Relay coil

Fig.2-2 Function of the electropneumatic positioner type SPE405



3 Installation

Procedure

1. Make sure the positioner has not been damaged during transportation or installation.

Note

The supply air must be clean and dry instrument air and have a constant pressure within the range of 4–8 bar (60–120 psi).



2. Connect the supply air to connection marked “SUPPLY”.
3. All pneumatic connections are G 1/4”, female thread.
4. Connect air signal to actuator at connections marked “A” and “B”.

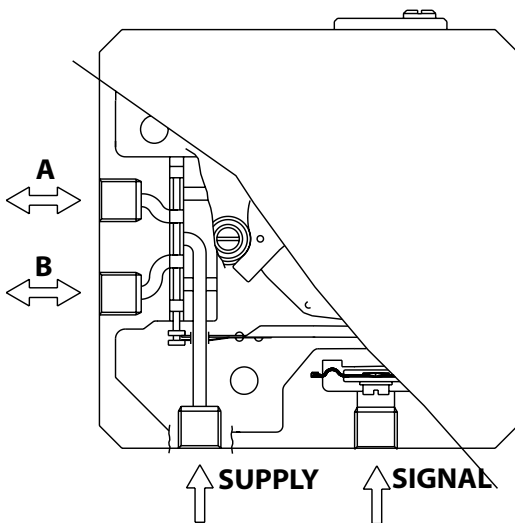


Fig.3-1 Installation

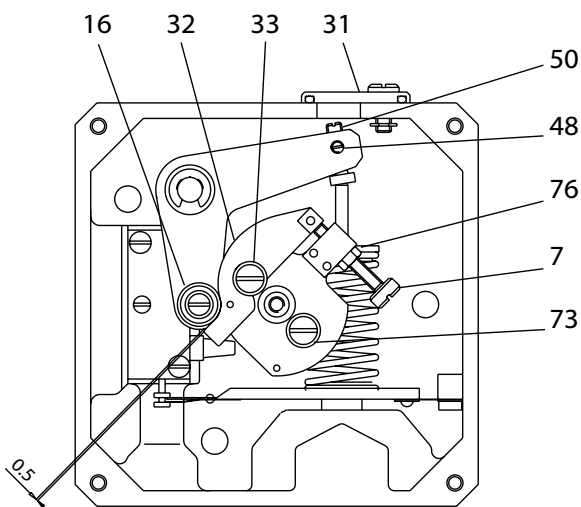


3.1 Zero point and range adjustment

1. At initial position (closed valve), make sure that there is a clearance of 0.5-2 mm between the ball bearing (→ Fig.3-2/16) and the cam disc (→ Fig.3-2/32) at an input signal of 4mA, 20 kPa, 3 psi.
2. To adjust the basic position of the cam disc, loosen the screws (→ Fig.3-2/33) and (→ Fig.3-2/73) and position the cam disc in accordance with point 1 above. At correct position, tighten the screws.
3. Keep the input signal 4mA, 20 kPa, 3 psi. Fine tuning of zero adjustment is done with the screw (→ Fig.3-2/50), which can be reached through the cover (→ Fig.3-2/31). If friction is high loosen the screw (→ Fig.3-2/48)
4. Change the input signal to 20mA, 100 kPa, 15 psi. For range adjustment, loosen the screw (→ Fig.3-2/33) and the lock nut (→ Fig.3-2/76). Adjust the curve height by means of the adjustment screw (→ Fig.3-2/7). Actuator shall go to end stop open position. In case of a big adjustment of screw (→ Fig.3-2/7), check again clearance between ball bearing and cam disc in close position 4mA, 20 kPa, 3 psi. If outside range 0,5-2 mm go back to point 1 and recalibrate zero point.
5. When the adjustment of zero and range is completed, make sure the screw (→ Fig.3-2/33) and the lock nut (→ Fig.3-2/76) are tightened.
6. The zero point adjustment screw is equipped with an adjustable friction-locking device. For adjustment, use the screw (→ Fig.3-2/48). After calibration completed tighten the screw (→ Fig.3-2/48).

Note

At reverse function, AC, use the adjustment screw (→ Fig.3-2/7) for zero adjustment and the zero point screw (→ Fig.3-2/50) for range adjustment.



