

# EP 2300/EP 2400

## Electro-pneumatic Positioner

### INSTALLATION INSTRUCTIONS

#### CAUTION

The installation of explosion proof electrical equipment must comply to the procedures contained in the certificates of conformance. Country specific regulations may apply. The electrical safety is determined only by the supplying device (Positioner operation with limited voltage only).

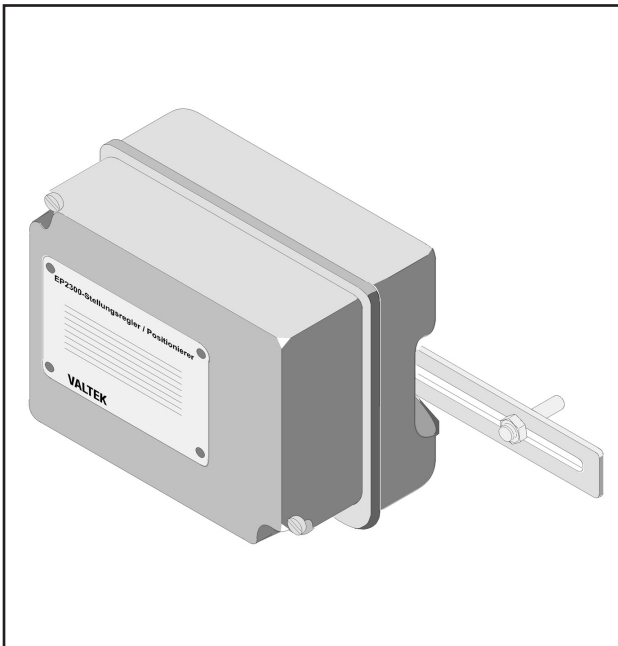


Fig. 1: Electro-pneumatic Positioner

### GENERAL

The electro-pneumatic positioner EP2300/EP2400 of Valtek interfaces electronic control to pneumatic actuators and provides accurate control for the stroke of pneumatic actuators. They are easy to adapt and improve the performance of the control loop with optimized dynamic behaviour.

The EP2300/EP2400 series is the first electro-pneumatic positioner which uses piezoelectric microvalve with low power consumption allowing connection via two existing wire connections. No extra power supply is needed. The easy stroke feedback lever makes the units very compact and robust for industrial applications.

The EP2300 series is suitable for intrinsically safe circuits in hazardous locations. The EP2400 series has the same performance, but without intrinsic safety.

### FEATURES

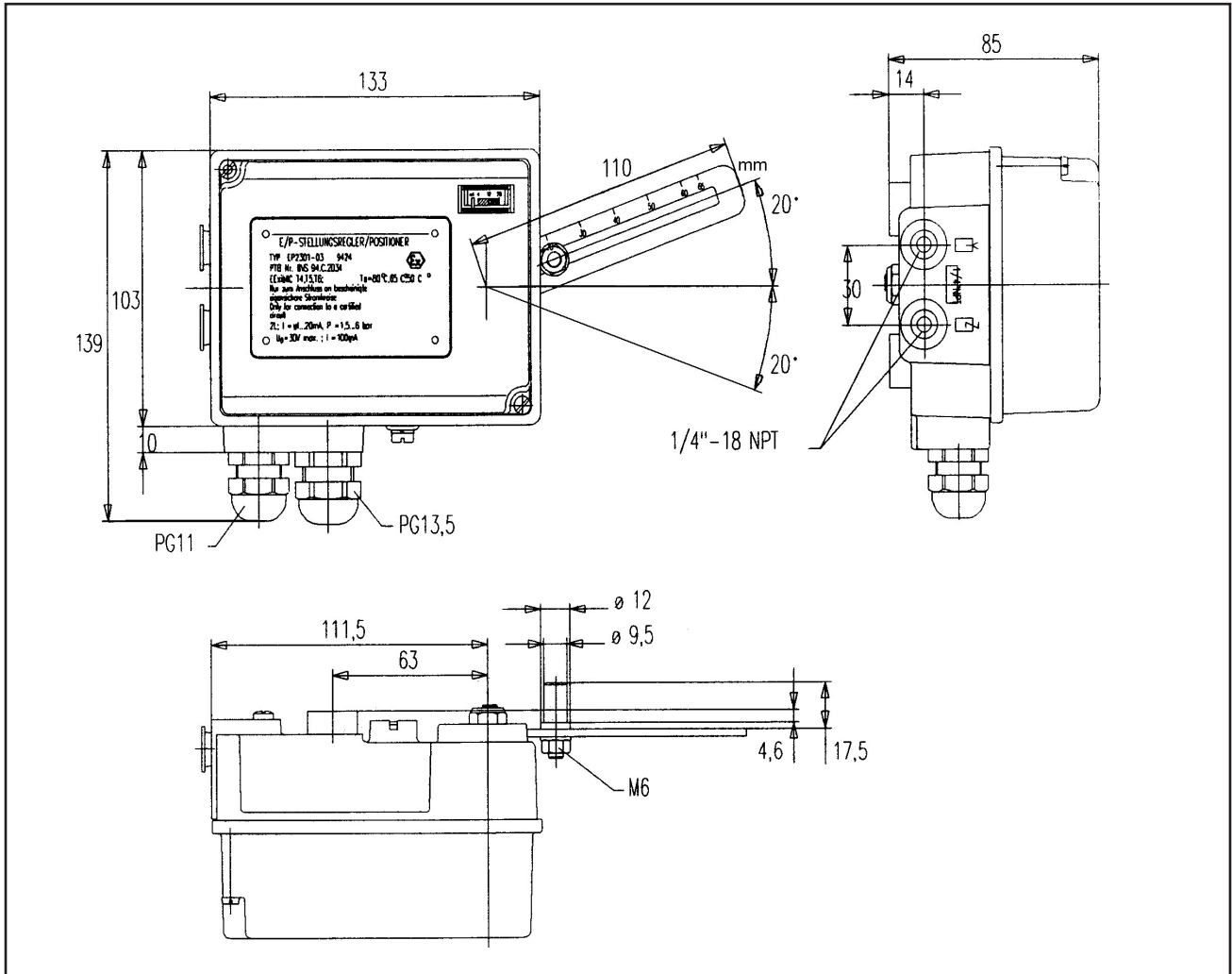
- Accurate control performance and high dynamic behaviour with PI control characteristics
- Robust modular design
- Pressure regulator eliminates variations in supply air pressure
- Innovative, reliable transducer technology (piezo electric microvalve)
- Simple start-up with switch selectable configuration
  - input signal: direct or reverse
  - actuator type: direct or reverse
  - split range start: 4 mA or 12 mA
- High resistance against shock and vibration
- Two wire system for signal and power supply line
- Good serviceability due to modular design
- Available Options:
  - limit switches
  - milliammeter (input signal display)
  - stroke feedback loop (4...20 mA)
- Universal mounting kit according to NAMUR specifications.

