Pneumatic Positioner
Type 4765

Fig. 1 · Type 4765

Mounting and operating instructions

EB 8359-1 EN

Edition August 2000

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- *Assembly, start-up and operation of the device may only be performed by trained and experienced personnel familiar with this product.*
  According to these mounting and operating instructions, trained personnel is referred to persons who are able to judge the work they are assigned to and recognize possible dangers due to their specialized training, their knowledge and experience as well as their knowledge of the relevant standards.
- *Any hazards which could be caused by the process medium, the signal pressure and moving parts of the control valve are to be prevented by means of appropriate measures.*
- *If inadmissible motions or forces are produced in the actuator as a result of the level of the supply air pressure, this must be restricted by means of a suitable pressure reducing station.*
- *Proper shipping and appropriate storage are assumed.*

Versions

Type		**4765-**	**0**	**1**	□	**0**	**0**	□	**1**
Measuring spring	1				1				
	2				2				
	3				3				
Pneumatic connections	G 1/4							1	
	NPT 1/4							3	

Controlled variable (travel range)	7.5 to 60mm, 90 mm with extended lever	
Reference variable	0.2 to 1 bar	
Split-range from 0 to 50 % or 50 to 100 % input signal span (up to 50 mm travel)	0.2 to 0.6 bar and 0.6 to 1 bar	
Measuring spring	Selection, see Table on page 13	
Auxiliary supply air	From 1.4 to 6 bar (20 to 90 psi)	
Signal pressure p_{st} (output)	Max. 0 to 6.0 bar (0 to 90 psi)	
Characteristic	Linear characteristic Deviation from terminal-based conformity: ≤1.5 %	
Hysteresis	< 0.5 %	
Sensitivity	< 0.1 %	
Operating direction	Reversible	
Proportional band X_p at 1.4 bar supply air	1 to 3 % with spring 1 and 2, 1 to 1.5 % with spring 1 and 2	
Air consumption in steady state X_p = 1 %	Supply = 1.4 bar: 0.13 m_n^3/h	Supply air = 6 bar: 0.33 m_n^3/h
Air output	Δp 1.4 bar: 3.0 m_n^3/h	Δp 6 bar: 8.5 m_n^3/h
Travel time with Type 3271 Actuator (actuator stem extends)	240 cm^2 ≤1.8 s 350 cm^2 ≤2.5 s 700 cm^2 ≤10 s	
Permissible ambient temperature	–20 to +80 °C, extended temperature range on request	
Effect	Temperature: < 0.02 % / 1 K Supply: < 0.2 % / 0.1 bar Variable position when rotated 180°: < 3.5%	
Degree of protection	IP 54, (IP 65 special version)	
Weight	Approx. 1.1 kg	
Materials	Case: Die-cast aluminum, chrome plated and plastic coated Exterior parts: Stainless steel	

1. Design and principle of operation

The pneumatic positioner is used to assign valve stem position (controlled variable) and control signal (reference variable). In this process, the instrument signal, supplied by a control device, is compared to the travel of the control valve, and a pneumatic signal pressure (output variable) is supplied to the actuator.

The positioner essentially consists of a lever with attached shaft and measuring spring, the measuring diaphragm and the pneumatic control system comprising nozzle, flapper plate and booster.

In addition, a pressure gauge can optionally be attached for the instrument input signal and the positioner output signal.

The positioner operates according to the force-balance principle. In this way, the stroke of the actuator stem or the plug stem (controlled variable x) is transmitted to the lever (1) and the measuring spring (6) via the plate (20). This action twists the measuring spring and varies the torsional force.

The instrument input signal (p_e) supplied by the upstream controller produces a positioning force on the measuring diaphragm (8). This force is compared with the force of the measuring spring (6). At the same time, the motion (deflection) of the measuring diaphragm is transmitted to the flapper plate (10.2) via the feeler pin (9.1), thereby releasing pressure from the nozzle (10.1).

Supply air is piped to the pneumatic booster (12) and flows through the X_p adjustment (13) and the nozzle (10.1) until it hits the flapper plate (10.2).

