Type 3767 Electropneumatic Positioner

Fig. 1: *Type 3767*

Mounting and Operating Instructions

EB 8355-2 EN

Edition April 2011

CE Ex certified

Definition of signal words

DANGER!
Hazardous situations which, if not avoided, will result in death or serious injury

WARNING!
Hazardous situations which, if not avoided, could result in death or serious injury

NOTICE
Property damage message or malfunction

Note:
Additional information

Tip:
Recommended action

1 General safety instructions

For your own safety, follow these instructions concerning the mounting, start up and operation of the device:

– The device 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 in the valve by the process medium, the signal pressure or by moving parts are to be prevented by taking appropriate precautions.
  If inadmissible motions or forces are produced in the pneumatic actuator as a result of the supply pressure level, it must be restricted using a suitable supply pressure reducing station.
– Explosion-protected versions of this device are to be operated only by personnel who has undergone special training or instructions or who is authorized to work on explosion-protected devices in hazardous areas. See section 7.

To avoid damage to any equipment, the following also applies:

– Proper shipping and storage are assumed.

Note:
Devices with a CE marking fulfill the requirements of the Directives 2014/34/EU and 2014/30/EU.
The Declaration of Conformity is available on request.

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2 Design and principle of operation

The positioner consists of an electropneumatic converter and a pneumatic unit equipped with a lever for travel pick-up, a measuring diaphragm, and the pneumatic control system with nozzle, diaphragm lever (flapper plate), and booster.

The positioner is designed either for direct attachment to SAMSON Type 3277 Actuators or for attachment to actuators according to NAMUR (IEC 60534-6) using an adapter housing.

The positioner can be additionally equipped with either inductive limit contacts and/or a solenoid valve or position transmitter.

The control signal, e.g. 4 to 20 mA, issued by the controller is transmitted to the electropneumatic converter (13) where it is converted into a proportional pressure signal p_e.

The positioner operates according to the force-balance principle. The valve travel, i.e. the valve position, is transmitted to the pick-up lever (1) over the pin (1.1) and determines the force of the range spring (4). This force is compared to the positioning force generated by the pressure p_e at the measuring diaphragm (5).

If either the control signal or the valve position changes, the diaphragm lever (3) moves, altering the distance to the nozzle (2.1 or 2.2), depending on the adjusted direction of action of the positioner.

The supply air is supplied to the booster (10) and the pressure regulator (9).

The controlled supply air flows through the X_p restriction (8) and the nozzle (2.1, 2.2) and hits the diaphragm lever (flapper plate).

Any change in the reference variable or the valve position causes the pressure to change upstream or downstream of the booster.

The air controlled by the booster (signal pressure p_{st}) flows through the volume restriction (11) to the pneumatic actuator, causing the plug stem to move to a position corresponding to the reference variable.

The adjustable X_p restriction (8) and volume restriction (11) are used to optimize the positioner control loop.

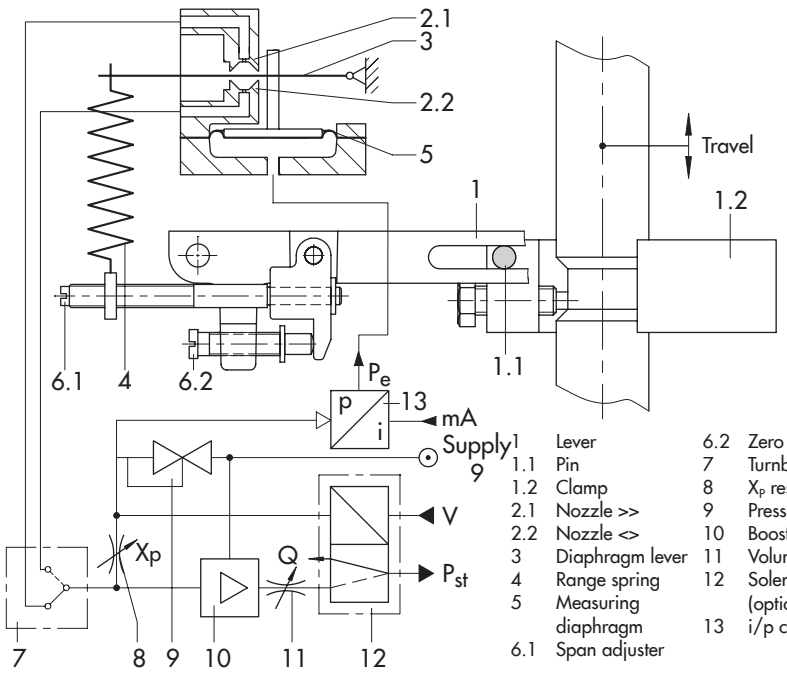
The pick-up lever (1) and the range spring (4) must be selected to match the rated valve travel and the nominal span of the reference variable.

Positioner with inductive limit contacts

In this version, the rotary shaft of the positioner carries two adjustable tags which actuate the built-in proximity switches.

Positioner with solenoid valve

When the positioner is equipped with a solenoid valve, the valve can be moved to the fail-safe position, regardless of the positioner's output signal. If a control signal corresponding to the binary signal '0' (OFF) is applied to the input, the signal pressure p_{st} is shut off and the actuator is vented. The actuator springs move the valve to its fail-safe position.



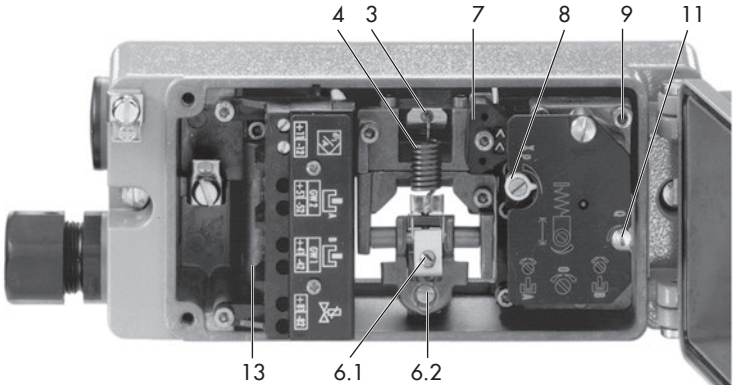


Fig. 2: *Functional diagram and inside view*

When a control signal corresponding to the binary signal '1' (ON) is applied to the input, the signal pressure p_{st} is applied to the actuator, allowing the valve to move according to the input signal issued by the control equipment.

Positioner with position transmitter

A positioner containing a position transmitter cannot be equipped with integrated limit contacts or an integrated solenoid valve since the position transmitter requires most of the space inside.

The position transmitter is used to assign the valve position, i.e. the valve travel, to an output signal of 4 to 20 mA. The tuning of the position transmitter ensures that both end positions "valve CLOSED" or "valve OPEN" as well as all intermediate positions can be signalized. Since the valve position is signalized independently of the input signal to the positioner, the position transmitter is a suitable option for checking the actual valve position.

2.1 Versions and article code

Electropneumatic positioner Type 3767-	x	x	x	0	1	x	x	x	x	x	x	0	0	0
Explosion protection														
Without	0						2							
Ⓔx II 2G Ex ia IIC T6 according to ATEX	1													
CSA/FM intrinsically safe/non incendive	3													
Ⓔx II 3G Ex nA II T6 acc. to ATEX	8													
Additional equipment														
Without		0												
Inductive limit contacts 2x SJ2-SN		2												
(Analog position transmitter 4 to 20 mA) [1]		6	0								0			
3/2-way solenoid valve														
Without			0											
6 V DC			2											
12 V DC			3											
24 V DC			4											
Type of mounting														
Standard range spring				0	1									
Pneumatic connections														
¼-18 NPT						1								
ISO 221/1-G ¼						2								
Electrical connections														
Plastic cable gland M20 x 1.5, blue							1	0						
Plastic cable gland M20 x 1.5, black							2	0						
Cable gland M20 x 1.5, nickel-plated brass							2	1						
Housing version														
Die-cast aluminum									1					
CrNiMo steel									2					
Reference variable														
4 to 20 mA										1				
0 to 20 mA										2				
1 to 5 mA										3				
Temperature range														
Standard											0			
Low-temperature version														
$T_{min} \geq -45$ °C; optional limit contacts, solenoid valve							2	1			2			
Special versions														
Without												0	0	0