7	Adjustment screw	32	Cam disc	50	Zero point screw
16	Ball bearing	33	Screw	73	Screw
31	Cover	48	Screw	76	Nut

Fig.3-2 Zero point and range adjustment



4 Maintenance

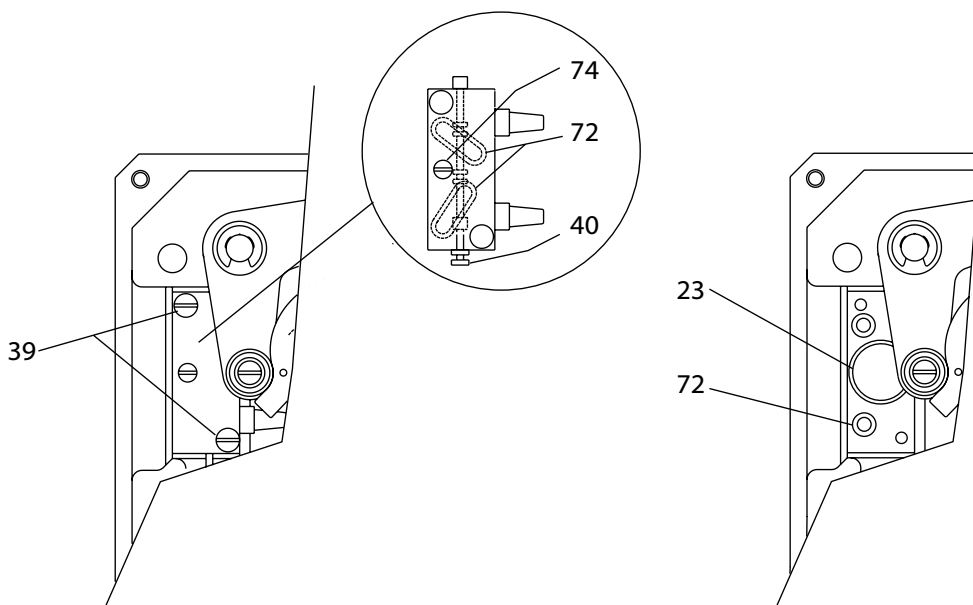
The positioner is in principle maintenance-free.

The supply air for positioners must be mechanically clean and free from oil and water and have a constant pressure. Faulty operation is mostly due to contamination of the supply air. The supply air must have a constant pressure within the range of 4-6 bar (60-90 psi).

4.1 Cleaning of pilot valve

Procedure

1. Loosen the screws (→ Fig.4-1/39) and carefully remove the pilot valve. Remove the screw (→ Fig.4-1/74) that keeps the pilot valve together.
2. Handle the components with care and pull out the slide (→ Fig.4-1/40). Wash housing and slide with solvent and blow clean.
3. Remove the filter (→ Fig.4-1/23) located under the pilot valve, and the O-rings (→ Fig.4-1/72). Wash with solvent of type acetone and blow clean.
4. Put in a new filter and new O-rings.
5. Assemble the pilot valve and remount the complete unit into the positioner.



23 Filter
39 Screw

40 Slide
72 O-ring

74 Screw

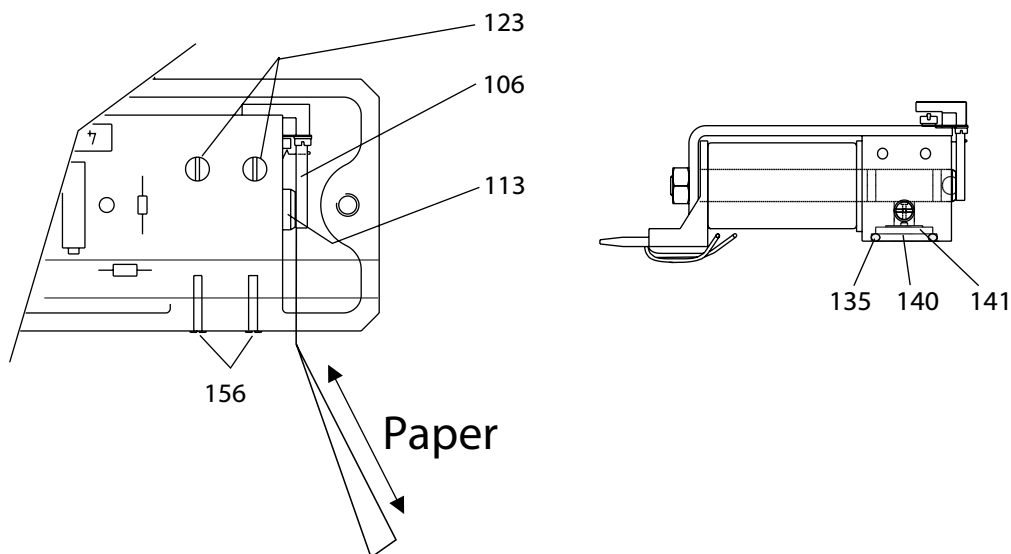
Fig.4-1 Cleaning of pilot valve



4.2 Replacement of filter for I/P-converter

Procedure

1. Remove the cover.
2. Insert a thin paper strip between the flapper (→ Fig.4-2/106) and the nozzle (→ Fig.4-2/113). Move the paper strip back and forth a few times.
3. Loosen the screws (→ Fig.4-2/156) and (→ Fig.4-2/123).
4. Put the circuit card carefully aside and lift up the I/P-converter.
5. Remove the O-ring (→ Fig.4-2/135) and the filters (→ Fig.4-2/140) and (→ Fig.4-2/141).
6. Mount new filter and new O-ring.
7. Re-assemble the I/P-converter, circuit card and cover.