Any changes of the instrument input signal p_e or the valve stem position cause a pressure variation upstream and downstream of the booster. The air released by the booster (signal pressure pst) flows to the pneumatic actua-

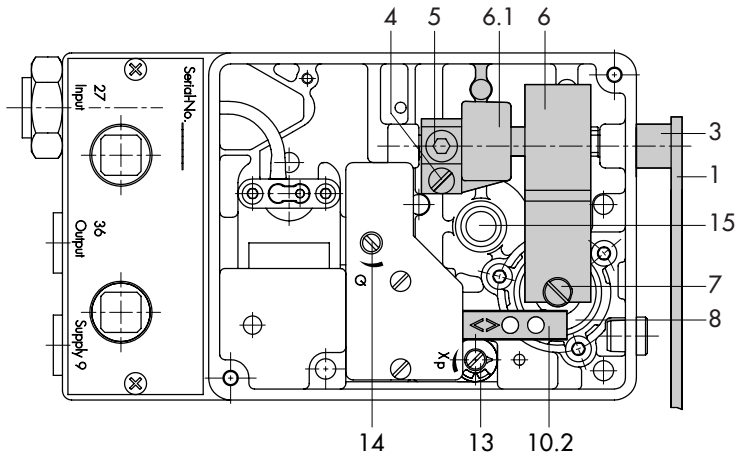
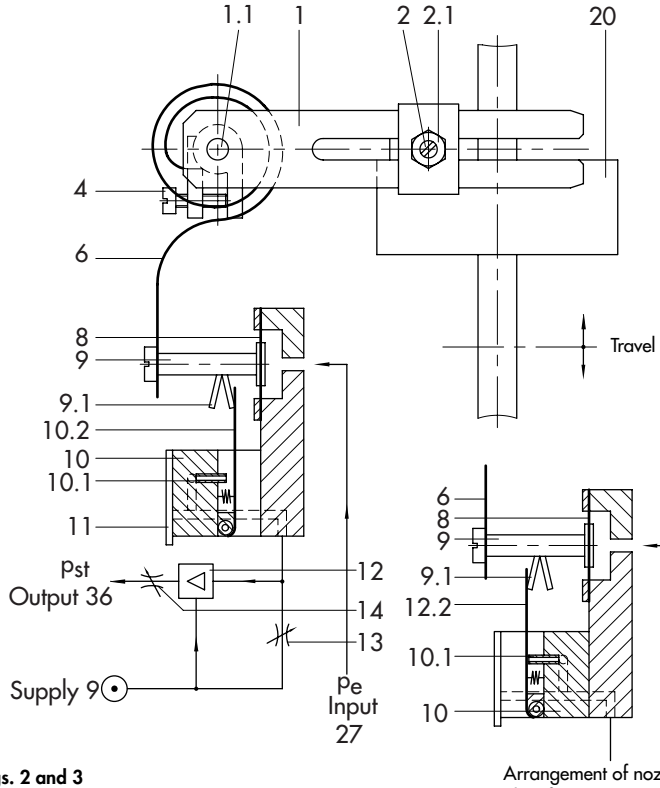


Fig. 2 · Positioner open

tor via the volume restrictor (14), causing the plug stem to take on a position corresponding to the reference input variable. The adjustable tuning throttles (13 and 14) are used to optimize the control loop. The measuring spring (6) corresponds to the rated valve travel and the nominal reference input span. It can be exchanged.



Legend Figs. 2 and 3

1	Lever for valve travel	6.1	Stop angle		
1.1	Shaft	7	Mounting screw		
2	Pin	8	Measuring diaphragm	11	Cover plate
2.1	Nut	9	Diaphragm lever	12	Booster
3	Sleeve	9.1	Feeler pin	13	X_p adjustment
4	Zero point adjuster	10	Nozzle block	14	Volume restriction Q
5	Mounting screw	10.1	Nozzle	15	Bore for mounting screw
6	Measuring spring	10.2	Flapper plate	20	Plate

Fig. 3 · Schematic diagram

2. Attachment to control valve

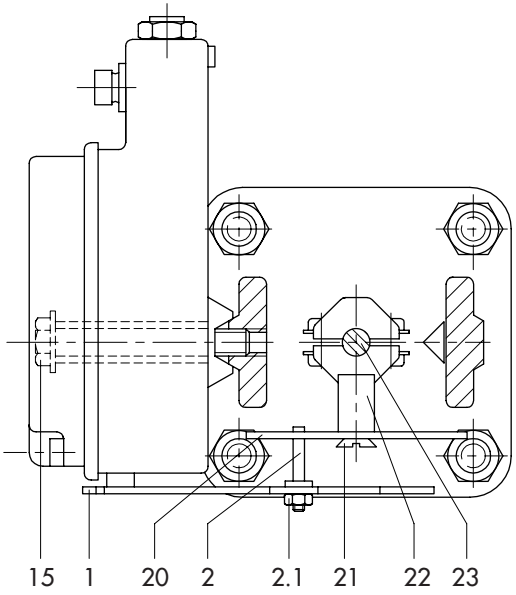
For attaching the positioner to control valves with casted yoke, attachment parts order no. 1400-5745 are required. For rod-type (pillar) yokes, you require attachment kit order no. 1400-5745 and1400-5342 (see Table 2, page 18).