[1] Available until March 2011

2.2 Technical data

Positioner		
Travel range, adjustable	Direct attachment: 7.5 to 30 mm Attachment according to IEC 60534-6: 7.5 to 120 mm or	
Opening angles	30° to 90° depending on the cam disk	
Reference variable		
Signal range	0/4 to 20 mA	1 to 5 mA
Span	8 to 20 mA	2 to 4 mA
Coil resistance R_i at 20 °C	200 Ω	880 Ω
Supply air	1.4 to 6 bar (20 to 90 psi)	
Air quality acc. to ISO 8573-1	Max. particle size and density: Class 4 Oil content: Class 3 · Pressure dew point: Class 3 or at least 10 K below the lowest ambient temperature to be expected	
Signal pressure p_{st} (output)	Can be limited between approx. 2.5 to 6.0 bar (38 to 90 psi)	
Characteristic	Linear characteristic, deviation from terminal-based conformity ≤1 %	
Hysteresis	≤0.3 %	
Sensitivity	≤0.1 %	
Direction of action	Reversible	
Proportional band Xp	<1 to 2.5 % (proportional-action coefficient K_p: >100 to 40)	
Air consumption	At 1.4 bar supply pressure: ≤280 l_n/h	At 6 bar supply pressure: ≤280 l_n/h With lowest setting of pressure regulator
Air output capacity	To fill actuator with air: 3.0 m_n^3/h To vent actuator: 4.5 m_n^3/h	8.5 m_n^3/h 14.0 m_n^3/h
Permissible ambient temperature	–20 to 80 °C with plastic cable gland –40 to 80 °C with metal cable gland (special version down to –45 °C) –20 to 70 °C with position transmitter See test certificates in the appendix for explosion-protected devices	
Influences	Temperature: ≤0.3 %/10 K Supply air: ≤1 % between 1.4 and 6 bar Vibration: None between 10 and 150 Hz and 4 g	
Explosion protection	See test certificate in the appendix for type of protection Ex ia IIC T6	
Degree of protection	IP 54 (IP 65 and NEMA 4X possible by fitting a filter check valve. See table on accessories on page 19)	
Electromagnetic compatibility	Complying with EN 61000-6-2, EN 61000-6-3 and NAMUR Recommendation NE 21	
Compliance	CE · EAC	
Weight	Approx. 1 kg	

2.3 Additional equipment

Inductive limit contacts					
Two proximity switches		SJ2-SN			
Control circuit		Values according to downstream transistor relay			
Hysteresis at rated travel		≤1 %			
Solenoid valve					
Input		Binary DC voltage signal			
Nominal signal		6 V DC	12 V DC	24 V DC	
Signal '0' (no response) DC signal at –25 °C		≤1.2 V	≤2.4 V	≤4.7 V	
Signal '1' (response) DC signal at 80 °C		≥5.4 V	≥9.6 V	≥18 V	
Maximum permissible signal		28 V	25 V	32 V	
Coil resistance R_i at 20 °C		2909 Ω	5832 Ω	11714 Ω	
Air consumption in steady state		In addition to that of the positioner: OFF ≤60 l_n/h · ON ≤10 l_n/h			
Closing time for	Type 3277 Actuator	120 cm²	240 cm²	350/355 cm²	700 cm²
Rated travel and signal pressure range (K_{VS} = 0.14)	0.2 to 1 bar	≤ 0.5 s	≤1 s	≤1.5 s	≤4 s
	0.4 to 2 bar		≤2 s	≤2.5 s	≤8 s
	0.6 to 3 bar		≤1 s	≤1.5 s	≤5 s
Position transmitter [1), 2)]		**–**		**Output circuit, intrinsically safe**	
Output signal		Two-wire connection 4 to 20 mA, reversible operating direction			
Auxiliary power		Minimum terminal voltage: 12 V DC max. 45 V DC		Only with intrinsically safe circuit	
Characteristic		Linear characteristic Deviation from characteristic according to terminal point method: ≤1 %			
Hysteresis		≤0.6 %			
Response		≤0.1 %			
Influence of power supply		≤1 % when voltage changes occur within the specified limits			
High-frequency influence		≤0.1 %, f = 150 MHz, 1 W power output at a distance of 0.5 m			
Load influence		≤0.1 %			
Permissible ambient temperature		–20 to 70 °C		–20 to → *See test certificate*	
Ambient temperature influence		≤0.4 % on lower measuring range value, ≤0.2 % on measuring span			
Ripple of output signal		≤0.3 %			

1) Data based on standard spring (15 mm travel with Type 3277 Actuator) and gain of 100.
2) Available until March 2011

2.4 Summary of explosion protection approvals

Type	Certification			Type of protection
3767	STCC	Number Valid until	No. 974 2017-10-01	0Ex ia IIC T6 X 2Ex s II T6 X
3767-1	EAC Ex	No. Date Valid until	RU C DE.08.00697 2014-12-15 2019-12-14	1Ex ia IIC T6/T5/T4 Gb X Ex tb IIIC T 80°C Db X
	KCs	Number Date Valid until	13-KB4BO-0037 2013-01-31 2017-01-31	Ex ia IIC T6/T5/T4
	EC type examination certificate	No. Date	PTB 01 ATEX 2167 2001-11-29	II 2G Ex ia IIC T6
3767-3	CSA®	No. Date	1607848 2005-09-16	Ex ia IIC T6: Class I, Zone 0; Class I, II, Div. 1, Groups A, B, C, D, E, F, D; Class I, II, Div. 2, Groups A, B, C, D, E, F, D;
	FM APPROVED	No. Date	3020228 2005-02-28	Class I, Zone 0 AEx ia IIC Class I, II, III, Div. 1, Groups A, B, C, D, E, F, G Class I, Div. 2, Groups A, B, C, D; Class II, Div. 2 Groups F, G; Class III;
3767-6	IECEx	No. Date	IECEx TSA 05.0004X 2005-05-24	Ex ia I/IIC T6 IP 65, Ex nI/IIC T6 IP 65
3767-8	EAC Ex	No. Date Valid until	RU C DE.08.00697 2014-12-15 2019-12-14	2Ex nA ic IIC T6/T5/T4 Gc X
	Statement of conformity	Number Date	PTB 01 ATEX 2170 X 2003-05-28	II 3G Ex nA II T6

3 Mounting on control valves

The positioner can be mounted either directly to SAMSON Type 3277 Actuator or to control valves with cast yokes or rod-type yokes according to IEC 60534-6 (NAMUR). Combined with an intermediate piece, the positioner can also be mounted on rotary actuators. The standard positioner is delivered without accessories. Any additionally required accessories are listed together with their order numbers in the following tables. Do not remove the protective cover on the back of the positioner until you actually start to attach the positioner.

Mounting position and operating direction

The operating direction of the positioner also determines its mounting position on the actuator as illustrated in Fig. 3, Fig. 4 and Fig. 6.

The turnboard (7 in Fig. 2) at the positioner must be mounted correspondingly.

For an increasing input signal (reference variable), the signal pressure p_{st} can either be increasing (direct action >>) or decreasing (reverse action <>). Similarly, as the reference variable decreases, the signal pressure can either decrease (direct action >>) or increase (reverse action <>).

On the turnboard (7), the operating direction is indicated by symbols (direct >>, reverse <>). Depending on the position of the turnboard, the adjusted operating direction and the associated symbol become visible.

If the required operating direction does not correspond to the visible symbol, or if you want to change the operating direction, remove the fastening screw at the turnboard, turn the board by 180° and refasten the turnboard. Make sure the three rubber gaskets inserted in the housing remain in position.

NOTICE

When any subsequent changes are made, e.g. reversing the operating direction of the positioner control loop or changing the actuator fail-safe action from "actuator stem extends" to "actuator stem retracts" or vice versa, the positioner's mounting position must be changed accordingly.

3.1 Direct attachment to Type 3277 Actuator

Note:

The required accessories are listed in Table 1 to Table 4 on page 18.

The attachment of the positioner either on the left or right side of the actuator (always looking onto the signal pressure connection or switchover plate) is determined by the required operating direction of the positioner, i.e. >> or <>.