106 Flapper

113 Nozzle

123 Screw

135 O-ring

140 Filter

141 Fine filter

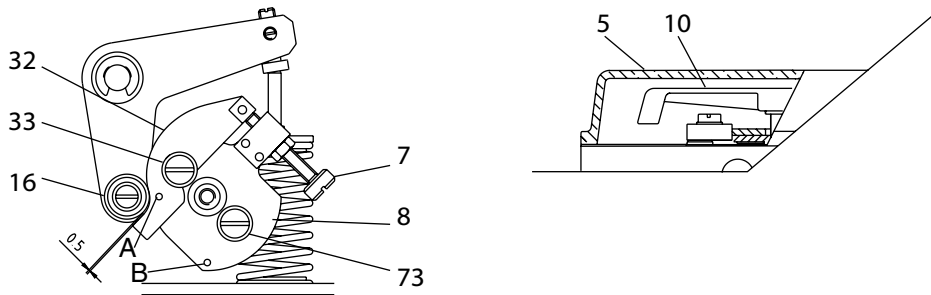
156 Screw

Fig.4-2 Replacement of filter for I/P-converter



4.3 Replacement of cam disc

A number of different cam discs are available to cover various signal ranges, angles of rotation and valve characteristics (→ Tab.4-1).



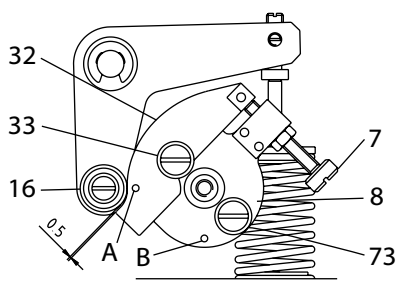
5	Cover	8	Plate	16	Ball bearing	33	Screw
7	Adjustment screw	10	Indicator	32	Cam disc	73	Screw

Fig.4-3 Cam disc position at closed valve AO

Procedure

1. Remove the cover (→ Fig.4-3/5) and the indicator (→ Fig.4-3 /10). Note the correct positions for these two details.
2. Loosen the screw (→ Fig.4-3/33) and remove the cam disc (→ Fig.4-3/32).
3. Put in a new cam disc and tighten.
4. Make zero point and range adjustment (→ Chap.3.1).
5. Put back the indicator and the cover.

4.3.1 Replacement of cam discs type split range



7	Adjustment screw	16	Ball bearing	33	Screw
8	Plate	32	Cam disc	73	Screw

Fig.4-4 Cam disc position at closed valve AO



Procedure

1. Remove the cover (→ Fig.4-3/5) and the indicator (→ Fig.4-3/10).
Note the correct positions for these two details.
2. Loosen the screws (→ Fig.4-4/33) and (→ Fig.4-4/73).
3. Remove the cam disc (→ Fig.4-4/32) and the plate (→ Fig.4-4/8).
4. Remove the adjustment screw (→ Fig.4-4/7) and mount it in the opposite direction.
5. Turn the plate (→ Fig.4-4/8) 180° and put it back. Hole (→ Fig.4-4/B), located at a greater distance from the centre of the shaft, shall now be located right in front of the ball bearing (→ Fig.4-4/16).
6. Mount the new cam disc and tighten.
7. Make zero point and range adjustment (→ Chap.3.1).
8. Put back indicator and cover.

4.3.2 Cam discs for positioner SP405 and SPE405

Type	Art. No.	Function	Range (SP405)	Range (SPE405)
A	14051	Linear AO	20 - 100 kPa	4 - 20 mA
		Linear AC	20 - 100 kPa	4 - 20 mA
B	14052	Linear AO	20 - 60 kPa	4 - 12 ¹ mA
		Linear AC	20 - 60 kPa	4 - 12 ¹ mA
C	14053	Linear AO	60 - 100 kPa	12 - 20 ¹ mA
		Linear AC	60 - 100 kPa	12 - 20 ¹ mA
D	14054	Percent AO	20 - 100 kPa	4 - 20 mA
E	14055	Percent AO	20 - 60 kPa	4 - 12 ¹ mA
F	14056	Percent AO	60 - 100 kPa	12 - 20 ¹ mA
G	14057	Percent AC	20 - 100 kPa	4 - 20 mA
H	14058	Percent AC	20 - 60 kPa	4 - 12 ¹ mA
K	14059	Percent AC	60 - 100 kPa	12 - 20 ¹ mA

¹ Split range

AO = Direct function (Increased input signal opens the valve).
AC = Reverse function (Increased input signal closes the valve).

