

# Pneumatic Positioner Type 4765



Fig. 1 · Type 4765 Positioner

## Mounting and Operating Instructions

**EB 8359-1 EN**

Edition April 2008



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### General safety instructions



- ▶ *The positioner is to be mounted, started up or operated only by trained and experienced personnel familiar with the product.  
According to these Mounting and Operating Instructions, trained personnel refers to individuals 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 applicable standards.*
  - ▶ *Any hazards that could be caused by the process medium, the operating pressure, the signal pressure or by moving parts of the control valve are to be prevented by means of the appropriate measures.*
  - ▶ *If inadmissible motions or forces are produced in the pneumatic actuator as a result of the supply pressure, the supply pressure must be restricted by a suitable supply pressure reducing station.*
  - ▶ *Proper shipping and appropriate storage are assumed.*
-

## Versions

Pneumatic Positioner	Type 4765-	0	1	x	0	0	x	1	x	x	x	x	0
Range spring													
Range spring 1, travel = 15 mm				1									
Range spring 2, travel = 30 mm, split-range 15 mm				2									
Range spring 3, travel = 60 mm, split-range 30 mm				3									
Pneumatic connections													
ISO 228/1 G ¼								1					
¼-18 NPT								3					
Temperature range													
Standard									0				
Low temperature down to -50 °C									1				
Special version													
None										0	0	0	
For oxygen as the operating medium										0	0	1	

<b>Type 4765 Positioner</b>		
Travel range	7.5 to 60 mm, with 90 mm lever extension	
Reference variable	0.2 to 1 bar	
Split-range 0 to 50 % and 50 to 100 % (up to 50 mm travel)	0.2 to 0.6 bar and 0.6 to 1 bar	
Range spring	See table on page 13	
Supply air	1.4 to 6 bar (20 to 90 psi)	
Output signal pressure $p_{st}$	Max. 0 to 6 bar (0 to 90 psi)	
Characteristic	Linear · Deviation from terminal-based conformity: $\leq 1.5\%$	
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 or 2 1 to 1.5% with spring 3	
Air consumption in steady state, $X_p = 1\%$	With 1.4 bar supply air: 0.13 $m_n^3/h$	With 6 bar supply air: 0.33 $m_n^3/h$
Air output capacity	At $\Delta p$ 1.4 bar: 3.0 $m_n^3/h$	At $\Delta p$ 6 bar: 8.5 $m_n^3/h$
Transit time for Type 3271 Actuator "Stem extends"	240 $cm^2$ : $\leq 1.8\ s$ · 350 $cm^2$ : $\leq 2.5\ s$ · 700 $cm^2$ : $\leq 10\ s$	
Permissible ambient temperature	-20 to +80 °C · Extended temperature range on request	
Influences	Temperature $< 0.02\%/1\ K$ Supply air $< 0.2\%/0.1\ bar$ Effect when turned by 180°: $< 3.5\%$	
Degree of protection	IP 54 · Special version IP 65	
Weight	Approx. 1.1 kg	
Materials	Housing: Die-cast aluminum, chromated and plastic-coated External parts: Stainless steel	

## 1 Design and principle of operation

The pneumatic positioner is used for the correlation between the valve stem position (controlled variable  $x$ ) and the input signal (reference variable  $w$ ).

In this case, the input signal issued by a controller is compared to the travel (valve stem position) of the control valve, and a pneumatic signal pressure (output variable  $y$ ) is delivered.