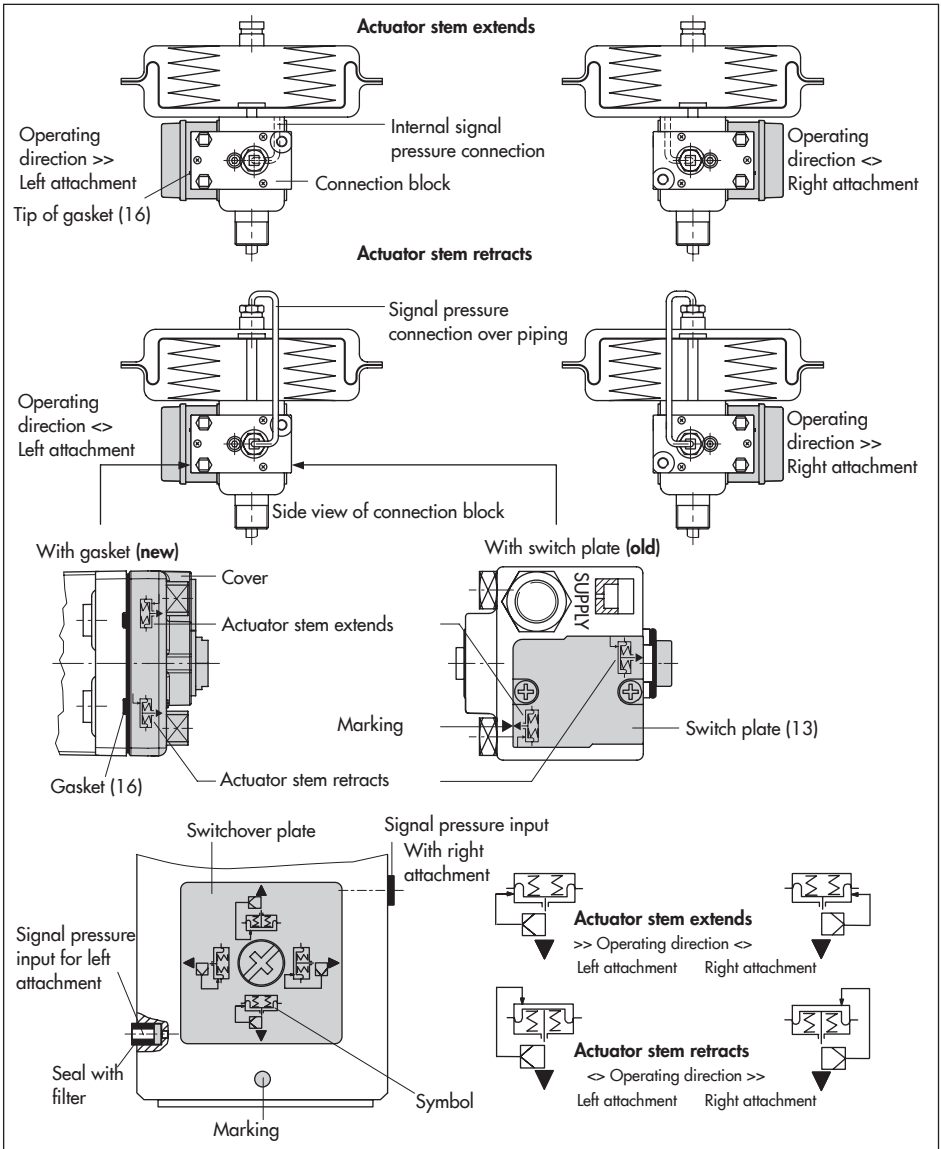


Fig. 3: *Mounting position and connection of signal pressure for Type 3277 Actuator (top) and Type 3277-5 Actuator (120 cm²) (bottom)*

1. Fasten the clamp (1.2) to the actuator stem, making sure that the fastening screw rests in the groove of the actuator stem.
2. Fasten the associated pick-up lever D1 or D2 (with 355/700 cm² actuators) to the feedback lever of the positioner.
3. Secure the intermediate plate (15) with the gasket facing towards the actuator yoke.
4. Position the positioner such that the pick-up lever slides in line over the pin (1.1) of the clamp (1.2). Fasten the positioner to the intermediate plate (15).
5. Mount cover (16).
6. Check whether the correct range spring has been installed as listed in Table 4. Range spring 1 is installed as standard. If necessary, replace it with range spring 2 included in the accessories and fix it at the outer hook-in holes.

Actuators with 240, 350, 355, and 700 cm² diaphragm areas

7. Make sure that the tip of the gasket (16) projecting from the side of the connection block (Fig. 3, middle) is positioned to match the actuator symbol for the actuator's fail-safe action "actuator stem extends" or "actuator stem retracts".
   If this is not the case, unscrew the three fastening screws and lift off the cover. Turn the gasket (16) by 180° and re-insert it.
   The old connection block version requires the switch plate (13) to be turned to align the actuator symbol with the arrow marking.
8. Place the connection block with the associated gaskets against the positioner and the actuator yoke. Fasten it using the screw.
   For actuators with fail-safe action "actuator stem retracts", additionally mount the external signal pressure pipe.

Actuator with 120 cm² diaphragm area

The signal pressure is transmitted to the diaphragm chamber over the switchover plate (Fig. 3 and Fig. 4, bottom).

7. Remove screw plug on the back of the positioner (Fig. 5) and seal the side signal pressure output with the stopper included in the accessories.
8. Mount the positioner so that the hole in the intermediate plate (15) covers the seal in the hole of the actuator yoke.
9. Align the switchover plate with the corresponding actuator symbol. Fasten it to the actuator yoke.

! ***NOTICE***

If a solenoid valve or a similar device is additionally mounted onto a 120 cm² actuator, do not remove the M3 screw plug at the back of positioner. In this case, the signal pressure must be transmitted from the signal pressure output to the actuator over an additional ***connecting plate*** *(Table 2). The switchover plate is not used in this case.*

Air purging of the spring chamber

If the spring chamber of the actuator is to be purged with the exhaust air from the positioner, use piping (Table 3) to connect the spring chamber (with "actuator stem extends" version) to the connection block. To do so, remove the stopper from the connection block. For an actuator with fail-safe action "actuator stem retracts" and in Type 3277-5 Actuators with an effective diaphragm area of 120 cm², the exhaust air from the positioner is connected to the spring chamber over an internal hole.

> ***NOTICE***
> *When the valve is installed, the side cover of the actuator must be mounted such that the vent plug points downward.*

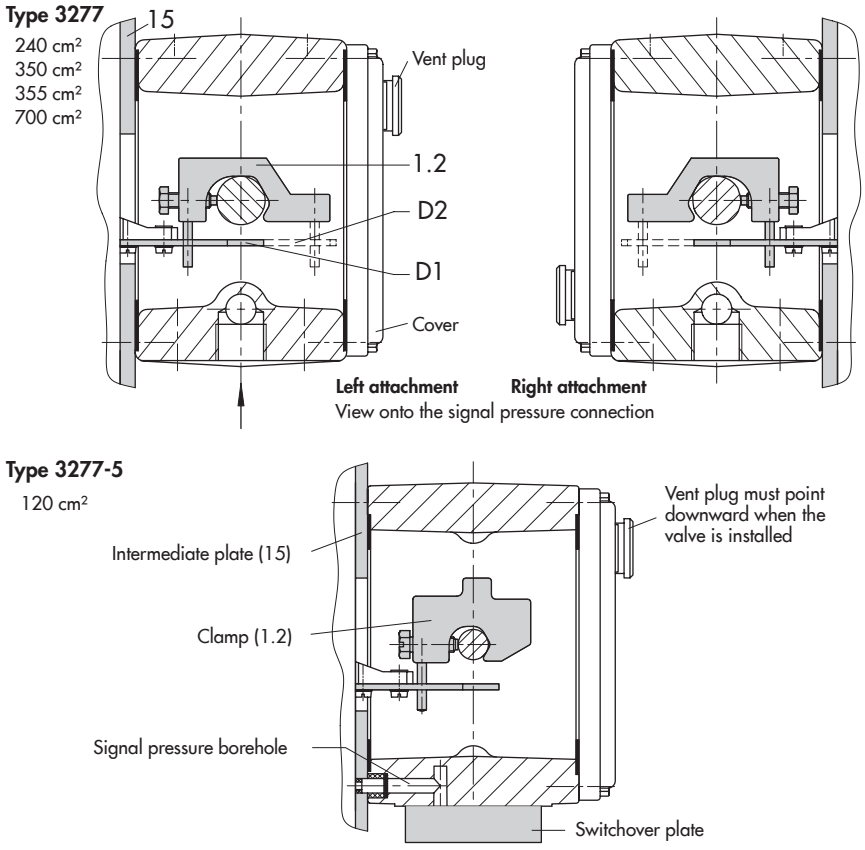


Fig. 4: *Mounting the clamp*

Table 1: *Lever (see Fig. 4)*			**Mounting kit**
Actuator size	Lever with associated clamp and intermediate plate		Order no.
120 cm²	D1 lever with stopper for output (38)	Standard version	1400-7116
		Version compatible with paint	1402-0944
240/350 cm²	D1 lever (33 mm long with 17 mm clamp)	Standard version	1400-6370
		Version compatible with paint	1402-0942
355/700 cm²	D2 lever (44 mm long with 13 mm clamp)	Standard version	1400-6371
		Version compatible with paint	1402-0943

Table 2: *Switchover plates and connecting plates*		Order no.
Switchover plate (for 120 cm² actuator)	Type 3277-5xxxxxx.**00** Actuator (old)	1400-6819
New switchover plate	Type 3277-5xxxxxx.**01** Actuator (new) or higher	1400-6822
Connecting plate for additional attachment of, e.g. a solenoid valve	Type 3277-5xxxxxx.**00** Actuator (old), G ⅛ Type 3277-5xxxxxx.**00** Actuator (old), ⅛ NPT	1400-6820 1400-6821
New connecting plate	Type 3277-5xxxxxx.**01** Actuator (new) or higher G ⅛ and ⅛ NPT	1400-6823
Note: *Only new switchover and connecting plates can be used with new actuators (Index **01**). Old and new plates are not interchangeable.*		
Required connection block for 240, 350, 355, and 700 cm² actuator (including gaskets and fastening screw)	G ¼	1400-8819
	¼ NPT	1402-0901

Table 3: *Pipe connection*	Material	Actuator size [cm²]	Order no.
Required pipe connection including screw fitting For actuator with "actuator stem retracts" or with air purging of the top diaphragm chamber	Steel	240	1400-6444
	Stainless steel	240	1400-6445
	Steel	350	1400-6446
	Stainless steel	350	1400-6447
	Steel	355/700	1400-6448
	Stainless steel	355/700	1400-6449

Table 4: *Range spring*	Travel [mm]	Actuator size [cm²]	Order no.
2 (4.5 coils)	7.5	120, 240	1400-6443
1 (9.5 coils, installed as standard)	10 to 15	120, 240 and 350	1400-6442
2	15	355/700	1400-6443
1	30	355/700	1400-6442

Accessories		Order no.
Pressure gauge mounting block (only for 120 cm²)	G ¼	1400-7458
	¼ NPT	1400-7459
Pressure gauge mounting kit for supply pressure and signal pressure	Stainless steel/brass	1400-6950
	Stainless steel/stainless steel	1400-6951
Filter check valve, replaces vent plug and increases the degree of protection to IP 65		
Filter check valve in housing with G ¼ thread	Polyamide, IP 65 degree of protection	1790-7408
	1.4301, IP 65 degree of protection	1790-7253
	Polyamide, NEMA 4 degree of protection	1790-9645
	1.4301, NEMA 4 degree of protection	1790-9646
Assortment of spare parts including gaskets and diaphragms		1400-9895

3.2 Attachment according to IEC 60534-6

Required mounting parts are listed in Table 5. The rated travel of the valve determines which lever and range spring (Table 6) are required.