All cams are for a rotary motion of 60°-90°.
The above table shows only standard cams.
Other types of cams on request.

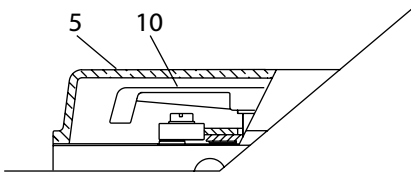
Tab.4-1 Cam discs for positioner SP405 and SPE405



4.4 Change-over function

If not particularly specified, the positioner is mounted to the actuator and connected for direct action. I.e. increased input signal opens the valve, AO.

4.4.1 Change-over to reverse function, AC

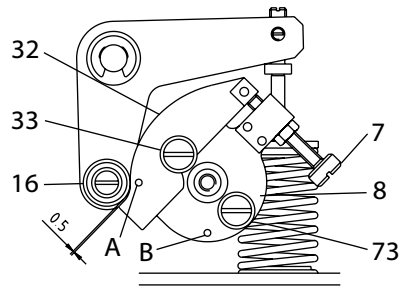
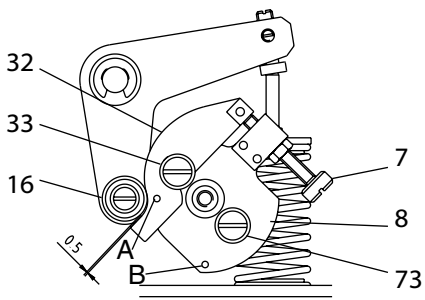


5 Cover 10 Indicator

Fig.4-5 Change-over to reverse function, AC

Procedure

1. Remove the cover (→ Fig.4-5/5) and the indicator (→ Fig.4-5/10).
2. Loosen the screws (→ Fig.4-6/33) and (→ Fig.4-6/73).
3. Remove the cam disc (→ Fig.4-6/32).
4. Lift up the plate (→ Fig.4-6/8).
5. Turn the plate (→ Fig.4-6/8) and put it back (→ Fig.4-7).
6. Re-assemble the cam disc in upside down position (→ Fig.4-8).
(The cam disc will now have a rising slope at clock-wise rotation).
7. Change connections to the actuator.
8. Make zero point and range adjustment (→ Chap.3.1).
9. Put back indicator and cover.



- 7 Adjustment screw
- 8 Plate
- 16 Ball bearing
- 32 Cam disc

- 33 Screw
- 73 Screw

Fig.4-6 Cam disc position at closed valve AO - Standard

Fig.4-6 Cam disc position at closed valve AO "Split range"

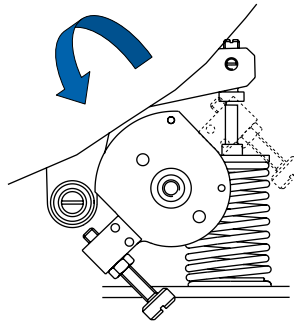
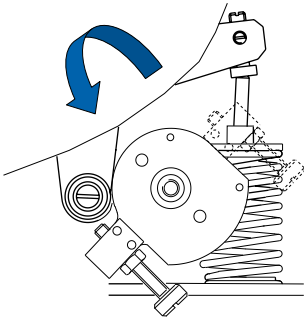


Fig.4-7 Turning the plate - Standard

Fig.4-7 Turning the plate - "Split range"

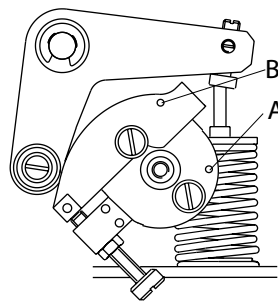
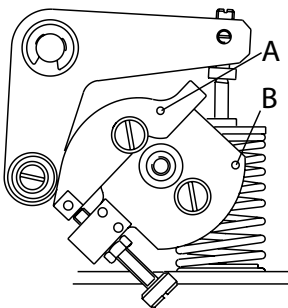