Since the positioner can be attached either on the right or left side of the valve, the actual positioner-valve arrangement must be determined in advance.

Note corresponding Figs. 6 to 9 on page 11.

2.1 Attachment to valve with casted yoke

1. Screw plate (20) to the coupling clamp (22) of the valve using screws (21).
2. Unscrew the positioner cover, and secure the positioner on the valve yoke using the mounting screw (15). Always make certain that the pin (2) is led within the wire strap and therefore clamped against the plate (20).



Legend Figs. 4 and 5

1	Lever
2	Pin
2.1	Nut
15	Mounting screw
20	Plate
21	Screw
22	Coupling
23	Plug stem
24	Travel indicator
26	Clamping plate
27	Valve stem (pillar)
28	Support

Fig. 4 · Attachment to casted yokes (NAMUR rib)

2.2 Attachment to valve with rod-type (pillar) yoke

1. Screw the plate (20), off-centered, on the travel indicator (24) of the plug stem (23) using the screws (21).
2. Place the support (28) and the clamping plate (26) on the pillar (27), and loosely screw together. Push the support until the center of the plate (20) and the support (28) are aligned at half of the valve travel (mid-range).
3. Tightly screw together the support and the clamping plate.
4. Subsequently, mount the positioner on the support using the mounting screw (15). Always make certain that the pin (2) is led within the wire strap and therefore clamped against the plate (20).

2.3 Case cover

After attaching the positioner to the yoke as described above, make certain that the vent plug on the case cover is directed "downwards" when the valve is installed.

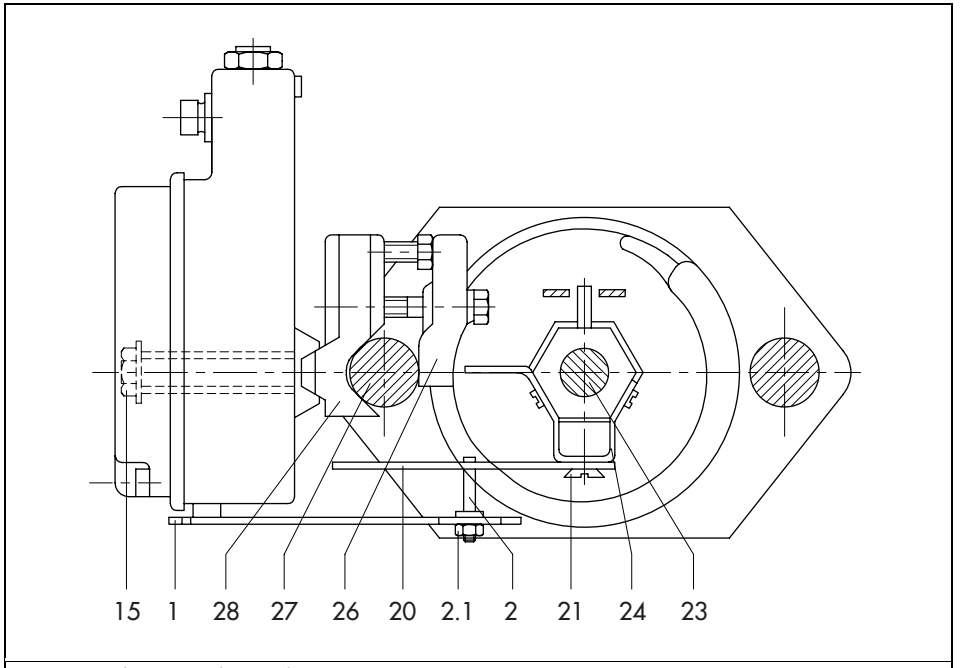


Fig. 5 · Attachment to rod-type yokes

3. Air connections

The air connections are designed as tapped holes with 1/4- NPT or ISO 228/1-G1/4 threads.
The common male connections for metal and copper pipes or plastic hoses can be used.