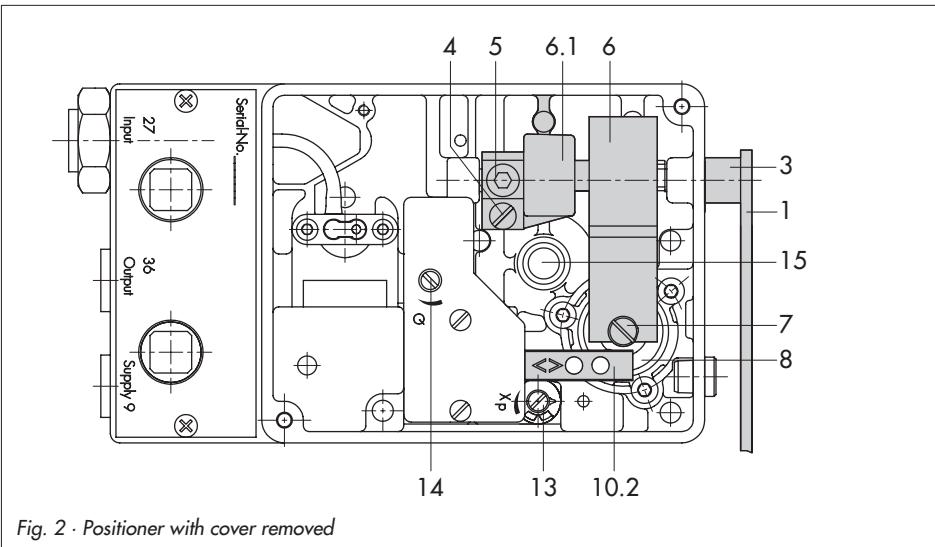
The positioner consists of a lever with attached shaft and range spring, diaphragm and the pneumatic control system comprising nozzle, flapper plate and booster.

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 range spring (6) by the plate (20). This action twists the range spring and varies the torsional force.

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

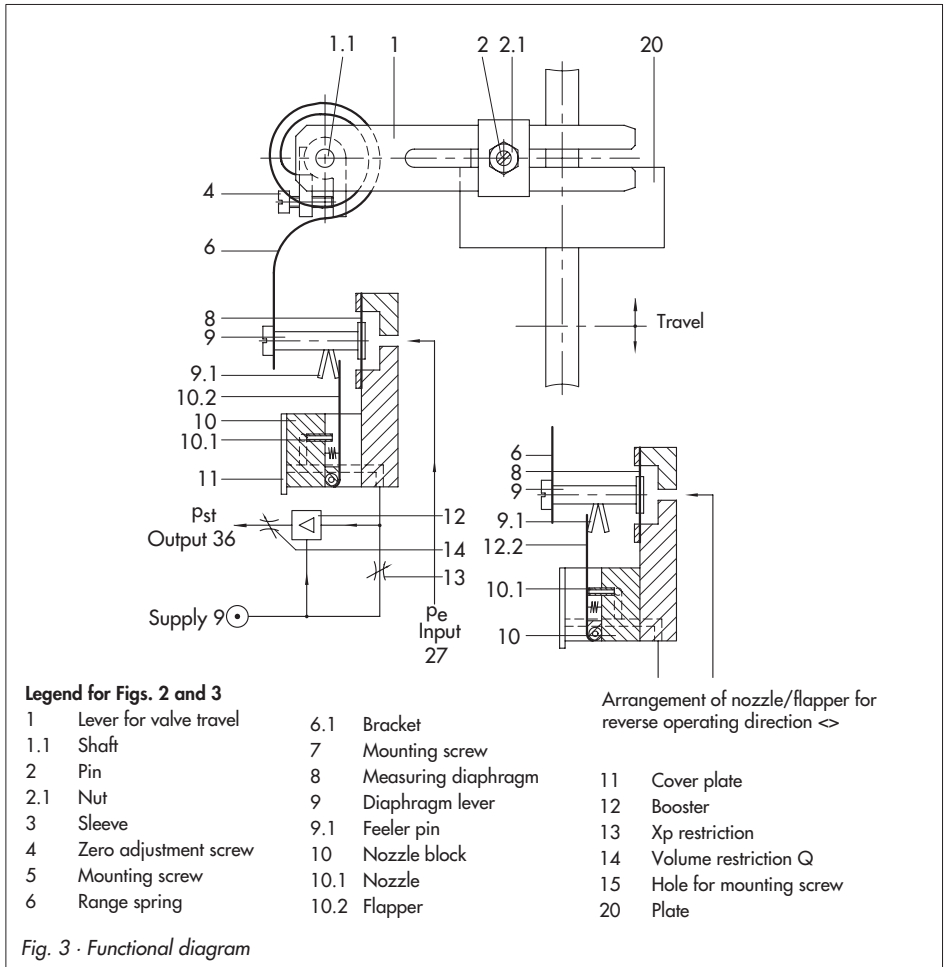
Supply air is supplied to the pneumatic booster (12) and flows through the  $X_p$  restriction (13) and the nozzle (10.1) until it hits the flapper plate (10.2).