An adapter housing is used for attachment (Fig. 7). The valve travel is transmitted by the lever (18) and the shaft (25) to the bracket (28) of the adapter housing and then passed on to the pin (27a) on the lever of the positioner. To ensure that the pin (27a) is properly located in the bracket (28), fix the spring included in the accessories at the back of the positioner housing as illustrated in Fig. 5.

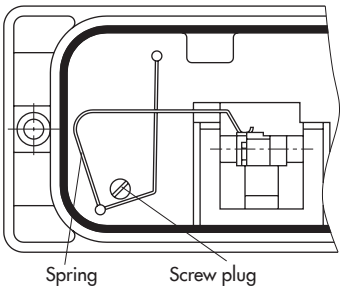


Fig. 5: *Installing the spring on the back of the housing*

The positioner can be mounted either on the left or right side of the control valve (Fig. 6 and Fig. 7). Turn the positioner at the adapter housing by 180° to determine or change the operating direction of the positioner/ control valve unit.

Left attachment		Right attachment	
Mounting position on the plate looking onto the travel pick-up (20), actuator facing upward (see also Fig. 7)			
Actuator with "actuator stem extends" (FA) fail-safe action			
Direct operating direction >>	Reverse operating direction <>	Direct operating direction >>	Reverse operating direction <>
Electrical connection	Pneumatic connections		Electrical connection
Actuator with "actuator stem retracts" (FE) fail-safe action			
Direct operating direction >>	Reverse operating direction <>	Direct operating direction >>	Reverse operating direction <>
Pneumatic connection	Electrical connections		Pneumatic connection

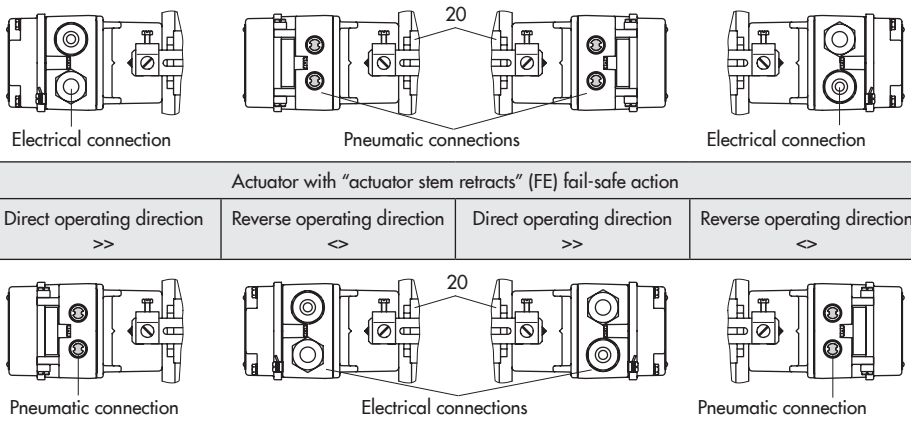


Fig. 6: *Attachment to the left or right of the valve for NAMUR attachment (IEC 60534-6)*

3.2.1 Mounting sequence

Select the required mounting parts and range spring from Table 5 and install them as illustrated in Fig. 7:

Valve with cast yoke

1. Screw the plate (20) to the stem connector of the actuator and plug stems using the countersunk screws.
   Use the additional bracket (32) for 2100 and 2800 cm² actuators.
2. Remove the rubber stopper from the adapter housing and fasten the adapter housing either on the left or right of the NAMUR rib using the hexagon head screw as shown in Fig. 6.

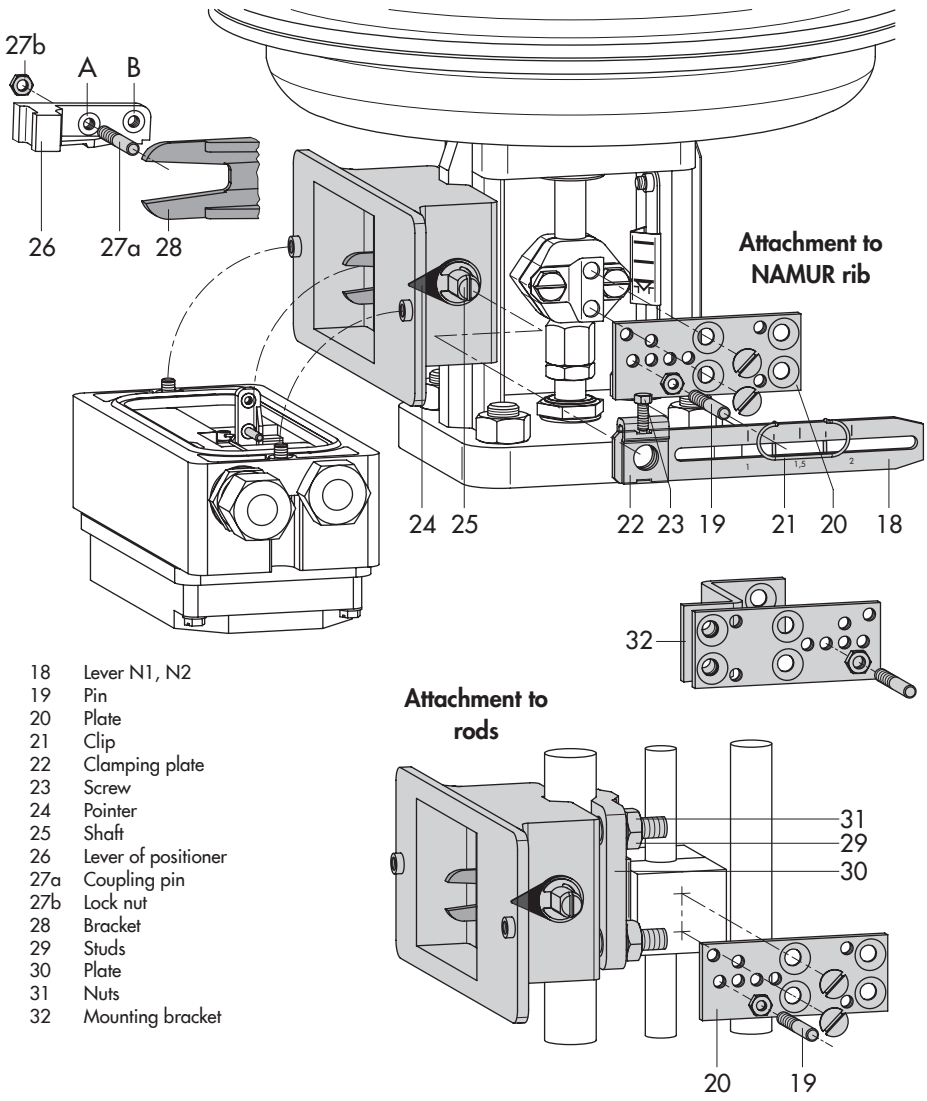
Valve with rod-type yoke

1. Screw the plate (20) to the follower clamp of the plug stem.
2. Screw the studs (29) into the adapter housing.
3. Place the adapter housing with the plate (30) onto either the left or right valve rod and screw tight using the nut (31). Make sure that the adapter housing is at the correct height to mount the lever (18) so that it is in a horizontal position when the valve is at mid-travel.
4. Screw the pin (19) into the middle row of holes on the plate (20) and lock it into position over the correct lever marking (1 or 2) as indicated in Table 6.
5. Clamp the clip (21) onto the lever (18). The clip must be clamped onto the lever (18) with the open side facing downward when the positioner is attached with the air connection at the front.
6. Attach the lever (18) including clamping plate (22) to the shaft (25), making sure that the clip clasps the pin (19).

3.2.2 Initial adjustment of travel

1. Move the valve to 50 % travel.
2. Move the shaft (25) in the adapter housing so that the black pointer (24) matches the cast marking on the adapter housing.
3. Fasten the clamping plate (22) in this position using the screw (23).
4. Screw the pin (27a) into the positioner lever on the side where the press nut is located. Lock it in position with the hex nut on the other side, observing the mounting position A or B according to Table 6 and Fig. 7.
5. Place the positioner on the adapter housing, taking into account the mounting direction. Fasten it, making sure that the pin (27a) rests against the bracket (28). The pin must not slip out of the bracket once installed.
6. Check whether the correct range spring has been installed as listed in Table 6. Range spring 1 is installed as standard. If necessary, replace it with range spring 2 included in the accessories and fix it at the outer hook-in holes.
7. Perform positioner setting as described in section 5.1.