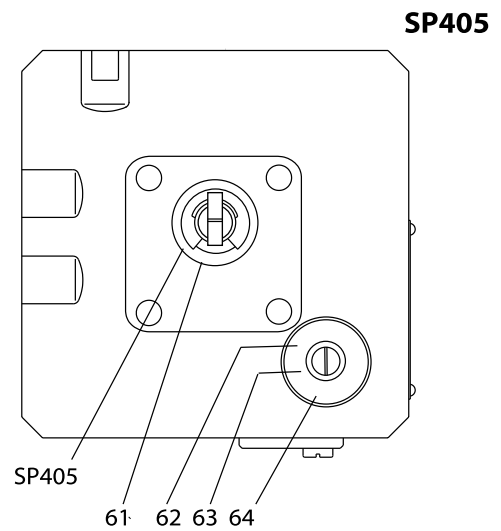
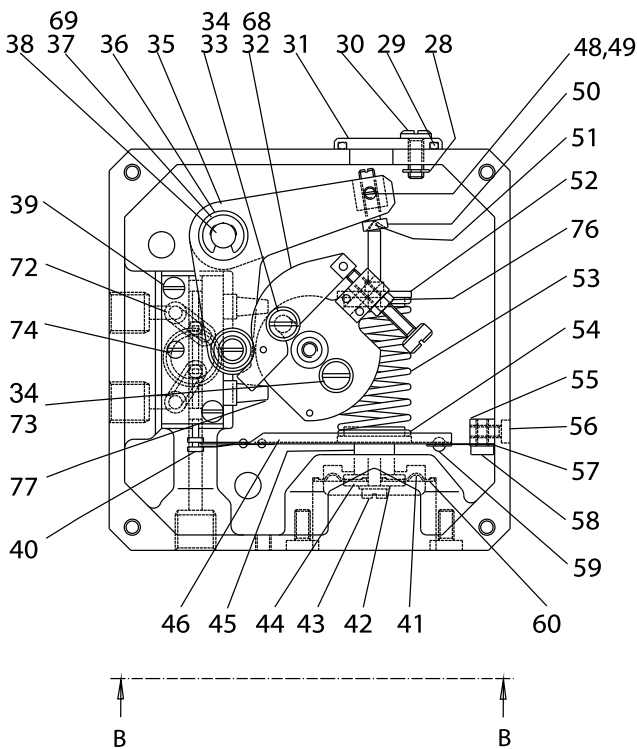
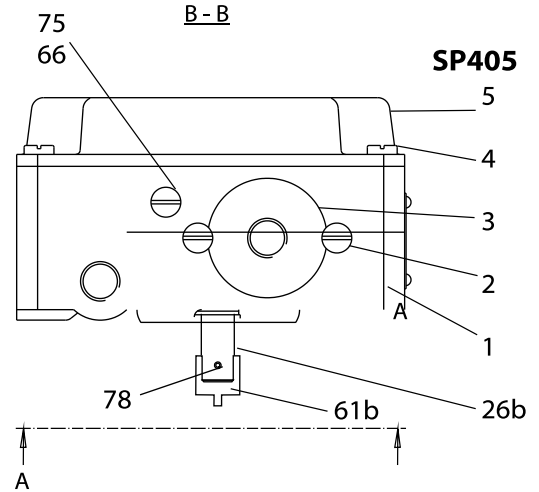
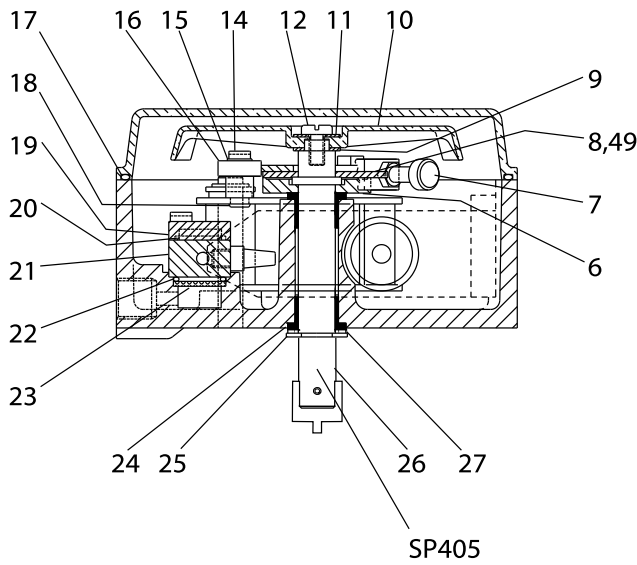
Fig.4-8 Cam disc position at closed valve AC - Standard

Fig.4-8 Cam disc position at closed valve AC "Split range"