Any changes of the input signal  $p_e$  or the valve stem position cause the pressure upstream and downstream of the booster to change. The air released by the booster (signal pressure  $p_{st}$ ) flows to the pneumatic actuator over the volume restriction (14), causing

ing the plug stem to take on a position corresponding to the reference input variable.

The adjustable tuning restrictions (13 and 14) are used to optimize the control loop. The range spring (6) corresponds to the rated valve travel and the nominal reference input span. It can be exchanged.



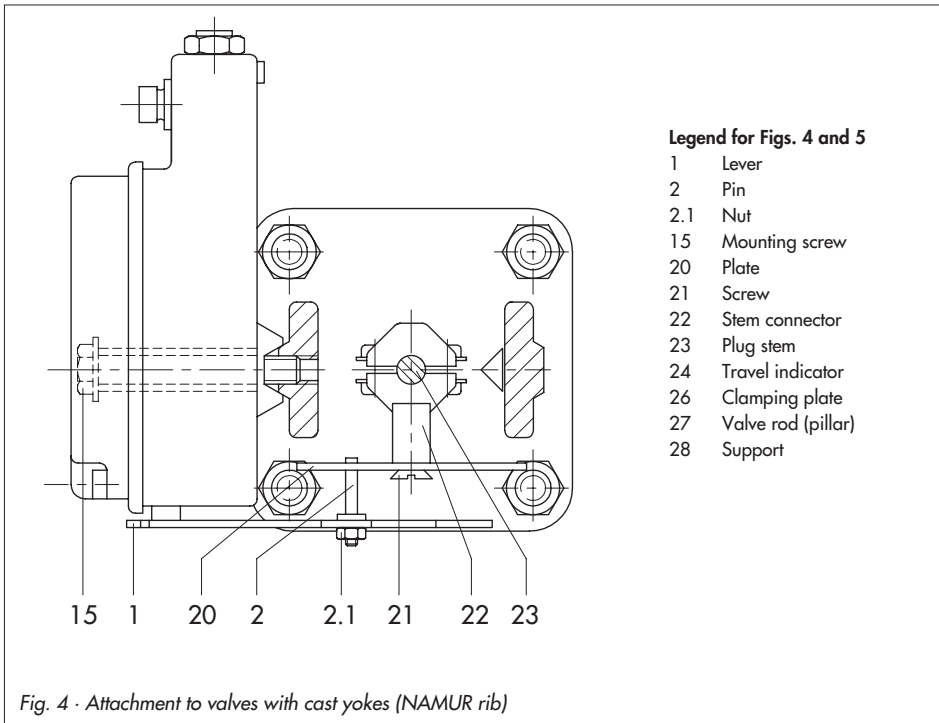
## 2 Attachment

To attach the positioner to valves with cast yokes, mounting parts (order no. 1400-5745) are used. For valves with rod-type yokes (pillars), the mounting kit (order no. 1400-5745) and additionally the mounting kit (order no. 1400-5342) are necessary (see also Table 2 on page 19).

Since the positioner can be attached on either side of the valve, the physical location (left or right attachment) should be determined before actual attachment (see corresponding Figs. 6 to 9 in section 4.1).

### 2.1 Attachment to valves with cast yokes

1. Fasten the plate (20) to the stem connector clamps (22) of the valve using the screws (21).
2. Unscrew the positioner cover, and secure the device to the valve yoke using the mounting screw (15). The O-ring included in the mounting kit is not required for this device. Make sure that the pin (2) is routed inside the wire strap and therefore clamped against the plate (20).



## 2.2 Attachment to valves with rod-type yokes

1. Screw the plate (20), off-centered, to the travel indicator (24) of the plug stem (23) using the screws (21).
2. Place both the support (28) and the clamping plate (26) on the rod (27) and lightly fasten. Move the support until both the center of the plate (20) and the support (28) are aligned at half the valve travel.
3. Screw tight the support and clamping plate.

4. Mount the positioner to the support using the mounting screw (15). Make sure that the pin (2) is led inside the wire strap and therefore clamped against the plate (20).

## 2.3 Cover of the positioner housing

After attaching the positioner, make sure that the vent plug on the cover of the positioner housing points downwards after the valve has been installed.