Mounting position



18	Lever N1, N2
19	Pin
20	Plate
21	Clip
22	Clamping plate
23	Screw
24	Pointer
25	Shaft
26	Lever of positioner
27a	Coupling pin
27b	Lock nut
28	Bracket
29	Studs
30	Plate
31	Nuts
32	Mounting bracket

Fig. 7: *Attachment according to IEC 60534-6 (NAMUR)*

Table 5: *Mounting kits*	Control valve		Travel [mm]	With lever	Order no.
NAMUR mounting kit, see Fig. 7 for parts.	Valve with cast yoke		7.5 to 60	N1 (125 mm)	1400-6787
			22.5 to 120	N2 (212 mm)	1400-6789
	Rod diameter [mm] of rod-type yoke	20 to 25		N1	1400-6436
		20 to 25		N2	1400-6437
		25 to 30		N1	1400-6438
		25 to 30		N2	1400-6439
		30 to 35		N1	1400-6440
		30 to 35		N2	1400-6441
Attachment to Fisher and Masoneilan linear actuators (one of each mounting kits is required per actuator)					1400-6771 and 1400-6787
Additional range spring acc. to Table 6	Range spring 1 (9.5 coils, installed as standard) Range spring 2 (4.5 coils)				1400-6442 1400-6443
Accessories					Order no.
Pressure gauge mounting block			G ¼		1400-7458
			¼ NPT		1400-7459
Pressure gauge kit			Stainless steel/brass		1400-6950
			Stainless steel/stainless steel		1400-6951
Filter check valve, replaces vent plug and increases the degree of protection to IP 65					
Filter check valve in housing with G ¼ thread			Polyamide, IP 65 degree of protection		1790-7408
			1.4301, IP 65 degree of protection		1790-7253
			Polyamide, NEMA 4 degree of protection		1790-9645
			1.4301, NEMA 4 degree of protection		1790-9646
Assortment of spare parts including gaskets and diaphragms					1400-9895

Table 6: *Mounting position*										
Travel [mm] [1]	7.5	15	15	30	30	60	30	60	60	120
Pin at marking [1]	1	2	1	2	1	2	1	2	1	2
Distance between pin and lever fulcrum	42 to 84 mm						84 to 168 mm			
With lever	N1 (125 mm long)						N2 (212 mm long)			
Pin (27a) at position	A		A		B		A		B	
Required range spring (see Table 5)	2		1		1		1		1	

[1] Calculate intermediate values

3.3 Attachment to rotary actuators

The positioner can also be mounted on rotary actuators according to VDI/VDE 3845 (September 2010) using the mounting parts listed in Table 7.

Table 7: *Complete mounting parts, including range spring 2, but not including the cam disk*		Order no.
Actuator acc. to VDI/VDE 3845 (September 2010), level 2		1400-8815
SAMSON Type 3278 Actuator VETEC Type S	160 cm²	1400-7103
	320 cm²	1400-7104
VETEC Type R	R 110 to R 250	1400-7117
Attachment Masoneilan	Camflex I, DN 25 to 100	1400-7118
	Camflex I, DN 125 to 250	1400-7119
	Camflex II	1400-7120
Required range spring		Order no.
Standard operation of reference variable, range spring 2 (4.5 coils)		1400-6443
Split-range operation, range spring 1 (9.5 coils, installed as standard)		1400-6442
Cam disk with accessories		Order no.
~, linear basic characteristic [3] ~, equal percentage basic characteristic [3]	(0050-0072), 0 to 90° opening angle, also for Type 3310	1400-6664
~, linear [1] ~, equal percentage [2]	(0050-0073), 0 to 90° opening angle (0050-0080), 0 to 70° opening angle, for control butterfly valves	1400-6665 1400-6774
~, linear [1] ~, equal percentage [2]	(0050-0081), 0 to 70° opening angle, for control butterfly valves	1400-6775
~, linear [1] ~, equal percentage [2]	(0050-0074, VETEC), 0 to 75° opening angle (0050-0075, VETEC), 0 to 75° opening angle (0059-0007, Camflex) to be set between 0 and 55° (0059-0008, Camflex) to be set between 0 and 55°	1400-6666 1400-6667 1400-6637 1400-6638
Accessories		
See list on page 24		

[1] Linearizes the flow characteristic
[2] Creates an equal percentage flow characteristic
[3] Based on opening angle

The rotary motion of these actuators is converted into a linear motion required by the pneumatic control unit of the positioner using the cam disk of the actuator shaft and a feeler roll on the positioner lever.

! ***NOTICE***

*Check whether the correct range spring has been installed as listed in Table 7. Range spring **1** is installed as standard. If necessary, replace it with range spring **2** included in the accessories and fix it at the outer hook-in holes.*

Double-acting springless rotary actuators require the use of a **reversing amplifier** on the connection side of the positioner housing (see section 3.3.4).

When using a reversing amplifier, the pressure regulator (9, Fig. 2) must be turned clockwise as far as it will go (also see section 4.1.2).

When attaching the positioner to the SAMSON Type 3278 Rotary Actuator (Fig. 8, left), the inside of the actuator and the unused reverse side of the diaphragm are purged with the positioner's exhaust air. Additional piping is not required.

When attaching the positioner to actuators from other manufacturers (Fig. 8, right), the reverse side of the diaphragm can be purged with air over a pipe connection installed between the actuator and intermediate piece.

3.3.1 Mounting the lever with feeler roll

1. Place the lever with feeler roll (35) on the side of the lever (37) opposite to where the press nuts are located and secure it using the supplied screws (38) and washers.

! ***NOTICE***

To ensure a close physical contact between the lever with feeler roll and the cam disk, attach the spring contained in the accessories kit (order no. 1400-6660) to the back of the positioner housing (see Fig. 5).

3.3.2 Mounting the intermediate piece

SAMSON Type 3278 Actuator

1. Fasten the adapter (36) to the free shaft end of the rotary actuator.
2. Fasten the intermediate piece (34) to the actuator housing using two screws. Align the intermediate piece so that the air connections of the positioner point toward the diaphragm case side.
3. Align the cam disk (40) and scale (39) as described in section 3.3.3 and fasten.

Actuators according to VDI/VDE 3845 (09/2010) (fixing level 2)

1. Place the assembled intermediate piece (34, 44, 45 and 42) onto the mounting bracket included in the scope of actuator delivery and fasten.
2. Align the cam disk (40) and scale (39) as described in section 2.3.3 and fasten.

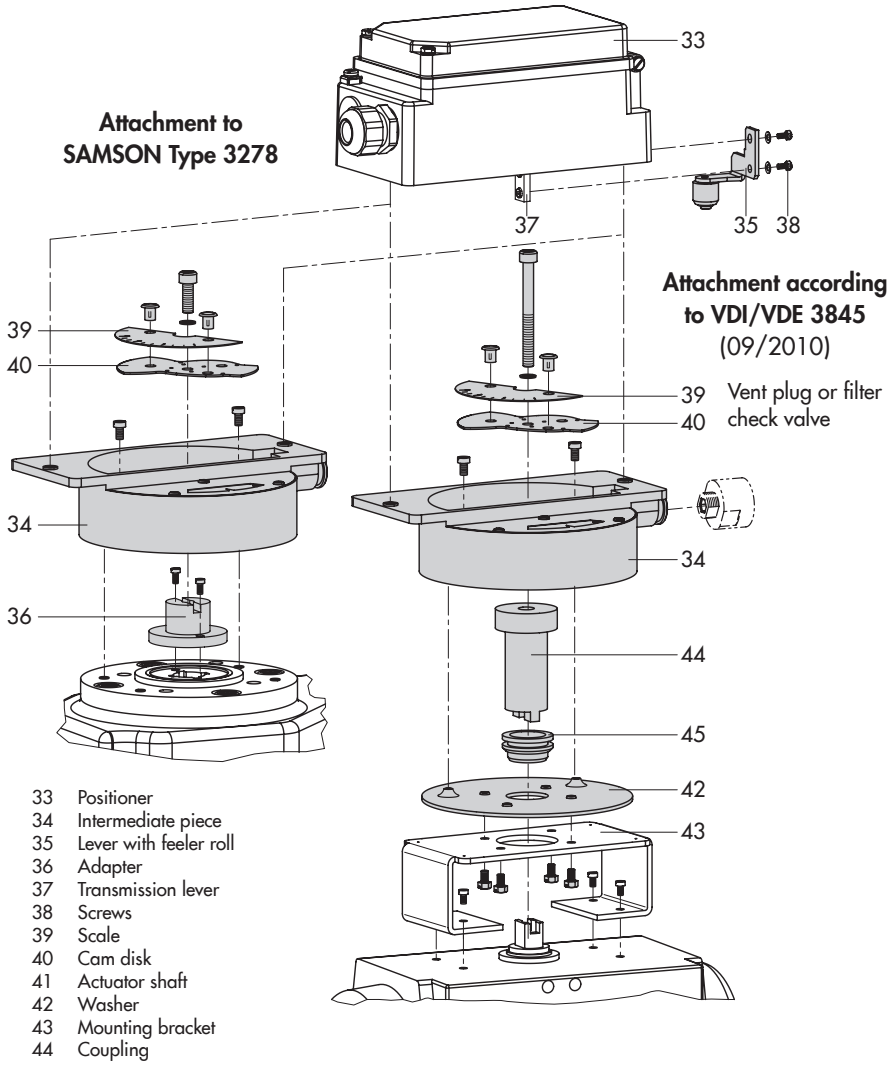


Fig. 8: *Attachment to rotary actuators*

3.3.3 Basic setting of the cam disk

The valve model used determines the basic setting of the cam disk.