### CONTENTS

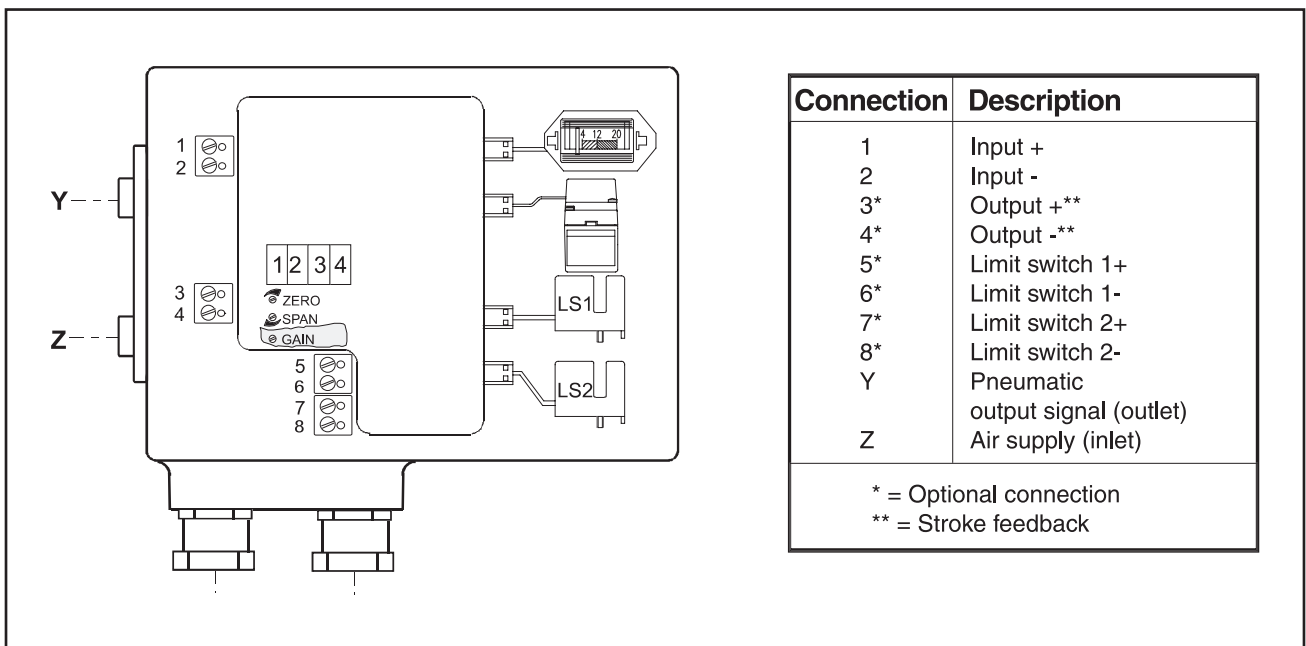
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## TECHNICAL DATA

	Specification	EP2300 series	EP2400 series
1. Input signal	input signal range	4...20 mA	
	input signal range for split range application	4...12 or 12...20 mA	
	equivalent electrical load	675 $\Omega$ max.	375 $\Omega$ max.
		at 20 mA input current	
	voltage supply min.	13.5 Vdc	7.5 Vdc
	voltage supply max.	30 Vdc	
	current supply min.	3.6 mA	
	current supply max.	100 mA	
	input capacitance	$\leq 32$ nF	
input inductance	$\leq 200$ $\mu$ H		
2. Valve stroke	stroke	6...65 mm (option: 10...100 mm)	
	characteristic	linear	
	conversion factor	0.4...8.6 mm/mA	
3. Auxiliary power	media characteristics	pressurized air or allowed gas, free of oil and dust according to IEC 770	
	oil contents	$\leq 1$ ppm	
	dust particles	$\leq 3$ mm	
	input pressure range	1.5...6.0 bar	
	air consumption	0.08 m <sup>3</sup> /h at 1.5 bar input pressure 0.12 m <sup>3</sup> /h at 6.0 bar input pressure	
	supply pressure effect	< 0.07 % per 1.0 bar supply air pressure	
4. Output	output pressure range	0...100 % of supply air pressure	
	flow capacity	2.4 m <sup>3</sup> /h at 1.5 bar input pressure 7.0 m <sup>3</sup> /h at 6.0 bar input pressure	
5. Control characteristics	proportional gain	K = 20...110	
	linearity	< 1.0 %	
	hysteresis	< 0.5 %	
	input sensitivity	< 0.05 %	
	repeatability	< 0.1 %	
	start-up drift	< 0.5 %	
	cut-off frequency	> 1 Hz at 1 dm <sup>3</sup>	
	vibration sensitivity	< 1 % at 1g (0.5...300 Hz) acc. to IEC 65B section 133 (draft)	
	ambient temperature sensitivity	< 0.3 % / 10 <sup>o</sup> K	
6. Environmental conditions	operating temperature	-20 <sup>o</sup> C...+80 <sup>o</sup> C) (option: -40 <sup>o</sup> C...+80 <sup>o</sup> C)	
	transport and storage temperature	-40 <sup>o</sup> C...+80 <sup>o</sup> C	
	operating humidity	5...95 % rh	
	application class	HTD acc. to DIN 40040	
	protection standard	IP 65 acc. to EN 60529	
	intrinsic safety	EEx ib II C T4/T5/T6; Tu=80/65/50 <sup>o</sup> C acc. to EN 50014 and EN 50020	no
	declaration of conformity	BVS 94.C.2034	no
	electromagnetic compatibility	10 V/m (27...500 MHz) acc. to IEC 801-2,3-4 EN 50082-2	
	RF immunity	acc. to EN 50081-2	
	electrical isolation	protect. class III (500 V) acc. to EN60730-1	
	mounting position sensitivity	< 0.2 %	