IMPORTANT
The supply air must always be dry and free of oil or dust. You are required to observe the maintenance instructions for downstream pressure reducing stations. Thoroughly purge the air lines prior to connection.

3.1 Pressure gauge

We recommend that pressure gauges be mounted to monitor the supply pressure and the signal pressure. These parts are listed as accessories in Table 2 on page 18.

3.2 Supply pressure

The required supply pressure is determined according to the bench range and the operating direction (fail-safe position) of the actuator.
Depending on the actuator, the bench range is indicated on the nameplate either as spring range or as signal pressure range. The operating direction is indicated by **FA** (actuator stem extends) or **FE** (actuator stem retracts or by the proper actuator symbol.

Actuator stem extends (FA)

Fail-safe position "Valve CLOSED"
(Globe and angle valves)

Required supply pressure =
Upper bench range value + 0.2 bar,
min. 1.4 bar.

Actuator stem retracts (FE)

Fail-safe position "Valve OPEN"
(Globe and angle valves)

The required supply pressure for tight-closing valves is estimated from the maximum signal pressure pst_{max}:

$$pst_{max} = F + \frac{d^2 \cdot \pi \cdot \Delta p}{4 \cdot A} \text{ [bar]}$$

d = Seat diameter [cm]
Δp = Differential pressure in the valve [bar]
A = Effective actuator area [cm^2]
F = Upper bench range value of the actuator

If nothing is specified, proceed as follows:

Required supply pressure =
Upper bench range value + 1 bar

The signal pressure (output) is routed either to the top or bottom side of the actuator as shown in Figs. 6 to 9.

4. Operation

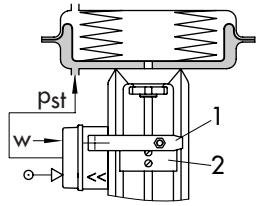
4.1 Combining the positioner and the actuator

Figs. 6 to 9 show the interdependence between actuator, reference variable, operating direction and prescribed mounting position. The positioner's mounting position changes every time a subsequent change is made, i.e. reversing the operating direction of the control loop or reversing the actuator action from "retracts" to "extends" and vice versa.

4.1.1 Determining and reversing the operating direction

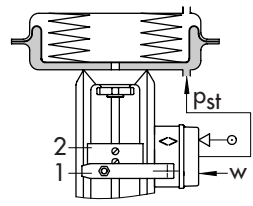
Whenever the instrument input signal p_e (reference variable) increases, the signal pressure p_{st} may increase (direct operating direction <<) or decrease (reverse operating direction <>).
Similarly, whenever the instrument input signal decreases, the signal pressure may decrease when the operating direction is direct (<<) and it may increase when the operating direction is reverse (<>).

Actuator action: Actuator stem "extends" (FA)



Lever (1) positioned above the plate

Fig. 6 · Operating direction <<, left attachment



Lever (1) positioned below the plate

Fig. 7 · Operating direction <>, right attachment

Actuator action: Actuator stem "retracts" (FE)

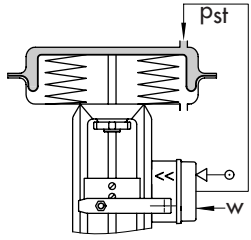


Fig. 8 · Operating direction <<, right attachment

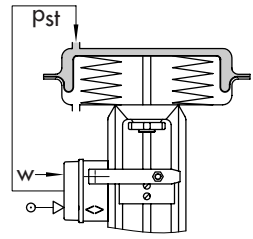


Fig. 9 · Operating direction <>, left attachment

Symbols on the flapper plate (10.2) indicate the operating direction (<< or <>). Depending on how the flapper plate is positioned, the applicable operating direction is shown by the corresponding symbol.
If the operating direction required by the selected function does not match the visible symbol or if the operating direction needs to be modified, proceed as follows:

1. Remove both screws on the cover plate, and lift off the nozzle block (10) including the cover plate.
2. Reposition nozzle block turned 180° together with the cover plate, and screw tight. Always make sure that the nozzle block and flapper plate are positioned in accordance with the feeler pin (9.1) as depicted in Fig. 10.

If the operating direction is to be modified once the positioner/actuator assignment has been determined, note the following: In addition to changing the nozzle block, the positioner must also be mounted in a different position.