5 Spare parts list

5.1 Pneumatic type SP405





Pos. No.	Description	Pos. No.	Description
1	Housing, Aluminium, SP405	34	Washer, dia. 5.3, Steel, Z.Pl., DIN 137B
2	Screw, M5x10, Brass, Nickel Pl. SS-ISO 1580	35	Feedback arm, Aluminium
3	Diaphragm cover, Aluminium	36	Bushing, Plastic
4	Screw, SS 2346	37	Locking ring, dia. 6, Steel, Z.Pl., SS-ISO 6799
5	Cover, Polycarbonate	38	Shaft, SS 2346
6	Locking ring, Steel, Z. Pl.	39	Screw, M4x25, Steel, Z.Pl., SS-ISO 1207
7	Adjustment screw, SS 2346	40	Slide, SS 2346
8	Plate, Brass, Nickel Pl.	41	Diaphragm, Silicone rubber
9	Washer, dia. 8.4, Steel, Z.Pl. DIN 137B	42	Washer, dia. 4.3x9x1, Nylon, DIN 125
10	Indicator, Polycarbonate	43	Screw, M4x20, Brass, Nickel Pl., SS-ISO 1207
11	Washer, 5x16, Steel, Z.Pl.	44	Washer, Aluminium
12	Screw, SS 2346	45	Distance bushing, Aluminium
14	Screw, M4x8, Steel, Z.Pl., SS-ISO 1207	46	Balance arm, Stainless steel
15	Washer, dia. 4.3x8, Steel, Z.Pl., DIN 125	48	Screw, M4x8, Steel, Z.Pl., DIN 551
16	Ball bearing, DIN 625, W687z	49	Plug
17	O-ring, dia. 140.0x2.5, EPDM	50	Zero point screw, SS 2331
18	Nipple, SS 2346	51	Guiding pin, SS 2331
19	Block, Aluminium	52	Spring holder, Aluminium
20	O-ring, dia. 12.1x1.6, EPDM	53	Compression spring, SS 2331-06
21	Valve housing, SS 2333	54	Spring holder, Aluminium
22	O-ring, dia. 16.1x1.6, EPDM	55	Holder, Steel, Z.Pl.
23	Filter, Plastic	56	Screw, M4x12, Z.Pl., SS-ISO 1207
24	Bushing, Plastic	57	Pressure plate, Stainless steel
25	Washer, 18x12.2x1, Stainless steel	58	Screw, M4x8, Steel, Z.Pl., SS-ISO 1207
26	Shaft, SS 2346	59	Rivet, 2.5x3, DIN 660
28	Locking ring, dia. 3.2, Steel, DIN 6799	60	Washer, Aluminium
29	O-ring, dia. 26.64x2.62, EPDM	61	Driver, SP405, SS2331-43
30	Screw, M4x14, SS 2343, SS-ISO 1207	62	Diaphragm, Hypalone CSM1
31	Cover, Aluminium	63	Screw, M5x10, Steel, Z.Pl., SS-ISO 1580
32	Cam disc, type A, Stainless steel	64	Washer, dia. 5x16, Steel, Z.Pl.
	Cam disc, type B, Brass, Nickel Pl.	66	Screw, M5x6, Brass, Nickel Pl.
	Cam disc, type C, Brass, Nickel Pl.	68	Rivet, 2.5x9, Steel, DIN 660
	Cam disc, type D, Brass, Nickel Pl.	69	Washer, 8.4x16x1.5, Steel, Z.Pl.
	Cam disc, type E, Brass, Nickel Pl.	72	O-ring, dia. 4.1x1.6, EPDM
	Cam disc, type F, Brass, Nickel Pl.	73	Screw, M5x8, Steel, Z.Pl., SS-ISO 1580
	Cam disc, type G, Brass, Nickel Pl.	74	Screw, M3x10, Steel, Z.Pl., SS-ISO 2009
	Cam disc, type H, Brass, Nickel Pl.	75	Washer, dia. 5.3x10, Nylon, DIN 125
	Cam disc, type K, Brass, Nickel Pl.	76	Nut, M4, Steel, Z.Pl., SS-ISO 4032
33	Screw, M5x10, Steel, Z.Pl., SS-ISO 1580	77	Silencer
		78	Elastic pin, dia. 2.5x10, Stainless steel