**Fig. 2: Dimensions**



**Fig. 3: Connections**

# MODEL SELECTION

Select the product version by using the following tables :

**EP2300 series**      **Version with Explosion Protection (intrinsic safety EEx ib II C T4/T5/T6; Tu=80/65/50°C):**

Model Selection Guide		EP23xx-xx	
0 = without stroke feedback loop 4...20 mA 1 = with stroke feedback loop 4...20 mA	}	_____	
2 = feedback lever type -20°C 3 = feedback lever type -40°C 4 = rotary type (90°∠) -20°C 5 = rotary type (90°∠) -40°C			
0 = without mA meter 1 = with mA meter			
0 = without limit switch 1 = with limit switch			

Table 1 Model Selection EP2300

**EP2400 series**      **Low-Voltage-Version (no intrinsic safety):**

Model Selection Guide		EP24xx-xx	
0 = without stroke feedback loop 4...20 mA 1 = with stroke feedback loop 4...20 mA	}	_____	
2 = feedback lever type -20°C 3 = feedback lever type -40°C 4 = rotary type (90°∠) -20°C 5 = rotary type (90°∠) -40°C			
0 = without mA meter 1 = with mA meter			
0 = without limit switch 1 = with limit switch			

Table 2 Model Selection EP2400

- |                       |  |              |
|-----------------------|--|--------------|
| Optional accessories: | 1. Volume booster 61H (1/4" NPT):                  | H 996313 100 |
|                       | 2. NAMUR mounting kit:                             | H 192685 001 |
|                       | 3. Pressure gauge assembly kit in brass:           | H 179379 013 |
|                       | 4. Pressure gauge assembly kit in stainless steel: | H 179379 015 |
|                       | 5. Feedback lever for 10...100 mm stroke:          | H 194512 002 |

## Shipping Weights

	Specification	EP2300 series	EP2400 series
Shipping weights (including universal mounting kit)	with pressure gauge	1.60 kg	1.60 kg
	without pressure gauge	1.10 kg	1.10 kg

## PRINCIPLE OF OPERATION

The positioner operates with the principle of electrical balance and uses an electro-pneumatic converter with piezo-electric effect.

The positioner consists of 3 main components (refer to Fig 4):

- Electro-pneumatic converter with pressure regulator, piezo-element and pneumatic amplifier
- Electronic control unit
- Feedback with potentiometer and stroke feedback lever.

The stroke of the air-operated actuator is monitored by the feedback lever and transmitted into a proportional voltage signal.

This signal will be compared to the input signal by the electronic control unit. The output of the electronic control unit supplies the electro-pneumatic converter with a voltage of 3 to 18 Vdc.

The electro-pneumatic converter is based on the piezo-electric effect which is the elastic deformation of a piezo-electric material proportionally to the voltage applied to it.

The deformation of the piezo-electric strip between two nozzels in the piezo-element results in a pneumatic output signal  $P_k$ , proportional to the voltage applied by the signal amplifier.

The supply air pressure to the piezo-element has to be constant. Therefore a small pressure regulator is installed in the air supply line of the piezo-element. The pressure regulator eliminates influences of air supply pressure variations into the control loop.

The pneumatic output signal  $P_k$  is applied to the pneumatic amplifier which provides the output air signal to the actuator. The actuator is connected via a linkage to a feedback potentiometer within the positioner. When the feedback signal equals the input signal the actuator has reached the required position.