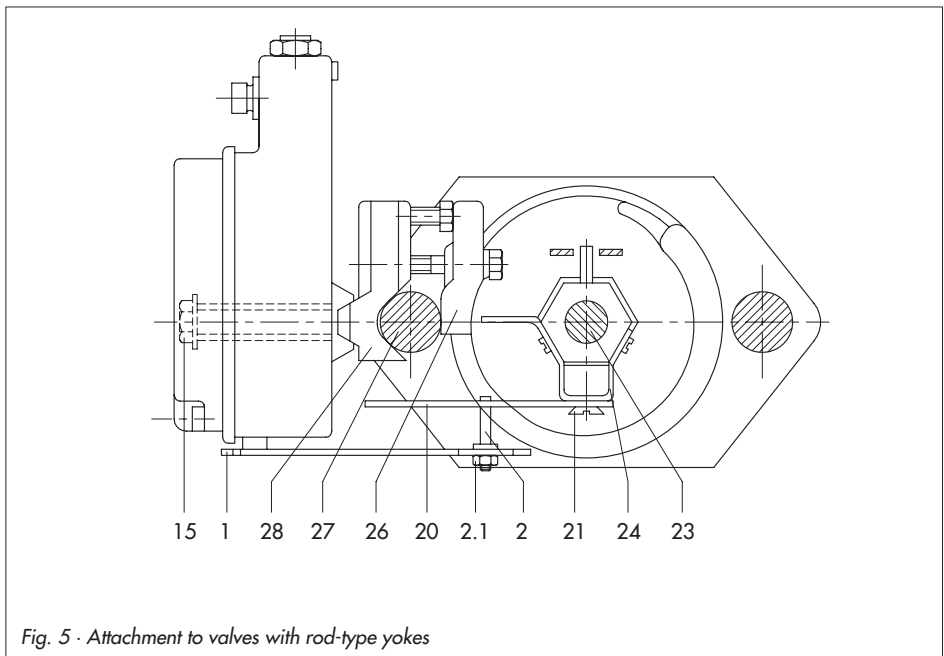


Fig. 5 · Attachment to valves with rod-type yokes

## 3 Connections

### 3.1 Pneumatic connections

The pneumatic connections are designed as tapped holes with ¼ NPT or ISO 2228/1-G ¼ thread. The conventional male connections for metal and copper pipes (or plastic hoses) can be used.

#### Note:

*The supply air must be dry and free of any oil and dust. Always observe the maintenance instructions applicable to the connected pressure reducing stations. Blow out air lines thoroughly before connecting them.*

#### 3.1.1 Pressure gauges

We recommend attaching pressure gauges for the supply air and signal pressure in order to monitor the positioner. The parts are listed as accessories in Table 2 on page 19.

#### 3.1.2 Supply pressure

The required supply pressure is determined by the bench range and the operating direction (fail-safe action) of the actuator.

The bench range is written on the nameplate as spring range or signal pressure range depending on the type of actuator. **FA** (actuator stem extends) or **FE** (actuator stem retracts) or a symbol indicates the operating direction.

#### Actuator stem extends (FA)

Fail-safe position Valve CLOSED  
(for globe and angle valves)

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

#### Actuator stem retracts (FE)

Fail-safe position Valve OPEN  
(for globe and angle valves)

The required supply pressure for a tight-closing valve is roughly estimated from the maximum signal pressure  $p_{st_{max}}$ :

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

$d$  = Seat diameter [cm]

$\Delta p$  = Differential pressure across valve [bar]

$A$  = Actuator diaphragm area [cm<sup>2</sup>]

$F$  = Upper bench range of actuator [bar]

**In the absence of such specifications, proceed as follows:**

Required supply pressure =  
Upper bench range value + 1 bar

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

## 4 Operation

### 4.1 Combining positioner and actuator

The arrangement of the actuator, input signal, operating direction and mounting location is schematically represented in Figs. 6 to 9.

Each subsequent change such as reversal of the operating direction or field reversing the actuator version from direct "Actuator stem extends" to reverse "Actuator stem retracts" or vice versa also involves changing the mounting location of the positioner.