You are absolutely required to ensure that the lever (1) is positioned correctly in relation to the plate (20), either above or below, as shown in Figs. 6 to 9).

4.2 Starting point and reference variable

The attached lever and the installed measuring spring of the positioner correspond to the rated valve travel and the reference variable (input signal) in accordance with Table 1, page 13.
In standard operating mode, the reference input span is 100 % = 0.8 bar. A narrower span of, for example 50 % = 0.4 bar, is only required in split-range operation (Fig. 12). This span can be changed by subsequently replacing the measuring span (see section 4.5). In the adjustment procedure of the positioner, the travel must be adjusted to the reference variable and vice versa.

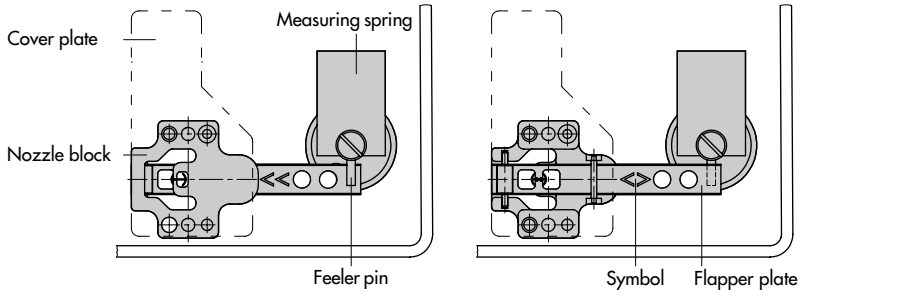


Fig. 10 · Position of the nozzle block, cover plate removed

With a reference input span comprising 0.2 to 1 bar, the valve must have passed full travel from 0 to 100 % where the starting point then begins at 0.2 bar and the span ends at 1 bar. In split-range operation, the controller output signal is split to operate two control valves in such a way that each valve moves through its entire travel at half the instrument input signal each (e.g. first control valve is set from 0.2 to 0.6 bar, the second valve from 0.6 to 1 bar). To avoid overlapping, consider a dead band (hysteresis) of give-or-take 0.05 bar according to Fig. 12.

The starting point (zero) is adjusted using the zero adjustment screw (4). The reference input span and the final value is adjusted via pin (2).

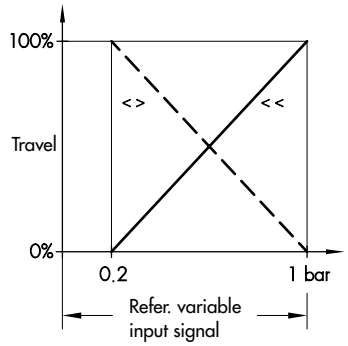


Fig. 11 · Standard operation

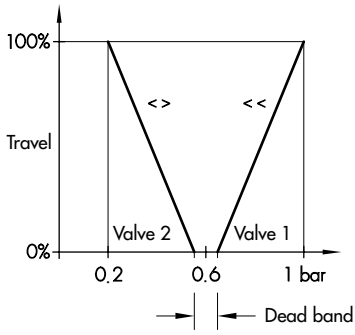


Fig. 12 · Split-range operation, 2 valves oper. in opposite directions

Table 1

Rated travel [mm]	Min./max. travel [mm]	Reference variable (input signal)	Measuring spring
Standard travel values for SAMSON valves with lever I (length 40 to 127 mm)			
15	7.5 to 15	100 % 50 %	1 2
30	14 to 32	100 % 50 %	2 3
60	30 to 70	100 %	3
Additional travel ranges with lever I and extended lever (length 40 to 200 mm)			
20	7.5 to 26	100 % 50 %	1 2
40	14 to 50	100 % 50 %	2 3
>60	30 to 90	100 %	3

4.3 Adjusting the valve

- Connect the control signal input to a compressed air source of max. 1.5 bar using a remote adjuster and a pressure gauge.
- Connect supply air to the auxiliary air input (supply 9).

4.3.1 Adjusting the air output (volume restriction Q) and the proportional band X_p

1. Close volume restriction (14) as far as the required speed of response allows. The speed of response can be checked by shortly pressing the measuring spring (6) against the stop.
2. Adjust reference variable at the input to approx. 50 % of its range. Then turn the ZERO adjustment screw (4) until the valve travel is stroked to approx. 50 %.