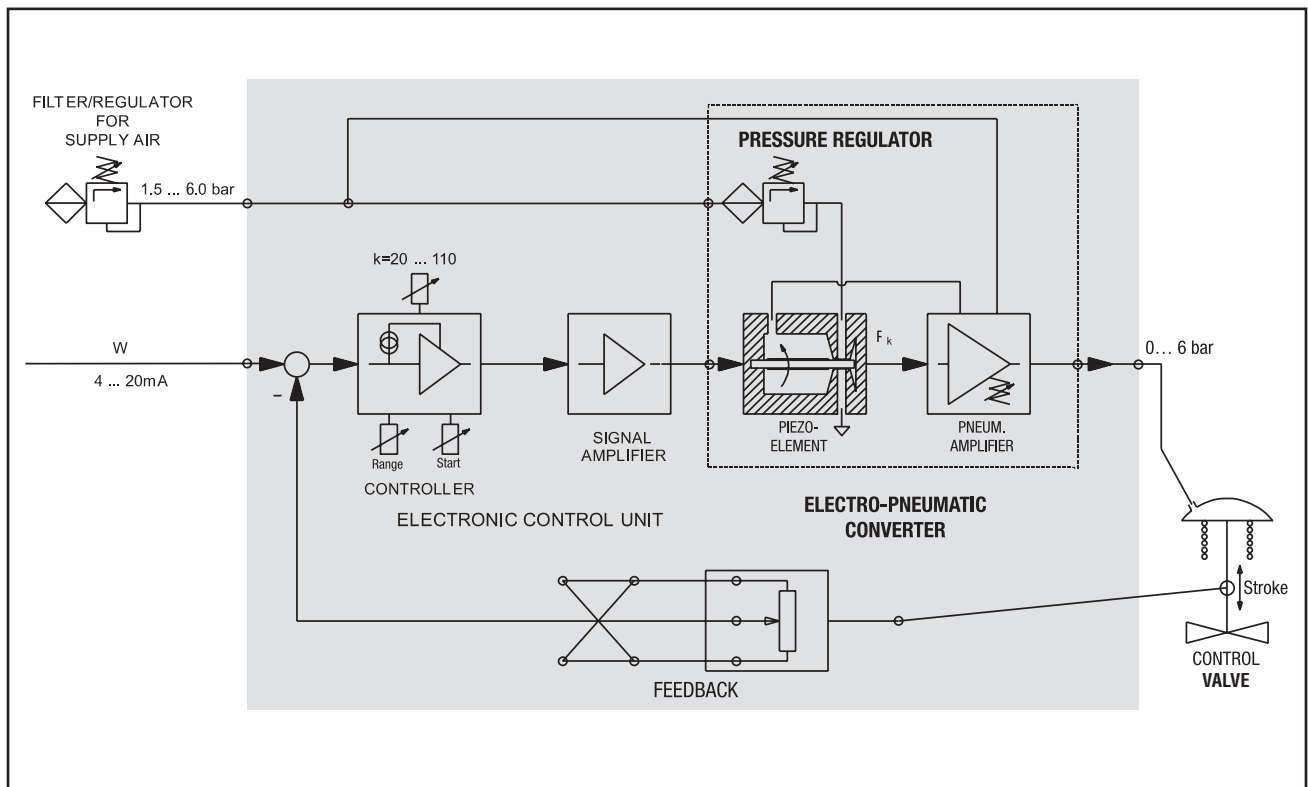


Fig. 4: Principle of Operation

## INSTALLATION

### Mounting

Before starting installation, inspect the electro-pneumatic positioner for any transit damages.

The positioner EP2300/EP2400 is installed with a mounting kit (according to NAMUR specification) to the left hand actuator support rod. Generally the unit can be installed in any mounting position. The stroke feedback is realised by a feedback lever (Fig. 8) and clamping devices (Fig. 5, pos. 7, 8 and 11). In the packing, the feedback lever is detached from the positioner, in order to save space. A feedback lever for 100 mm stroke must be ordered separately.

The mounting of rod actuators (according to NAMUR) is described in Figure 5.

For the two mounting possibilities of cast yoke actuators (according to NAMUR, IEC 534 part 6) refer to Figure 7. After installation check that all screw connections are tightened correctly and all moving parts are free from excessive friction.

### Mounting of the electro-pneumatic Positioner on a Pneumatic Actuator, direct acting (closed by pressure, see Fig. 6)

The mounting of a rod actuator kit (according to NAMUR) is described in a example by using the following equipment:

Actuator:	Series 2109, direct acting
Valve:	Valtek 2000, DN50, PN40
Safety position:	by pressure failure; open
Pre-assembly:	Valve with actuator (valve stroke is adapted with the actuator stroke)

For mounting, proceed as follows:

#### ❶ Mounting the feedback lever (see Fig. 5):

a. Unscrew the lock nut for the feedback lever attachment.

b. Place the feedback lever (12) upon the shaft end at the back of the positioner (embossed scale shows to the front) and fasten it with the lock nut. The pickup finger (15) shows to the back of the positioner.

#### CAUTION

Maximum torque 0.25 Nm.

#### ❷ Mounting the linking part and driving angle (see Fig. 5):

a. Attach the linking part (8) to the clamping device (7) and fasten it with two hexagon socket screws (10) and lock washers (9).

b. Attach the driving angle (11) to the linking part

(8) and fasten it with a hexagon socket screw (16) and a washer (17). Check that the slot of the driving angle (11) is centered.

#### ❸ Mounting the positioner (see Fig. 5):

a. Adjust the actuator to half valve stroke.

b. Position the feedback lever (12) right-angled to the outer edge of the positioner.

c. Pre-assemble the mounting angle (18) onto the left actuator pillar (5) hand-tight with two strap bolts (6), nuts (1) and lock washers (2).

d. Attach the positioner to the pre-assembled mounting angle and fasten it with two hexagon head screws (4) and two lock washers (3). Check that the pickup finger (15) is inserted in the slot of the driving angle (11) and the feedback lever (12) is positioned right-angled to the outer edge of the positioner.

#### NOTE:

**A slight unsymmetrical mounting increases the linearity deviation but does not affect the performance of the device.**

**Depending on the actuating size and stroke it is necessary to turn the driving angle (Fig. 5, pos. 11) by 180°– and attach it to the opposite side of the linking part (8).**

#### ❹ Adjustment of the stroke feedback:

a. The stroke feedback of the positioner must be adjusted according to the valve stroke and is calculated as follows (see Fig. 6):

$$\text{Actuator stroke} = \text{initial tension of actuator spring} + \text{valve stroke}$$

Calculating example:

The initial tension of the actuator spring = 10 mm for the starting position of the valve stroke = 0 %.

The valve stroke = 20 mm for the end position of the valve stroke = 100 %.