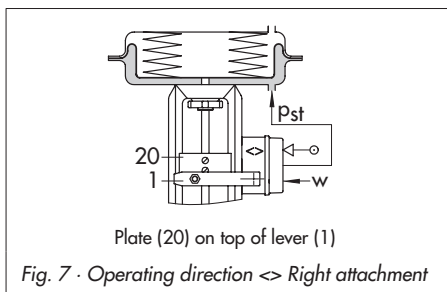
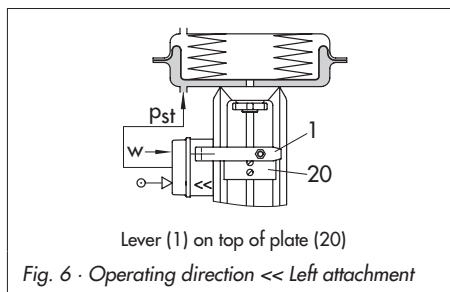
#### 4.1.1 Determining/reversing the operating direction

When the input signal (reference variable  $w$ ) increases, the signal pressure  $p_{st}$  can either be increasing (direct operating direction  $\ll$ ) or decreasing (reverse operating direction  $\gg$ ).

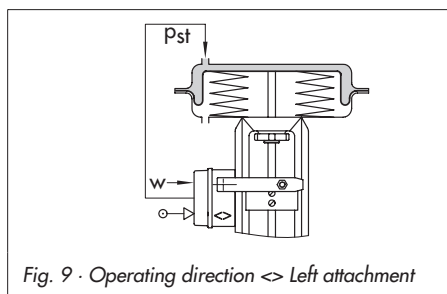
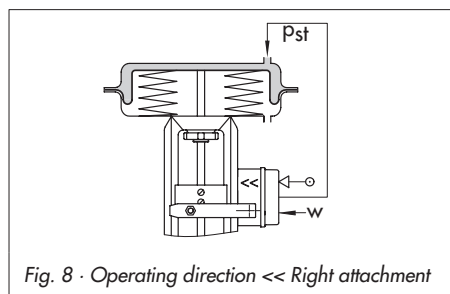
The same applies to a decreasing input signal; the output pressure either decreases (direct operating direction  $\ll$ ) or increases (reverse operating direction  $\gg$ ).

Symbols are located on the flapper plate (10.2) which identify the respective operating directions (direct  $\ll$  or reverse  $\gg$ ).

#### Actuator: Stem extends (FA)



#### Actuator: Stem retracts (FE)



If the operating direction of the required function does not match the symbol or if the operating direction is to be changed, proceed as follows:

1. Remove both screws of the cover plate, and lift off the nozzle block (10) along with the cover plate.
2. Reinstall the nozzle block turned 180° together with the cover plate and fasten.

Make sure that the nozzle block and flapper are correctly located above or below the feeler pin (9.1) as shown in Fig. 10.

If the operating direction is to be changed after the initially determined arrangement of positioner and actuator, note that the positioner must be mounted in a different location and the nozzle block must be turned.

Always consider the location of the lever (1) and the plate (20), "lever on top of plate" or reversed "plate on top of lever" as shown in Figs. 6 to 9.

## 4.2 Starting point and input signal (reference variable)

The attached lever and the installed range spring of the positioner correspond to the rated valve travel and the reference variable (input signal) according to Table 1.

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.

This span can be changed by subsequently replacing the range spring (see section 4.4). On adjusting the positioner, the travel must be adjusted to the reference variable and vice versa.

With a reference input span from 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.

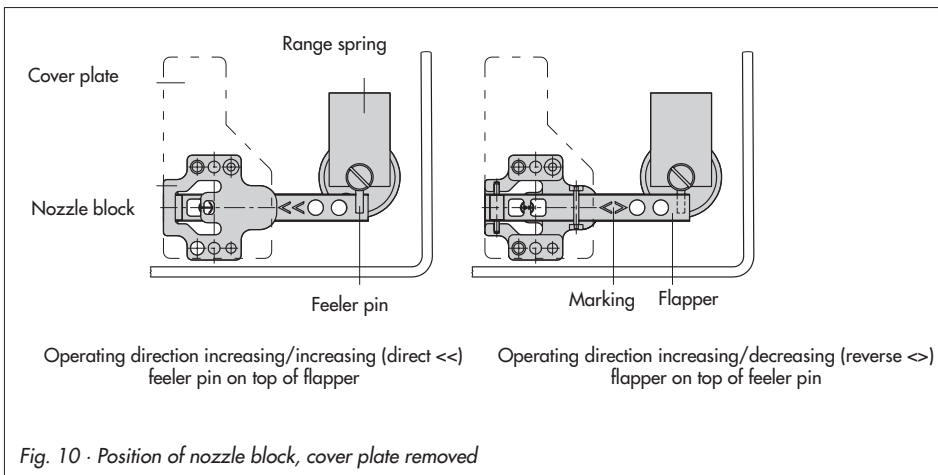


Fig. 10 · Position of nozzle block, cover plate removed

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 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  $\pm 0.05$  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 by the pin (2).