> ***NOTICE***
> *Cam disks tailored to the special characteristic of a valve cause the valve to open in a non-linear or non-equal percentage way.*
> *The visible difference between the set point (4 to 20 mA) and the actual position (opening angle) does not constitute a system deviation of the positioner.*

Fig. 9 and Fig. 10 show linear cam disks.

Fig. 9 illustrates a control valve assembly with a rotary actuator with spring-return mechanism that opens counterclockwise. The arrangement of the springs in the actuator determines the fail-safe position of the valve.

Fig. 10 shows how to adjust the cam disk when a double-acting springless rotary actuator is used. The direction of rotation (either counterclockwise or clockwise) depends on the actuator and valve model used. The cam disk must be set when the valve is closed.

Use the turnboard (7) to adjust the operating direction of the positioner, i.e. whether the valve opens or closes when the reference variable increases (direct >> or reverse <>).

Each cam disk carries two cam sections whose starting points are indicated by small holes. Depending on the operating direction of the rotary actuator (air-to-open or air-to-close), the starting point of the cam, either marked **N** (standard characteristic) or **I** (reverse characteristic), must point towards the lever with feeler roll. When the starting point is located on the back of the cam disk, turn over the cam disk.

> ***NOTICE***
> *The starting point (hole) of the selected cam must be aligned so that the fulcrum of the cam disk and 0° position on the scale as well as the arrow on the window are in line with each other.*

When aligning the cam disk, clip the double-sided scale disk on the cam disk, while making sure that the value on the scale matches the valve's direction of rotation.

> ***NOTICE***
> *Make sure the 0° position of the scale always corresponds to CLOSED position.*
> *Therefore, for fail-open actuators and for springless actuators, the maximum supply pressure needs to be applied to the actuator before aligning the cam disk.*

Single-acting rotary actuator with spring-return mechanism

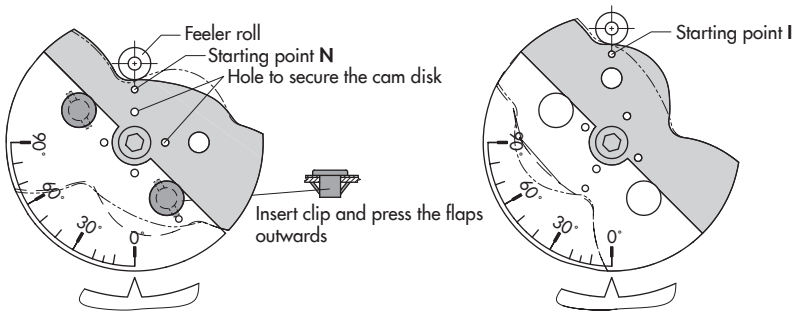
Linear cam disk (equal percentage cam disk is represented by a broken and dotted line)

Control valve opens counterclockwise

For valves that open clockwise, the cam disk must be turned over so that lever with feeler roll moves over the same disk segments as shown in the images below, but with the cam disk turning clockwise.

Fail-safe position: **Fail-close valve**

Direct operating direction >>				**Reverse operating direction <>**			
Reference variable	Signal pressure	Valve	Characteristic	Reference variable	Signal pressure	Valve	Characteristic
increases	increases	opens	N	decreases	increases	opens	I



Fail-safe position: **Fail-open valve**

Direct operating direction >>				**Reverse operating direction <>**			
Reference variable	Signal pressure	Valve	Characteristic	Reference variable	Signal pressure	Valve	Characteristic
decreases	decreases	opens	I	increases	decreases	opens	N

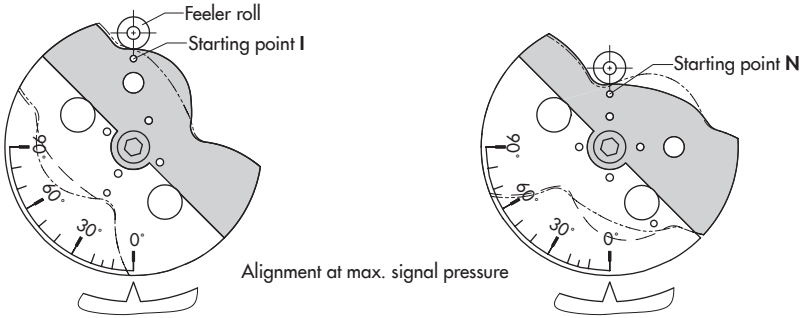


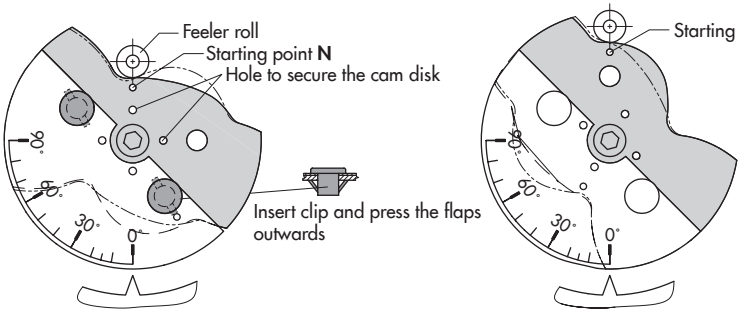
Fig. 9: *Cam disk settings for single-acting actuators*

Double-acting, springless rotary actuator with reversing amplifier

Linear cam disk (equal percentage cam disk is represented by a broken and dotted line)

View from the positioner onto the actuator shaft
Control valve opens counterclockwise – Based on a closed valve

Direct operating direction >>				**Reverse operating direction <>**			
Reference variable	Signal pressure	Valve	Charac-teristic	Reference variable	Signal pressure	Valve	Charac-teristic
increases	A1 increases, A2 decreases	opens	N	decreases	A1 increases, A2 decreases	opens	I



View from the positioner onto the actuator shaft
Control valve opens counterclockwise – Based on a closed valve

Direct operating direction >>				**Reverse operating direction <>**			
Reference variable	Signal pressure	Valve	Charac-teristic	Reference variable	Signal pressure	Valve	Charac-teristic
increases	A1 increases, A2 decreases	opens	N	decreases	A1 increases, A2 decreases	opens	I

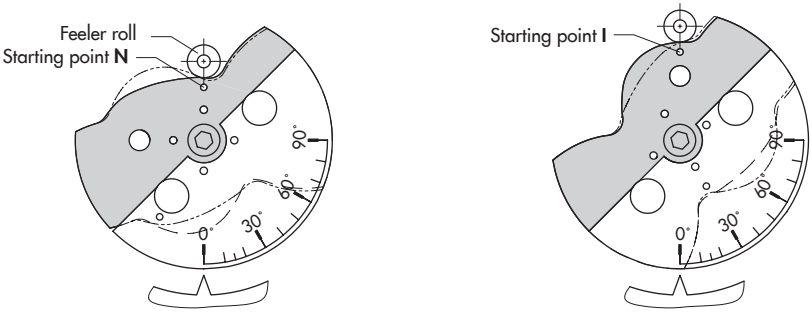


Fig. 10: *Cam disk settings for double-acting actuators*

Securing the aligned cam disk

To prevent the cam disk from turning, drill a hole into the adapter (36) or coupling (44) to allow a 2 mm dowel pin to be inserted.

Select one of the four holes located around the center hole of the cam disk to secure the cam disk in position.

3.3.4 Reversing amplifier for double-acting actuators

For the use with double-acting actuators, the positioner must be fitted with a reversing amplifier, e.g. the SAMSON Type 3710 Reversing Amplifier (see Mounting and Operating Instructions ▶ EB 8392).

The signal pressure of the positioner is supplied at the output A_1 of the reversing amplifier. An opposing pressure, which equals the required supply pressure Z when added to the pressure at A_1, is applied at output A_2. The rule $A_1 + A_2 = Z$ applies.

If a different reversing amplifier (item no. 1079-1118 or 1079-1119) is used, follow the mounting instructions described below:

Mounting

> ***NOTICE***
> *When using a reversing amplifier, the pressure regulator (9) must be turned as far as it will go in the clockwise direction.*
> *Remove the sealing plug (1.5) before mounting the reversing amplifier. The rubber seal (1.4) must remain installed.*

1. Screw the special nuts (1.3) from the accessories of the reversing amplifier into the threaded connections of the positioner.
2. Insert the gasket (1.2) into the recess of the reversing amplifier and slide both the hollowed special screws (1.1) into the connecting boreholes A_1 and Z.
3. Place the reversing amplifier onto the positioner and screw tight using the two special screws (1.1).
4. Use a screwdriver (8 mm wide) to screw the enclosed filters (1.6) into the connection boreholes A_1 and Z.