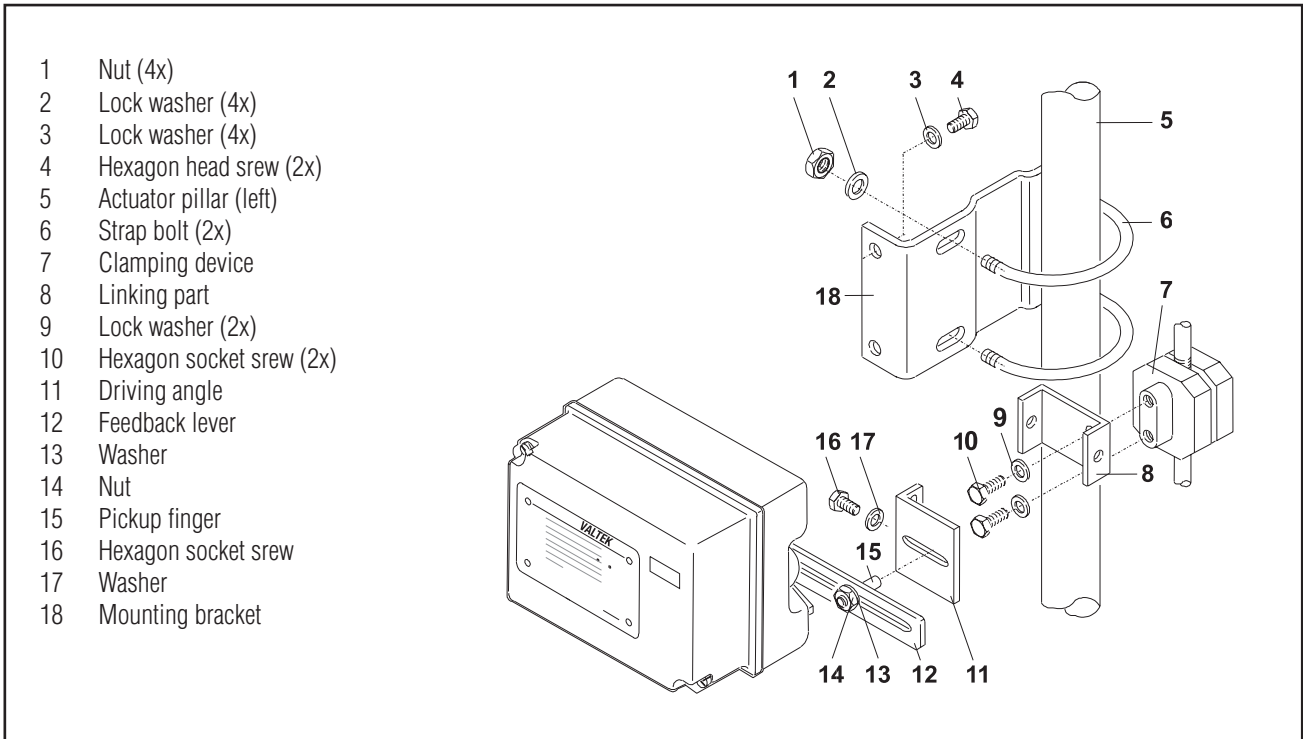
In this case the stroke feedback must be adjusted to 30 mm.

b. Loosen the nut (Fig. 5, pos. 14) of the feedback lever (12) and adjust the pickup finger (15) to the calculated actuator stroke by using the lever scale.

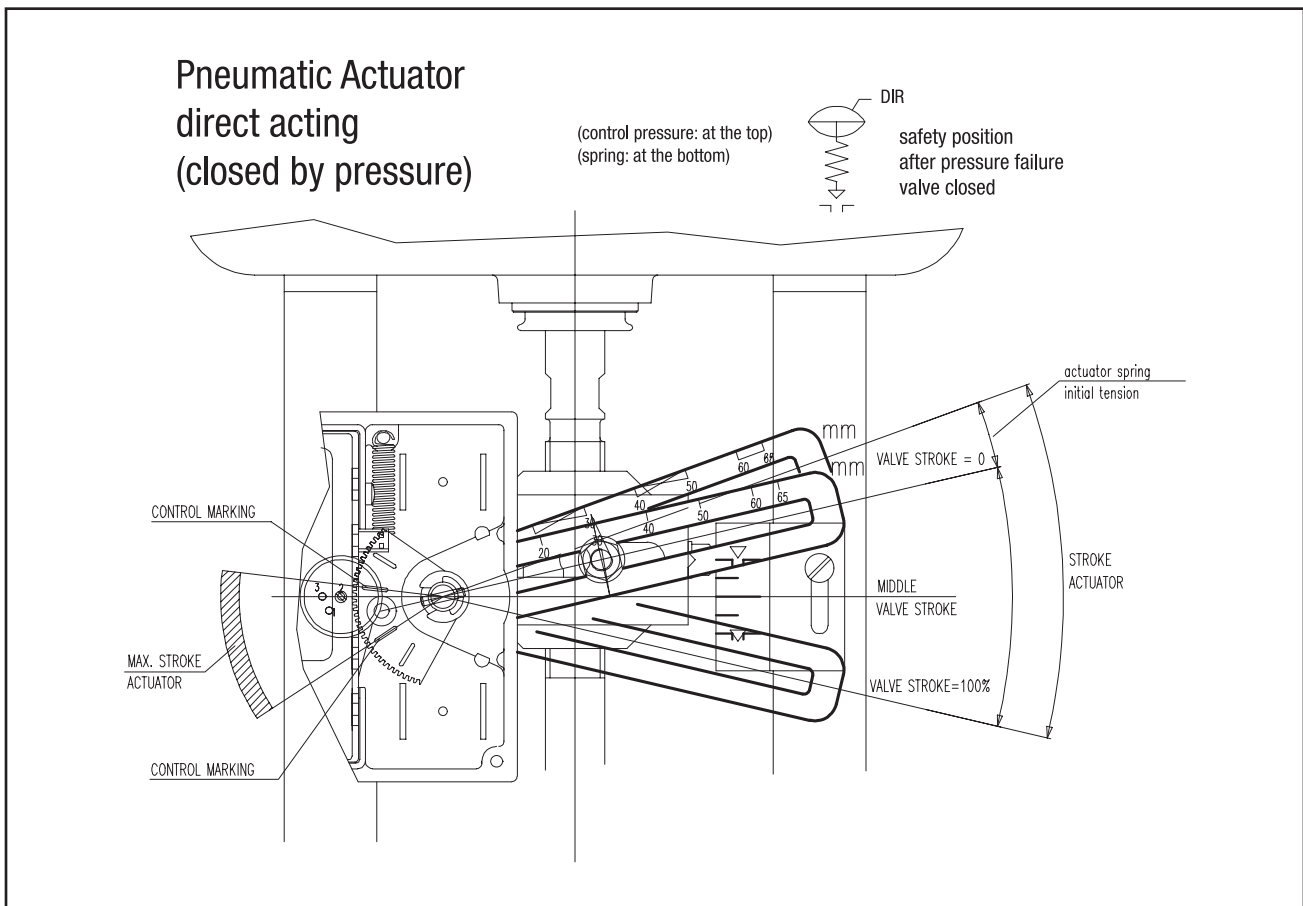
#### NOTE:

**Do not adjust the pickup finger (15) near the slot end of the driving angle (11). The minimum lateral distance should be approximately 5 mm.**

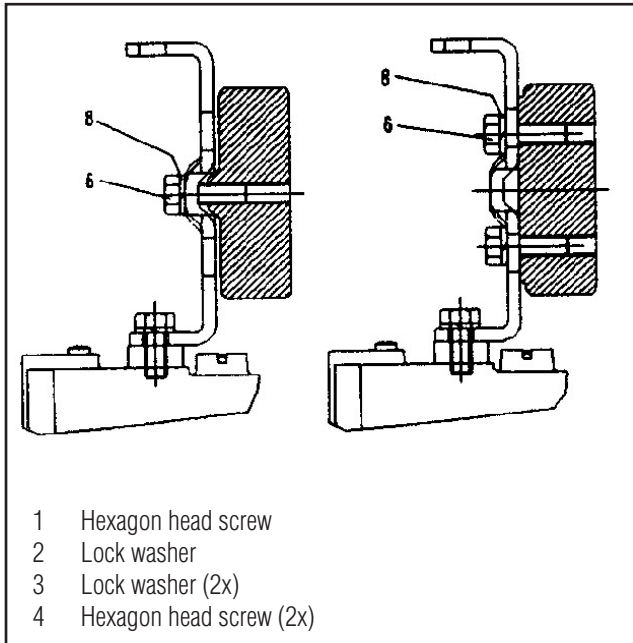
c. Check the adjustment of the stroke feedback by using the control marking on the toothed quadrant (see Fig. 6). The actuator stroke must be between the two control markings. Increase the stroke feedback, if the actuator stroke passes over the control markings.



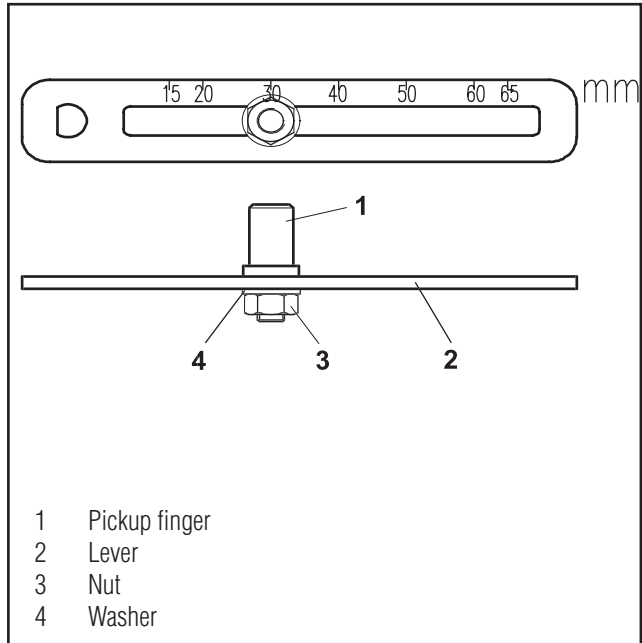
**Fig. 5: Mounting on a Rod Actuator (according to NAMUR)**



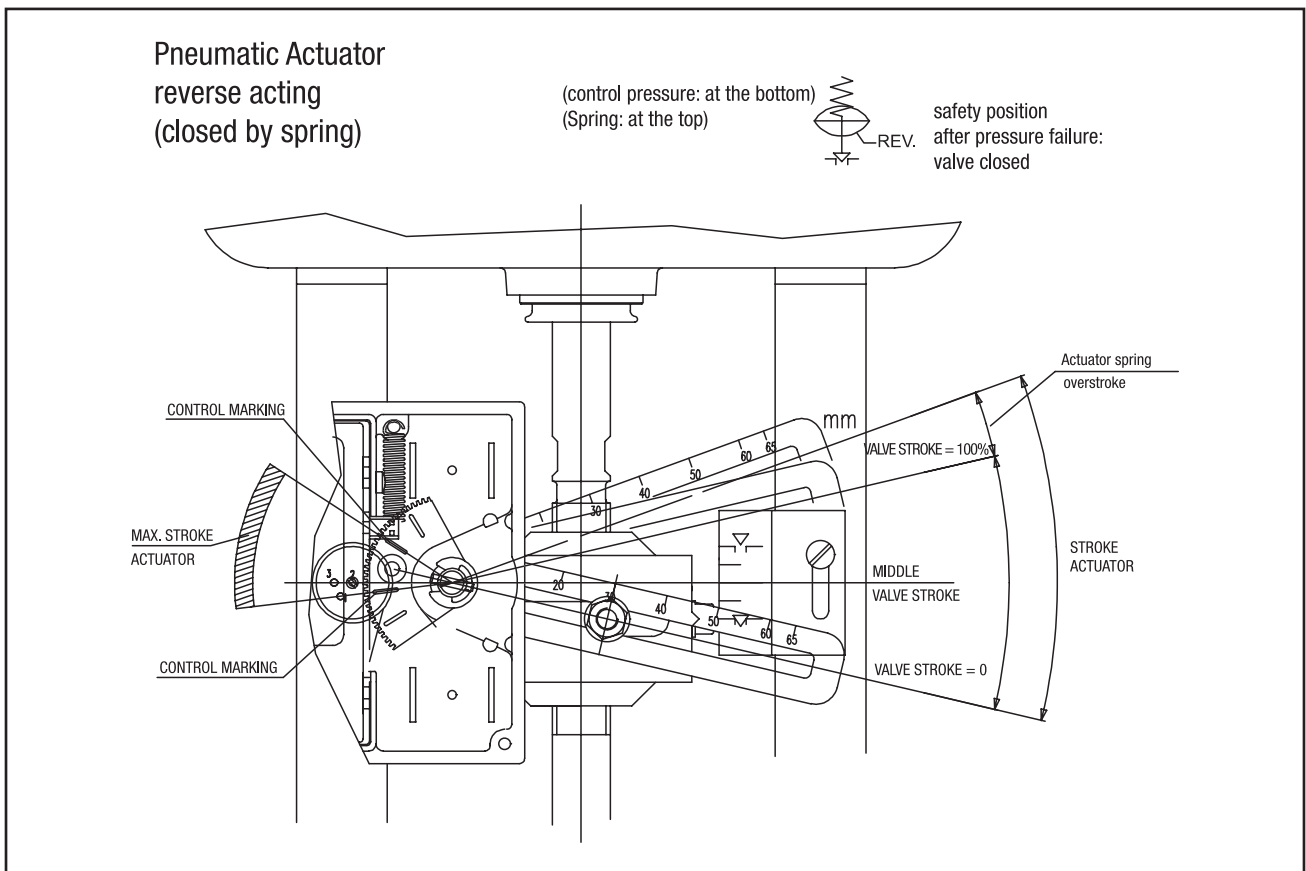
**Fig. 6: Basic Adjustment for Pneumatic Actuator, direct acting**