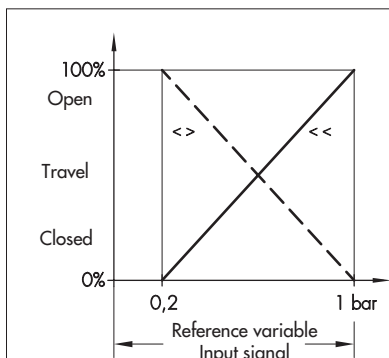


Fig. 11 · Standard operation

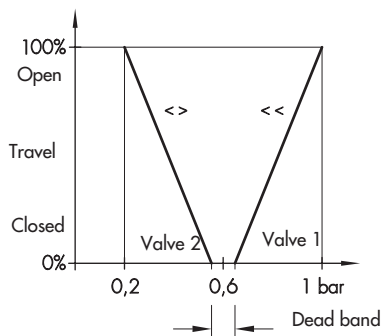


Fig. 12 · Split-range operation, two valves operating in opposite directions

Table 1

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

### 4.3 Setting the positioner at 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 the supply air to the supply input (supply 9).

#### 4.3.1 Setting the air delivery (volume restriction Q) and proportional band XP

1. Close the volume restriction (14) as far as the required speed of response allows.  
You can check the speed of response by pressing the range spring (6) as far as it will go.
2. Set the input signal to approximately 50 % of its range. Then, turn the zero

adjustment screw (4) until the valve is at approximately 50 % valve travel.

On setting the Xp restriction, observe the relationship with the supply air pressure as indicated in Fig. 13. The preset value of Xp should read approximately 3 %.

3. Check the plug stem's tendency to oscillation by pressing the range spring (6) briefly as far as it will go.  
Xp should be set to a value as small as possible, however, without causing noticeable overshoot.

**Note:**

*Always determine the Xp setting prior to adjusting the starting point. Subsequent modification displaces the zero point!  
The zero can also be shifted by altering the adjusted supply air pressure.  
If necessary, check the zero adjustment under operating conditions of the plant and, readjust, if need be.*

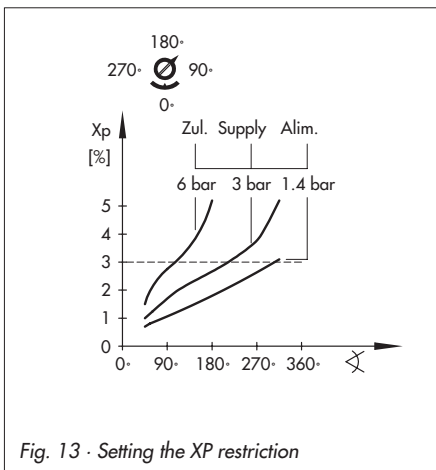


Fig. 13 · Setting the XP restriction

### 4.3.2 Setting actuator version "Stem extends"

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**Note:**

To ensure that the total closing force of the actuator can be effective in the control valve, the diaphragm chamber must be completely vented at the lower range value of the reference variable (operating direction <<) and at the upper range value (operating direction <>).

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.

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

1. Turn the zero adjustment screw (4) until the plug stem just begins to move from the resting position (observe plug stem with travel indicator).
2. Reduce the input signal on the ammeter and increase again slowly. Check whether the plug stem starts moving at a starting point of 0.23 bar and, if necessary, correct.

**Upper range value (span)** e.g. 1 bar

3. After the starting point has been adjusted, increase the input signal. The plug stem must be motionless at an upper range value of exactly 1 bar and therefore already moved through 100 % of its travel range (watch the travel indicator at the valve!). If the upper range value is incorrect, the pin (2) must be moved as follows in order to correct the signal:

4. Move pin to:
  - End of lever → to increase travel
  - Pivot → to reduce travel

If the span is corrected, the zero must be recalibrated. Afterwards, the span must also be checked.