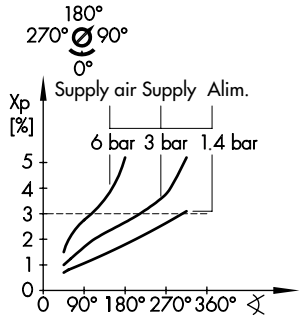


Fig. 13 · Adjusting the X_p throttle

When adjusting the X_p restriction, note the relationship of the supply air pressure according to Fig. 13. X_p should be preset to approx. 3 %.

3. Check tendency of plug stem to oscillate by shortly pressing the measuring spring (6) against the stop.
   The X_p value should be adjusted to the minimum possible value without the occurrence of significant oscillation.

IMPORTANT
The X_p restriction adjustment must always be determined prior to adjusting the starting point. Subsequent alteration shifts zero. Zero displacement can also occur from a change of the adjusted supply air. If applicable, check zero under prevailing operating conditions in the plant and readjust if necessary.

4.3.2 Adjusting the actuator: Actuator stem extends (FA)

IMPORTANT
For the full closing force to act on the control valve, the diaphragm chamber must be completely vented at the lower (operating direction <<) and upper (operating direction <>) value of the reference variable. When the operating direction is direct <<, the input signal is therefore set to a slightly higher starting point of 0.23 bar and when the operating direction is reverse <>, to a slightly lower starting point of 0.97 bar.

Starting point (zero point) e.g. 0.23 bar

1. Turn the ZERO adjustment screw (4) until the plug stem just begins to move from its resting position (watch the plug stem with the travel indicator).
2. Decrease the instrument input signal using the remote adjuster, and gradually increase again, checking whether the plug stem begins to move at 0.23 bar and correct, if necessary.

Final value (range) e.g. 1 bar

3. Once the starting point has been adjusted, increase the input signal.
   The plug stem must be motionless after having reached a final value of exactly 1 bar, therefore having passed 100 % travel (watch travel indicator on the valve).
   If the final value does not match, the pin (2) must be shifted as follows in order to correct the value:
4. Slide to
   end of lever → increases travel
   pivot → reduces travel
   After correcting the instrument input signal, zero must be readjusted.
   After that, check the final value once again.

Keep repeating the procedure until the two values match.

If a pressure gauge is available, check whether the actuator is completely vented at an instrument input signal of exactly 0.2 bar (operating direction <<), i.e. 1.0 bar (operating direction <>).

4.3.3 Adjusting the acutator: Actuator stem retracts (FE)

IMPORTANT

*For actuators of the type **"FE"**, a signal pressure which is high enough to tightly close the valve - even with existing upstream plant pressure - must be applied to the diaphragm chamber. For direct operating direction <<, the upper end value of the reference variable is 1 bar. For reverse operating direction <>, the lower end value of the reference variable is 0.2 bar.*

The required signal pressure is shown on the adhesive label attached to the positioner, or roughly calculated as described in section 3.1.2, page 10.

Starting point, e.g. 1 bar

1. Adjust the instrument input signal to 1 bar.
   Turn zero adjustment screw (4) until the control valve just begins to move from the resting position.
2. Increase the instrument input signal and gradually decrease again to 1 bar, checking whether the control valve begins to move at exactly 1 bar.
   Correct the deviation using the zero adjustment screw (4).
   Turning to the left moves the control valve earlier from its final position, and turning to the right, later.

Final value (range) e.g. 0.2 bar

3. Once the starting point has been adjusted, set the instrument input signal to 0.2 bar.
   When the final value reaches exactly 0.2 bar, the plug stem must be motionless and therefore have passed 100 % travel (watch travel indicator on the valve!).
4. If the final value does not match, slide the pin (2) to correct.
   Set to 1 bar again and turn the zero adjustment screw (4), until the pressure gauge indicates the **required signal pressure** (see also section 3.1.2).
   In case there is no pressure gauge available, set the starting point to 0.97 bar instead.

4.4 Replacing the measuring spring

If the range must be modified or if you want to change to split-range operation, replace the measuring spring as follows (see Fig. 3):

1. Remove the screw (7) from the measuring spring, loosen hexagon socket-head screw (5), and pull out the lever along with the shaft.
2. Replace the measuring spring. Then slide the lever with the shaft through the sleeve (3), case, and stop angle (6.1).
3. Secure measuring spring using the mounting screw (7).
4. Push the stop angle and the shaft toward one another so that the hexagonal screw (5) touches the flattened part of the shaft. Tighten the screw (5). Be sure to consider a play of 0.05 to 0.15 mm between the lever (1) and the sleeve (3), as well as between the measuring spring (6) and the case.