**Fig. 7: mounting on a Yoke Actuator  
(according to NAMUR, IEC 534 Part 6)**



**Fig. 8: Feedback Lever (standard)**



**Fig. 9: Basic Adjustment for Pneumatic Actuator, reverse acting**

## Mounting the electro-pneumatic Positioner on a Pneumatic Actuator, reverse acting (closed by spring, see Fig. 9)

The mounting of a rod actuator kit (according to NAMUR) is described in a example by using the following equipment:

Actuator:	Series 2109, reverse acting
Valve:	Valtek 2000, DN50, PN40
Safety position:	by pressure failure; closed
Pre-assembly:	Valve with actuator (valve stroke is adapted with the actuator stroke)

For mounting, proceed as follows:

① to ③ According to electro-pneumatic positioner, direct acting (see Page 6).

### ④ Adjustment of the stroke feedback:

a. The stroke feedback of the positioner must be adjusted according to the valve stroke and is calculated as follows (see Fig. 9):

$$\text{Actuator stroke} = \text{initial tension of actuator spring} + \text{valve stroke}$$

Calculating example:

The initial tension of the actuator spring = 10 mm for the starting position of the valve stroke = 0 %.

The valve stroke = 20 mm for the end position of the valve stroke = 100 %.

In this case the stroke feedback must be adjusted to 30 mm.

b. Loosen the nut (Fig. 5, pos. 14) of the feedback lever (12) and adjust the pickup finger (15) to the calculated actuator stroke by using the lever scale.

- Do not adjust the pickup finger (15) near by the slot end of the driving angle (11). The minimum distance must be approximately 5 mm.

c. Check the adjustment of the stroke feedback by using the control marking on the toothed quadrant (see Fig. 9). The actuator stroke must be between the two control markings. Increase the stroke feedback, if the actuator stroke passes over the control markings.

## Connection of the Air Piping

After mounting, the stationary pipework can be made with suitable pipe connections, e.g. Ermeto-Connections or other cutting ring connections:

Air connections:	1/4"-18 NPT (standard air connection)
Auxiliary power: (supply air)	pressurized air or allowed gas, free of oil and dust according to IEC 770
Pressure range:	1.5 to 6.0 bar

For connecting the air piping, the following notes should

be observed:

- The air ducts are equipped with filters which remove medium and coarse size dirt from the pressurized air. They are easily accessible for cleaning if necessary.
- Oil and dust particles must be removed from the pressurized air by a special fine filter. Therefore a fine filter with oil and water separating capability should be installed in front of the supply air connection Z.
- With a maximum operating pressure of 6 bar a reducing regulator is not required.
- With an operating pressure of more than 6 bar, a reducing regulator is required. The air supply of the reducing regulator must be larger than the air consumption of the positioner.
- Connect the outlet connector Y of the positioner to the actuator, independently from the action (direct or reverse).
- For positioners with pressure gauge first, attach the gauge-T-pieces.

## Wiring

Electrical connections: signal cable with cable passage PG11 to terminals

2 x 2,5mm

Input signal: 4...20 mA, 4...12 mA or 12...20 mA

- Observe the minimum requirements of voltage and equivalent electrical load:
  - EP2300 13,5 V d.c. / 675  $\Omega$  at 20 mA
  - EP2400 7,5 V d.c. / 375  $\Omega$  at 20 mA

- The performance is ensured only for a minimum input current of 3,5 mA.

For wiring, the following notes should be observed:

- Absolutely observe the note „CAUTION“ on page 1.
- For explosion proof electrical equipment the connection of a certified intrinsically safe circuit (light blue marking) is permissible only.
- The equipment must be earthed in accordance with the regulations. For potential compensation via ring circuit, connect a second earth cable to the additional terminal provided outside.

## START-UP

For start-up and adjustment unscrew the cover of the positioner. The positioner cover contains a short description of positioner functions and adjustment (see Fig. 10). The position of the required switches and potentiometers is shown in Fig. 3.

### Set-up of the coloured switches 1 to 4

#### • Switch no. 1 and 2:

Set switch no. 1 and 2 according to the direction of the input signal (command variable W). The command variable W can be a rising input signal 4...20 mA or a falling input signal 20...4 mA.

#### • Switch no. 3:

Set switch no. 3 according to the actuator type. Select DIR for direct acting actuators or REV for reverse acting actuators. This set-up drives the actuator stem into a safety position, when auxiliary power (supply current or supply air) fails.

Example for reverse acting actuators REV (control pressure to lower chamber):

The actuator stem is in the upper position. After an auxiliary power failure the actuator spring extends out the actuator stem.

#### • Switch no. 4:

If required, the startpoint can be preset to 4 mA or 12 mA by using switch no. 4.