Signal pressure connections

A_1: Connect output A_1 to the signal pressure connection on the actuator that causes the valve to open when the pressure rises.

A2: Connect output A_2 to the signal pressure connection on the actuator that causes the valve to close when the pressure rises.

Pressure gauge attachment

The mounting sequence shown in Fig. 11 remains unchanged. Screw a pressure gauge bracket onto the connections A_1 and Z.

Pressure gauge bracket:
– G ¼ 1400-7106
– ¼ NPT 1400-7107

Pressure gauges for supply air Z and output A_1 as listed in Table 4 and Table 5.

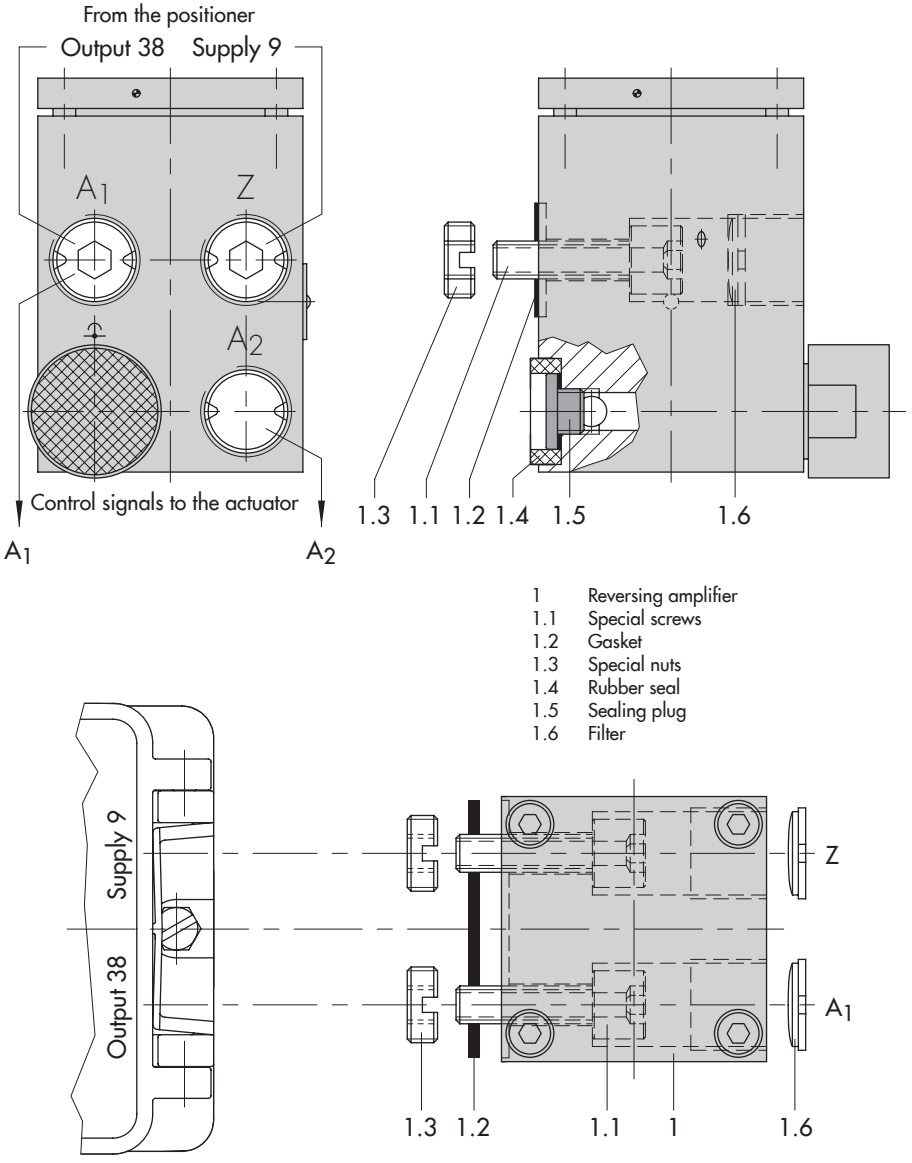


Fig. 11: *Mounting a reversing amplifier*

4 Connections

4.1 Pneumatic connections

The pneumatic connections are optionally designed as a bore with ¼ NPT or G ¼ thread. Customary fittings for metal or copper tubing or plastic hoses can be used.

! ***NOTICE***
The supply air must be dry and free from oil and dust. The maintenance instructions for upstream pressure reducing stations must be observed. Blow through all air pipes and hoses thoroughly before connecting them.

If the positioner is attached directly to the Type 3277 Actuator, the connection of the positioner's output pressure to the actuator is fixed. For attachment according to IEC 60534-6 (NAMUR), the signal pressure can be routed to either the top or bottom diaphragm chamber of the actuator, depending on the actuator's fail-safe action "actuator stem extends" or "actuator stem retracts".

Exhaust air

Models with index 3767-x...x**.03** and higher are equipped with a hinged cover without its own exhaust air hole. The exhaust air connections for these models are included in the accessories.

The vent plug is located on the plastic cover of the actuator for direct attachment, whereas for NAMUR attachment, it is located on the adapter housing. The vent plug is located on the intermediate piece or reversing amplifier for attachment to rotary actuators.

! ***NOTICE***
*If you intend to replace older models with index 3767-x...x.**02** or lower, the mounting parts may need to be replaced as well.*

4.1.1 Pressure gauges

To precisely tune the positioner, we recommend installing pressure gauges for the supply air and signal pressure.

The required parts are listed as accessories in Table 4, Table 5 and Table 7.

4.1.2 Supply pressure

The required supply air pressure depends on the bench range and the actuator's operating direction (fail-safe action).

The bench range is written on the nameplate either as the spring range or signal pressure range. The operating direction is marked **FA** or **FE**, or by a symbol.

Actuator stem extends (FA):
Fail-close
(for globe and angle valves)

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

Actuator stem retracts (FE):
Fail-open
(for globe and angle valves)

For tight-closing valves, the maximum signal pressure pstmax is roughly estimated as follows:

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

d = Seat diameter [cm]
Δp = Differential pressure across the valve [bar]
A = Actuator area [cm²]
F = Upper bench range value of the actuator [bar]

If there are no specifications, calculate as follows:
Required supply pressure =
Upper bench range value + 1 bar

Pressure regulator

After tilting the cover plate back, the pressure regulator (9) can be continuously adjusted. When the adjuster is turned counterclockwise as far as it will go, signal pressures for spring ranges up to 2.5 bar are controlled. When the adjuster is turned clockwise all the way, signal pressures for spring ranges up to 6.0 bar are controlled.

If the signal pressure must not exceed a certain value, this limit can be adjusted using a pressure gauge (accessories).

4.2 Electrical connections

DANGER!
For electrical installation, observe the relevant electrotechnical regulations and the accident prevention regulations that apply in the country of use. In Germany, these are the VDE regulations and the accident prevention regulations of the employers' liability insurance.
The following regulations apply to installation in hazardous areas:
EN 60079-14: 2008 (VDE 0165, Part 1) Explosive Atmospheres – Electrical Installations Design, Selection and Erection.
Adhere to the terminal assignment. Switching the assignment of the electrical terminals may cause the explosion protection to become ineffective. Do not loosen enameled screws in or on the housing. The maximum permissible values specified in the EC-type examination certificates apply when interconnecting intrinsically safe electrical equipment (U_i or U_0, I_i or I_0, P_i or P_0, C_i or C_0 and L_i or L_0).

Selecting cables and wires

Observe **clause 12 of EN 60079-14: 2008** (VDE 0165, Part 1) for installation of the intrinsically safe circuits.
Clause 12.2.2.7 applies when running multicore cables and wires with more than one intrinsically safe circuit.

The radial thickness of the insulation of a conductor for common insulating materials (e.g. polyethylene) must not be smaller than 0.2 mm.
The diameter of an individual wire in a fine-stranded conductor must not be smaller than 0.1 mm. Protect the conductor ends against splicing, e.g. by using wire-end ferrules.
When two separate cables are used for connection, an additional cable gland can be installed.
Seal cable entries left unused with plugs.
Fit equipment used in ambient temperatures **below –20 °C** with metal cable entries.

Zone 2/Zone 22

In equipment operated according to type of protection Ex nA II (non-sparking equipment) according to EN 60079-15:2003, circuits may be connected, interrupted or switched while energized only during installation, maintenance or repair.
Equipment connected to energy-limited circuits with type of protection Ex nL according to EN 60079-15:2003 may be switched under normal operating conditions.

The maximum permissible values specified in the statement of conformity and its addenda apply when interconnecting the equipment with energy-limited circuits in type of protection Ex nL IIC.

The wires for the reference variable must be connected to the terminals 11 and 12 located in the housing.