5. Converting the pneumatic positioner

The pneumatic positioner can be converted to a Type 4763 Electropneumatic Positioner using a corresponding conversion kit.
A conversion kit is required for each Type 6109 or Type 6112 i/p module (see Table 3 below, page 18), in which the boards, the screw gland and the mounting screws are contained.

For the Type 4763 Electropneumatic Positioner, refer to the Mounting and operating instructions ***EB 8359-2 EN.***

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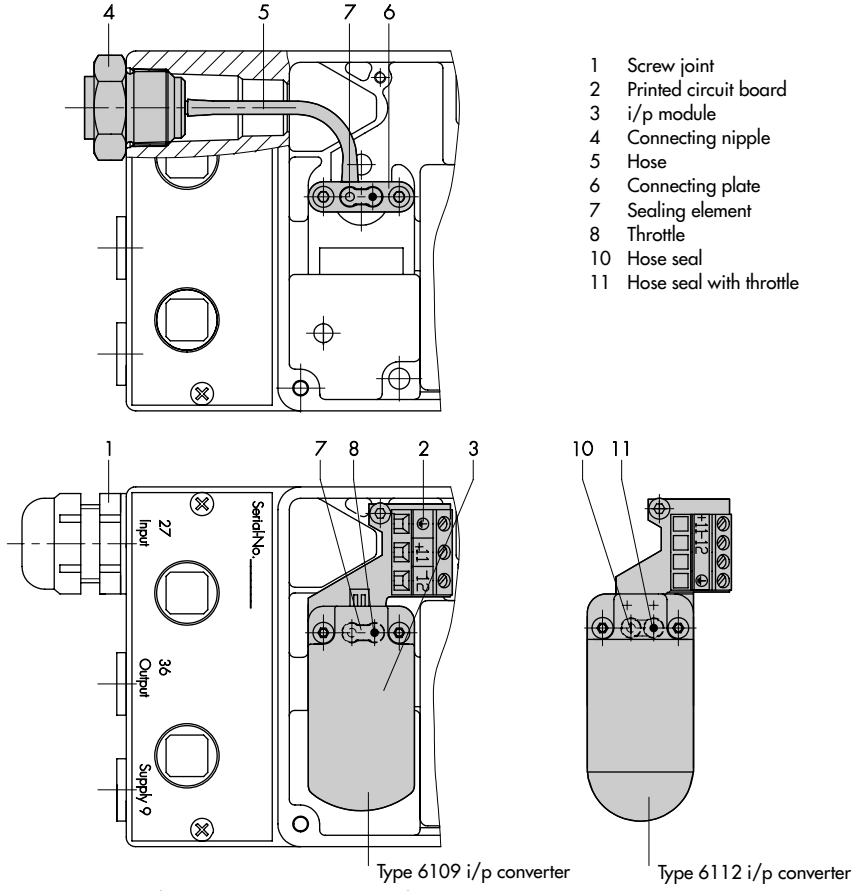
1. Loosen the connecting plate (6) and remove along with sealing element (7). Pull off the hose (5).
2. Twist the connecting nipple (4) from the case.

Type 6109 i/p converter module:

3. Push the i/p module over the plug connection onto the printed circuit board.
4. Insert the sealing element (7), on the bottom side, in the opening of the printed circuit board such that the throttle and the sieve (8) are situated on the right side above the innermost of the two case holes (supply air) when the module (dashed line in Fig. 14) is installed.
5. Secure the module and the printed circuit board in the case (two screws for the module, one screw for the printed circuit board). Subsequently assemble the cable gland (1) along with the sealing ring.

Type 6112 i/p converter module:

3. Place the i/p module on the plug of the printed circuit board, and tighten the lateral terminal screws.
4. Check whether the hose seals (10,11) are properly inserted on the bottom side. When the module (dashed line in Fig. 14) is installed, the seal with throttle and sieve must be situated on the right side above the innermost of the two case holes (supply air) .
5. Secure the module and the printed circuit board in the case (two screws for the module , one screw for the printed circuit board): Subsequently assemble the cable gland (1) along with the sealing ring.