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 Setting actuator version "Stem retracts"

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**Note:**

For actuators with "Actuator stem retracts", 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.

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The required signal pressure is indicated on the adhesive label on the positioner or is roughly estimated as in section 3.1.2.

**Starting point (zero)** 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). Turn it counterclockwise to move the control valve earlier from its final position and clockwise to move it later.

### Upper range value (span) e.g. 1 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).
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 Exchanging the range spring

If the range is to be altered or changed to split-range operation, replace the range spring as shown in Fig. 3 as follows:

1. Remove screw (7) on the range spring. Pull out hexagon socket screw (5) and the lever together with shaft.
2. Exchange range spring. Slide lever with shaft through sleeve (3), positioner housing and bracket (6.1).
3. Secure range spring with the screw (7).
4. Move bracket and shaft until the screw (5) sits on the flattened part of the shaft. Tighten screw (5). Allow for a play from 0.05 to 0.15 mm between the lever (1) and the sleeve (3) as well as between the range spring (6) and the positioner housing.

## 5 Converting a 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 converter module (see Table 3), which contains the printed circuit boards, the cable gland and the mounting screws.

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

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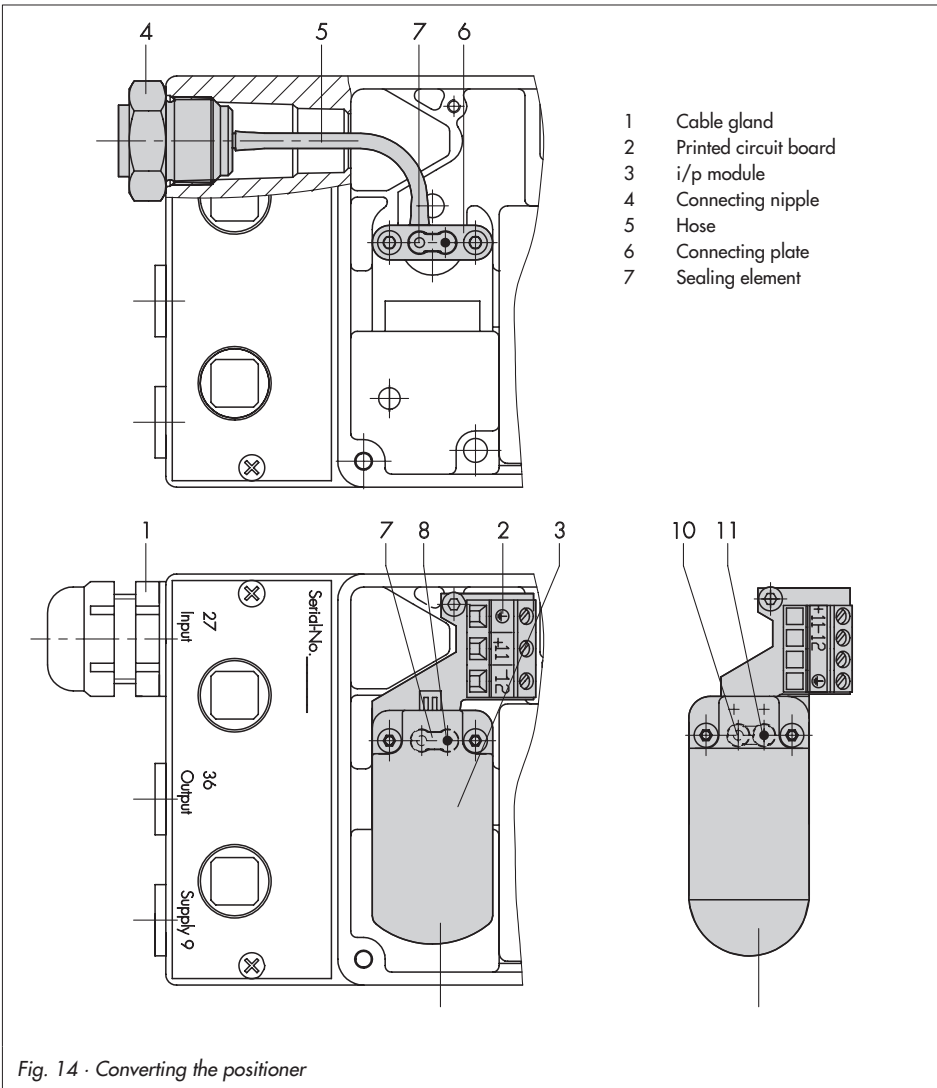
1. Undo the connecting plate (6) and remove along with sealing element (7). Pull off the hose (5).
2. Twist the connecting nipple (4) from the housing.