Fig.5-1 Spare part list pneumatic type SP405

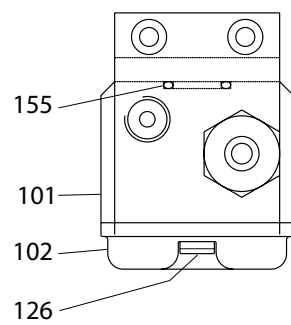
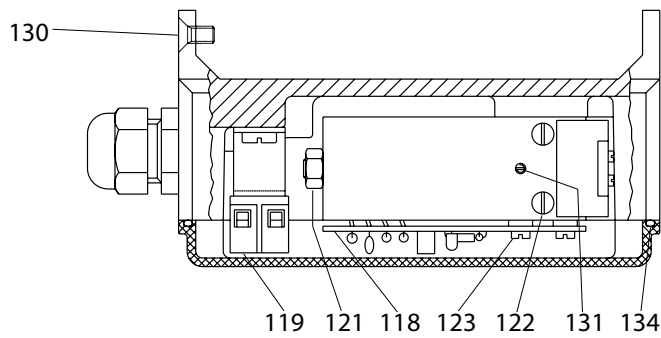
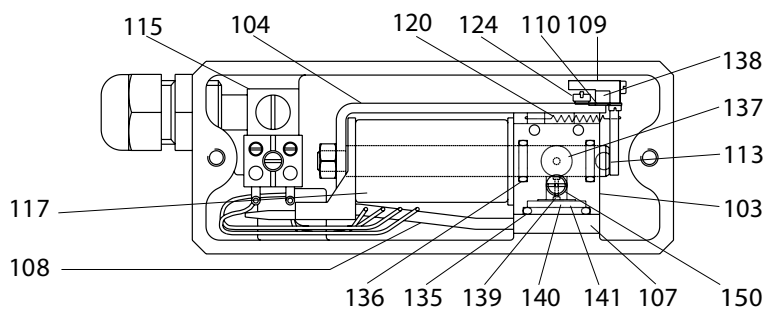
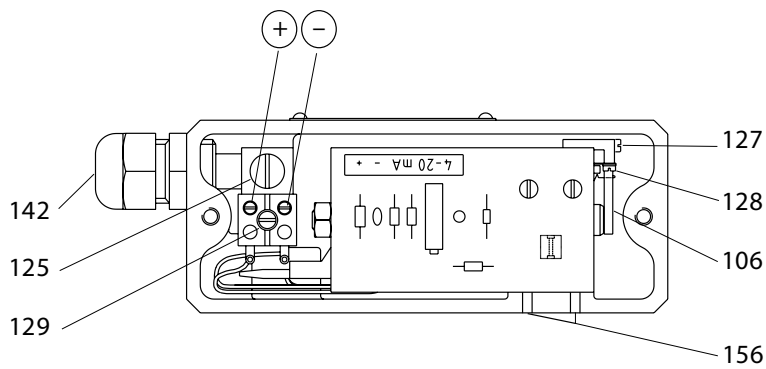
5.1.1 Recommended, available spare parts

Pilot valve std.	Art.No. 56026	Pos.No. 19, 20, 21, 39, 40, 74 and 77
Pilot valve, special vib. 5 ¹	Art.No. 54347	
Spare parts kit (O-rings and filter)	Art.No. 36931	Pos.No. 17, 20, 22, 23, 29 and 72
Evacuations diaphragm cpl.	Art.No. 14145	Pos.No. 62, 63 and 64
Diaphragm	Art.No. 14063	Pos.No. 41
Feedback arm cpl.	Art.No. 22083	Pos.No. 14, 15, 16, 35, 36, 37, 48, 49, 50 and 69
Shaft cpl. SP405	Art.No. 22965	Pos.No. 26b, 78, 61b
Cover + Indicator kit.	Art.No. 48332	Pos.No. 4, 5, 10, 11, 12, 17
Balance arm cpl.	Art.No. 14065	Pos.No. 46, 55, 57, 59, 58

1) For applications where the vibration speed of the valve positioner exceeds 40 mm / second.



5.2 I/P-converter E405





Pos. No.	Description	Pos. No.	Description
101	Housing, Aluminium	126	Screw, SS 2346
102	Cover, Polycarbonate	127	Screw, M2x5, Brass, Nickel Pl., SS-ISO 1207
103	Block, Aluminium	128	Screw, M2x2, Brass, Nickel Pl., SS-ISO 1207
104	Relay angle, Wacoperm 100	129	Screw, M3x14, Brass, Nickel Pl., SS-ISO 1207
106	Flapper, Wacoperm 100	130	Screw, M5x10, Brass, Nickel Pl., SS-ISO 2009
107	Adapter, Aluminium	131	Screw, M3x3, Brass, Nickel Pl., SS-ISO 4029
108	Tube, Copper	134	O-ring, dia.113.97x2.62, Nitrile
109	Counter weight, Brass	135	O-ring, dia. 15.3x2.4, Nitrile
110	Plate spring, Brass	136	O-ring, dia. 8.73x1.78, Nitrile
113	Nozzle, Delrin	137	O-ring, dia. 5.28x1.78, Nitrile
114	Holder for nozzle, Delrin	138	Damper, Viton 6703
115	Bracket, Brass	139	Nozzle, Sapphire
117	Relay coil	140	Filter, Plastic
118	Printed circuit card	141	Fine filter, Polypropylene
119	Terminal board	142	Cable entry
120	Zero spring, Stainless steel	150	Plug
121	Nut, M6, Brass, Nickel Pl., SS-ISO 4032	155	O-ring, dia. 15.3x2.4, Nitrile
122	Screw, M4x8, Brass, Nickel Pl., SS-ISO 1207	156	Screw, M4x16, Brass, Nickel Pl., SS-ISO 1207
123	Screw, M3x40, Brass, Nickel Pl., SS-ISO 1207		
124	Screw, M3x3, Stainless steel, SS-ISO 1207		
125	Screw, M5x10, Brass, Nickel Pl., SS-ISO 1207		