1 Screw joint
2 Printed circuit board
3 i/p module
4 Connecting nipple
5 Hose
6 Connecting plate
7 Sealing element
8 Throttle
10 Hose seal
11 Hose seal with throttle

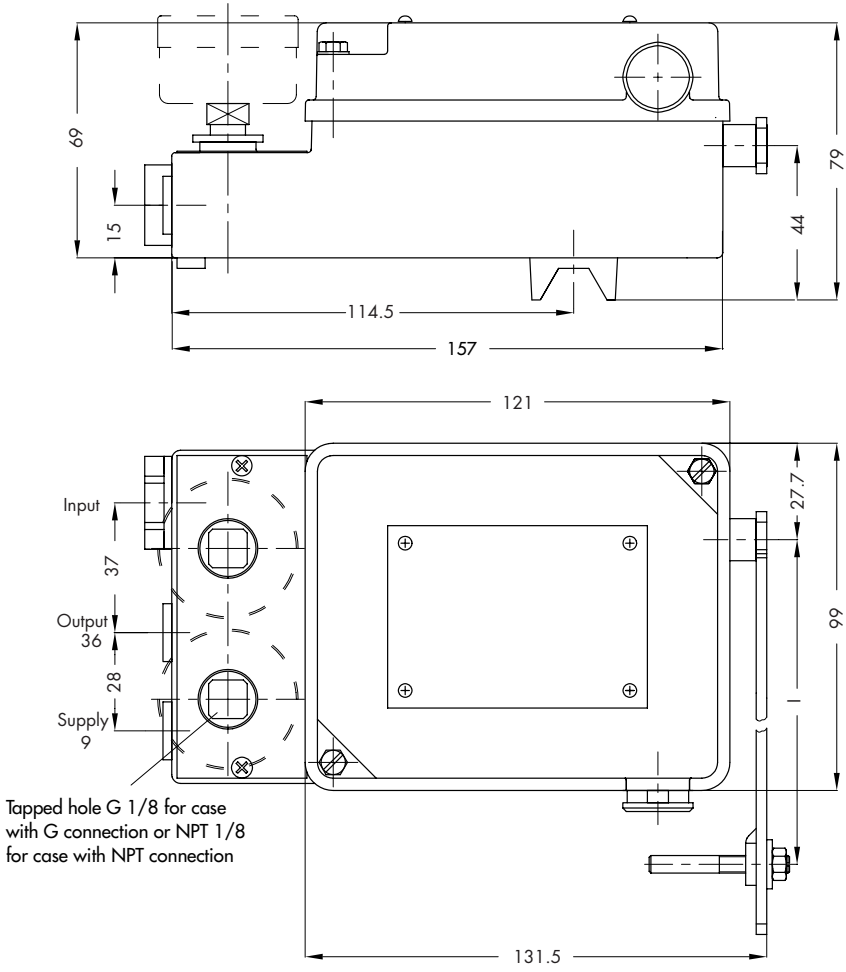
Fig. 14 · Converting the pneumatic positioner to an electropneumatic positioner

6. Tables for accessories, attachment parts and conversion kit

Table 2	
Accessories - attachment parts	Order no.
Measuring spring 1 Measuring spring 2 Measuring spring 3 Lever I Extended lever Pressure gauge attachment up to device Index .02 Pressure gauge attachment device Index .03 and higher Pressure gauge attachment, copper free up to device Index .02 Pressure gauge attachment, copper free device Index .03 and higher	1190-0736 1190-0737 1190-0738 1690-6469 1400-6716 1400-6718 1400-6950 1400-6719 1400-6951
Attachment kit for NAMUR-rib yokes Rod-type yokes according to NAMUR for pillar diameters 18 to 35 mm	1400-5745 1400-5745 and 1400-5342
Spare part kit with seals and diaphragms	1400-6792
Conversion kit for conversion to degree of protection IP 65 (for more details, see Samsomatic specifications Z 900-7 EN)	1790-7408

Table 3		
Required input signal (reference variable)	Required i/p converter Type (Order no.)	Additional coversion kit (Type Index .03 and higher) Order no.
4 to 20 mA 0 to 20 mA 1 to 5 mA	6109-0010 6112-002110 6112-003110	1400-6797 1400-6798 1400-6798

7. Dimensions in mm



Usable lever length l: 40 to 127 mm (with extended lever 40 to 200 mm)
Pneumatic connections: ISO-228/1-G1/4 or 1/4-18 NPT

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