### 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, in the opening of the printed circuit board so that the restriction and the filter (8) are situated on the right side above the innermost of the two housing holes (supply air) when the module (dashed line in Fig. 14) is installed.
5. Secure the module and the printed circuit board in the housing (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 side 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 housing holes (supply air).
5. Secure the module and the printed circuit board in the housing (two screws for the module, one screw for the printed circuit board): Subsequently assemble the cable gland (1) along with the sealing ring.

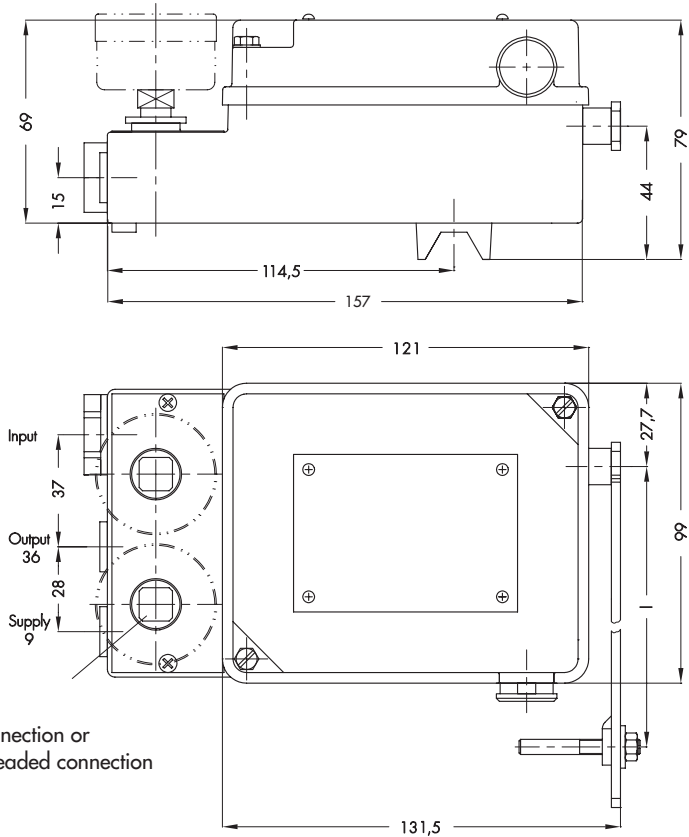


## 6 Accessories, mounting parts and conversion kits

<b>Table 2</b>	
<b>Accessories – Mounting parts</b>	<b>Order number</b>
Range spring 1	1190-0736
Range spring 2	1190-0737
Range spring 3	1190-0738
Lever I	1690-6469
Lever extension	1400-6716
Pressure gauge attachment	1400-6950
Pressure gauge attachment, free of copper	1400-6951
Mounting kit for valves with cast yoke acc. to NAMUR	1400-5745
Mounting kit for valves with rod-type yokes acc. to NAMUR for 18 to 35 mm rod diameters	1400-5745 and 1400-5342
Spare parts assortment with seals and diaphragms	1400-6792
Spare parts assortment with seals, diaphragms and pneumatic components (for model index .02 or higher)	1042-0040
Conversion kit to upgrade to degree of protection IP 65 (refer to SAMSOMATIC print Z 900-7 for more details)	1790-7408

<b>Table 3</b>		
<b>Required input signal (reference variable)</b>	<b>Required i/p module (order no.)</b>	<b>Additional conversion kit (index .03 or higher) Order no.</b>
4 to 20 mA	6109-0010	1400-6797
0 to 20 mA	6112-002110	1400-6798
1 to 5 mA	6112-003110	1400-6798

## 7 Dimensions in mm



Useable lever length l: 40 to 127 mm (with 40 to 200 mm lever extension)

Pneum. connection: ISO-228/1-G  $\frac{1}{4}$  or  $\frac{1}{4}$ -18 NPT









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