For final startpoint adjustment the ZERO-potentiometer must be used.

### Adjustment of the potentiometers

#### • ZERO-potentiometer (startpoint adjustment):

The startpoint can be adjusted according to the actuator spring with the ZERO-potentiometer by using a screwdriver.

Clockwise turns increase the stroke and counter clockwise turns decrease the stroke. The adjusted value is constant and is not influenced by the range adjustment.

#### • SPAN-potentiometer (range adjustment):

The end position can be adjusted according to the actuator spring with the SPAN-potentiometer by using a screwdriver.

Clockwise turns increases the stroke, counter clockwise turns decreases the stroke. The adjusted value is constant and is not influenced by the startpoint adjustment.

#### • GAIN-potentiometer (gain adjustment):

The gain of the positioner is factory set to  $K = 70$ . The gain is adjustable in a range from  $K = 20$  to 110 (see Fig. 11). Therefore pull off the protection cover of the printed circuit board. Below the coloured switches there are three potentiometers. The gain can be adjusted with the lower potentiometer, which is not accessible normally.

The GAIN-potentiometer is a 30-turns-trimming-potentiometer and is factory set to the half resistance value. I.e. 15 turns from the left or right limit stop.

After adjustment install the protection cover to the printed circuit board and fasten the positioner cover with screws.

Switch		Actuator	Safety Position after Auxiliary Power Failure	
1+2 W	4 Start		Air	Elektr.
↗	4/12		T	T
↘	4/12		T	T
↗	4/12		B	B
↘	4/12		B	B

Adjustment procedure:	GAIN set to $K = 70$
1. Input signal (W)	
2. Actuator type	
3. Startpoint 4/12mA	
4. ZERO-Poti 4/12mA	
5. SPAN-Poti 12/20mA	

ZERO SPAN GAIN	 -5 Turns $K=50$
----------------------	------------------------

Fig. 10: Short Description in the Positioner Cover

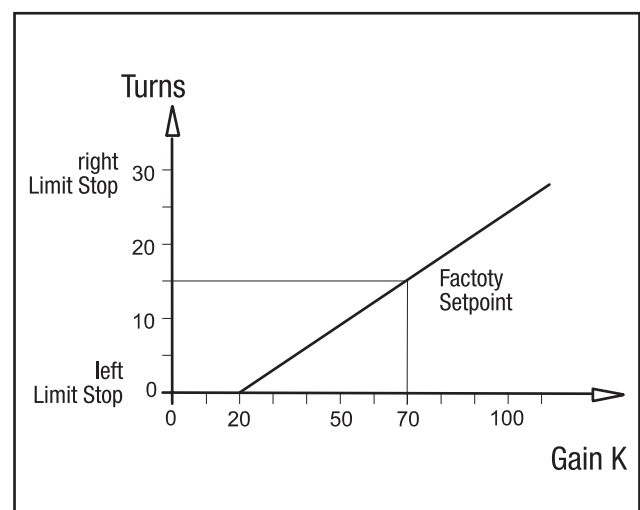
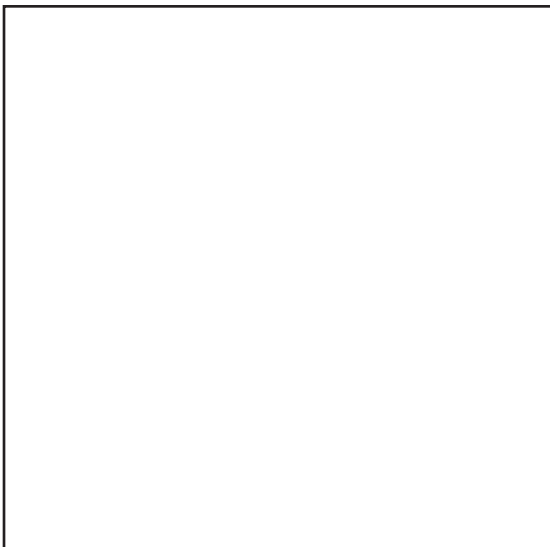


Fig. 11: Gain Adjustment with GAIN-Potentiometer

## HINTS AND TIPS

Question	Answer
<p>The positioner is not stable. It is oscillating around the desired position.</p>	<p>The gain of the positioner is factory set to 70. This is best for most applications. The gain must be reduced to eliminate unstable control behaviour. Generally it is sufficient to reduce the factory setpoint by 20. For this purpose, make five turns to the left from the factory setpoint to reduce the gain to 50. The adjustment by the GAIN potentiometer is described in the chapter „Start-up“ (page 10).</p>
<p>The actuator appears to lock up in one of the end positions.</p>	<p>To prevent damage from the unit, the stroke lever can move by more than <math>\pm 20</math> degrees from the horizontal position. The stroke lever can lock-up, if the adjustment of the pickup finger is wrong. Move the pickup finger to the right, until the whole stroke including overstroke (from zero to full supply air pressure) of the actuator is within the <math>\pm 20</math> degree limit („Mounting“ on page 6)..</p>
<p>The positioner does not operate.</p>	<p>The positioner is using the input signal to supply the electronics. A minimum input current of 3.5 mA is required to operate the unit. The minimum input voltage must be 13.5 V d.c. / 675 <math>\Omega</math> (7.5 V d.c. / 375 <math>\Omega</math> for EP2400)</p>
<p>The positioner does not reach the end position.</p>	<p>The equivalent electrical load of the positioner is 675 <math>\Omega</math> max. (375 <math>\Omega</math> for EP2400 series). Some older process control systems have high internal impedance and do not supply enough voltage/current to the positioner input. Use a process control system that supplies at least 13.5 Volt/20 mA (7.5 Volt/20 mA for EP2400 series)</p>
<p>The positioner reacts to the configuration DIP switches, but does not position properly with an input signal.</p>	<p>The ZERO- and SPAN potentiometers may be set out of range. Check the settings and repeat the start-up procedure of the „Installation“.</p>

**Table 3 Symptoms and solutions**



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