Fig.5-2 Spare part list I/P-converter E405

5.2.1 Recommended, available spare parts

I/P-converter, type E405, cpl. with housing	Art.No. 13583	
I/P-converter, type E405, excl. housing	Art.No. 13584	
Spare parts kit consisting of: O-rings and filters	Art.No.13585	(Pos.No. 134, 135, 137, 140, 141 and 155)
Cover cpl.	Art.No. 13586	(Pos.No. 102, 126, 134)



6 Maintenance schedule SP/SPE405

Symtom	Cause	Rectification
The input signal do not effect the actuator position	No supply pressure	Check supply pressure (4-8 bar)
	No input signal (SPE: 4-20 mA)	Connect the mA-signal (SPE)
	No input signal (SP: 20-100 kPa)	Connect the pneumatic signal (SP)
	Polarity fault	Change polarity, +/-
	Pneumatic signal waires not connected	Connect the signal waires between actuator and positioner
	Pilot valve stuck	Clean the pilot valve
	IP-module broken	Change the IP-module
The positioner do not work in the full range	Misadjusted span	Adjust range with the screw (→ Fig.5-1/7)
	Misadjusted zero	Adjust the zero point with the screw (→ Fig.5-1/50) Information about the zero point- and range adjustment (→ Chap.3.1)
	Air supply to low	Check supply pressure (4-8 bar)
	Impurity in the filter	Change the filter in the IP-module /SP405
	Impurity in the nozzle	Clean the filter with a paper (→ Chap.4.2)
	Oil or water in the filter	Change the filter in the IP-module/SPE
Inaccurate positioning	Balance arm worn	Change the balance arm
	Pilot valve worn	Change the pilot valve
	Oil or water in the filter/IP-module	Change filter in the IP-module /SPE
	Impurity in the filter	Change filter in the IP-module /SPE
	Leakage in the actuator	Check the actuator
	Cam worn	Change the cam
	Ball bearing worn	Change the ball bearing

Fig.6-1 Maintenance schedule SP/SPE405



7 Technical specification

	SP405	SPE405
Control signal: Standard	20-100 kPa	4 - 20 mA
Control signal: Split range	20-60 kPa 60-100 kPa	4 - 12 mA 12 - 20 mA
Air consumption: at balance and 6 bar supply pressure	max 10 NI/min	max 15 NI/min
Air capacity : at 6 bar supply pressure	450 NI/min approx.	450 NI/min approx.
Max voltage drop:	–	8.6 V at 20mA
Cam discs:	(→ Tab.4-1)	(→ Tab.4-1)
Connections:	G 1/4"	G 1/4"
Supply pressure:	4-8 bar	4-8 bar
Ambient temperature:	-40° to +100°C	-40° to +100°C
Hysteresis:	± 0.5 % ¹	± 0.5 % ¹
Repeatability:	< 0.5 % ¹	< 0.5 % ¹
Input resistance:	–	430 Ohm
Weight:	1.5 kg	2.3 kg
Supply air:	Dry and clean instrument air ²	Dry and clean instrument air ²
Protection class:	–	Equivalent to IP65

Fig.7-1 Technical specification

¹ Of chosen control signal, ² According to ISO 8573-1 Class 3.

8 Material specification

Detail	Material
Housing	Aluminium - Duasolid painted
Cover	Polycarbonate
Balance arm	Stainless steel
Feed back arm	Aluminium
Cam disc	Stainless steel (standard)
Feed back spring	Spring steel chromated
Pilot valve	Stainless steel
Pilot valve ViB 5	High-strength stainless steel ¹
Diaphragm	Silicone rubber

Fig.8-1 Material specification

¹ For applications where the vibration speed of the valve positioner exceeds 40 mm / second.



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