In general, it is not necessary to connect the positioner to a bonding conductor. Should this be required, however, this conductor can be connected inside the device or outside on the device.

Depending on the version, the positioner is equipped with inductive limit contacts and/or a solenoid valve.

Versions with position transmitter do not permit the connection of additional equipment.

The position transmitter is operated on a two-wire circuit. The usual supply voltage is 24 V DC.

Taking the resistance of the supply leads into account, the voltage at the position transmitter terminals can be between 12 and 45 V DC.

Refer to Fig. 12 or to the label on the terminal block.

Accessories:
Device index 3767-x...x.**03** and lower
Cable gland PG 13.5
Black plastic Order no. 1400-6781
Blue plastic Order no. 1400-6782
Nickel-plated brass Order no. 1400-6979

Adapter PG 13.5 to ½ NPT:
Metal to metal Order no. 1400-7109
Painted blue Order no. 1400-7110

Device index 3767-x...x.**04** and higher
Cable gland M20 x 1.5
Black plastic Order no. 1400-6985
Blue plastic Order no. 1400-6986
Nickel-plated brass Order no. 1890-4875

Adapter M20 x 1.5 to ½ NPT:
Powder-coated aluminum
Order no. 0310-2149

4.2.1 Switching amplifier

The operation of the inductive limit contacts requires switching amplifiers in accordance with EN 60947-5-6 to be connected in the output circuit. Observe the relevant regulations for installation in hazardous areas.

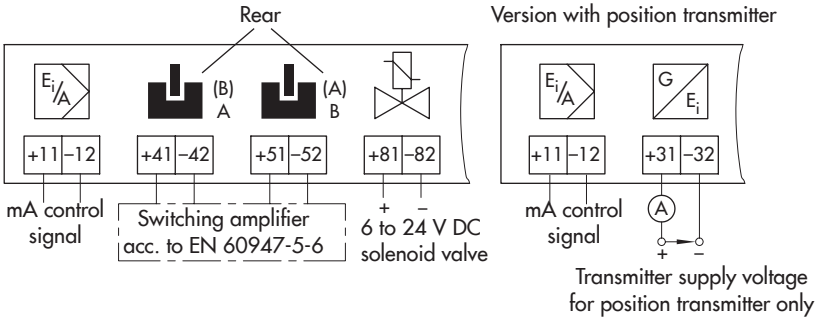


Fig. 12: *Electrical connections*

5 Operation

5.1 Tuning the positioner mounted onto the control valve

Starting point and reference variable

When adjusting the positioner directly at the control valve, the travel (opening angle) must be adapted to the reference variable.

With a reference variable, for example, 4 to 20 mA, the valve must move through its entire travel range from 0 to 100 % (Fig. 13, left).

For positioners for rotary actuator, an opening angle, for example, 0 to 70° must be assigned to the reference variable.

The starting point is based on the CLOSED position of the valve.

Depending on the actuator version ("actuator stem extends" or "actuator stem retracts") and the operating direction of the positioner (>> or <>), this starting point can be either the lower or upper range value (4 or 20 mA) of the reference variable.

The reference variable range and thus the upper range value determine the travel of the valve.

In split-range operation (Fig. 13, right), the control valves work with smaller reference variable ranges. The controller output signal is used to control two control valves, dividing it such that the valves move through their entire travel range at half the input signal range each (e.g. first valve set to 4 to 12 mA, second valve set to 12 to 20 mA). To avoid overlapping, allow for a dead band of ± 0.5 mA as shown in Fig. 13.

The **starting point** (zero) is adjusted at the zero adjuster **(6.2);** the span, i.e. the upper range value, is adjusted at the span adjuster **(6.1).**

During the adjustment, connect a suitable ammeter to the signal input and apply air to the supply air input.

! ***NOTICE***

When the positioner is controlled by a computer whose signal is limited, e.g. between 4 to 20 mA, set the positioner to the range from 4.5 to 20 mA.

This is the only way to ensure that the actuator is completely vented and the valve completely closed when the controller issues a 4 mA signal.

For operating direction <>, set the range to 4 to 19.5 mA.

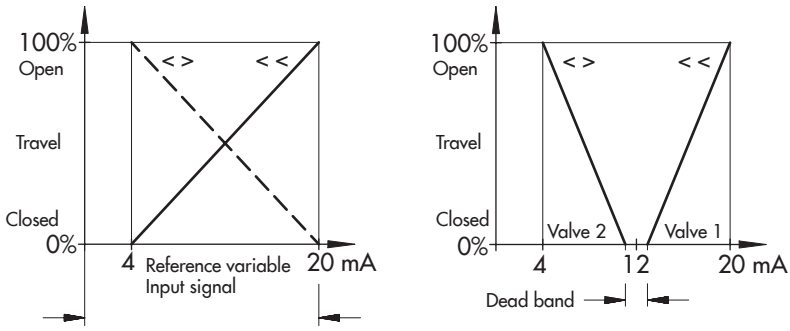


Fig. 13: *Normal or split-range operation*

5.1.1 Adjusting the proportional band Xp and air delivery Q

1. Close the volume restriction (11) as far as the required positioning speed permits.
   Check the positioning speed by pushing the diaphragm lever (3) as far it will go.
2. Adjust the reference variable at the input to approx. 50 % of its range.
3. Turn the zero adjuster (6.2) until the valve has reached approx. mid-travel.
4. Use the adjuster (8) to set the proportional band X_p to a value half way (half turn).
5. Check the valve's tendency to hunt and the positioning speed by briefly tapping the diaphragm lever (3).
   The X_p value is to be adjusted to be as small as possible, without considerable overshooting occurring.

> ***NOTICE***
> *Always adjust the X_p restriction before setting the starting point. Changing it later will cause the zero point to be shifted.*

5.1.2 Settings for actuator with "actuator stem extends" fail-safe action

Starting point (e.g. 4 mA)

1. Set the input signal at the ammeter to 4.5 mA
2. Turn the zero adjuster (6.2) until the valve just starts to move from its initial position.
3. Reduce the input signal to 0 mA and slowly increase it again. Check whether the valve starts to move at exactly 4.5 mA. Correct any deviation at the zero adjuster (6.2).

Upper range value (span) e.g. 20 mA

1. Once the starting point has been set, increase the input signal to 20 mA at the ammeter.

At exactly 20 mA, the plug stem must stand still, having moved through 100 % travel (watch the travel indicator at the valve).
If the upper range value is incorrect, turn the span adjuster (travel). Four turns correspond to a travel change of 10 % in standard operation. In split-range operation, this value is reduced by half.

Turn the adjuster clockwise to reduce the travel and counterclockwise to increase it.

2. After the correction has been completed, reduce the input signal and slowly increase it again.
   Check the starting point and the upper range value. Repeat the correction procedure until both values are correct.

! ***NOTICE***
When setting the zero adjuster (6.2), check whether the actuator is relieved of pressure.
When the input signal is 4 mA and the operating direction >>, or the input signal is 20 mA and the operating direction <>, the pressure gauge must indicate 0 bar.
Correct zero accordingly.

5.1.3 Settings for actuator with "actuator stem retracts" fail-safe action

! ***NOTICE***
When using an actuator with fail-safe action "actuator stem retracts", the diaphragm chamber must be pressurized with a signal pressure that is high enough to tightly close the valve against the upstream pressure in the plant. This applies to an upper range value of the reference variable (20 mA) with operating direction >> as well as a lower range value of the reference variable (4 mA) with operating direction <>.

The **required signal pressure** is either indicated on the positioner label or the required supply pressure can be roughly calculated as described in section 4.1.2.

Starting point (e.g. 20 mA)

1. Set the input signal at the ammeter to 20 mA

2. Turn the zero adjuster (6.2) until the valve just starts to move from its initial position.
3. Increase the input signal and slowly reduce it again to 20 mA. Check whether the valve starts to move at exactly 20 mA.
4. Correct any deviation at the zero adjuster (6.2). Turning the adjuster counterclockwise causes the valve to move from its end position earlier; turning clockwise causes the valve to move from its end position later.

Upper range value (span) e.g. 4 mA

1. Once the starting point has been set, increase the input signal to 4 mA at the ammeter. At exactly 4 mA, the plug stem must stand still, having moved through 100 % travel (watch the travel indicator at the valve).
2. If the upper range value is incorrect, turn the span adjuster (travel). Four turns correspond to a travel change of 10 % in standard operation. In split-range operation, this value is reduced by half.
   Turn the adjuster clockwise to reduce the travel and counterclockwise to increase it.
3. After the correction has been completed, set the input signal to 20 mA again.
4. Turn the zero adjuster (6.2) again until the pressure gauge indicates the **required signal pressure** (see section 4.1.2).

NOTICE

After mounting and tuning the positioner, make sure that the vent plug of the housing cover faces downward when the valve is installed.

5.2 Changing the operating direction

If the operating direction of directly attached positioners (Fig. 3) is to be changed after they have been installed, turn the turnboard (7) and change the position of the connection block, positioner and clamp (1.2).

For attachment according to IEC 60534-6 (NAMUR), turn the turnboard (7) and the positioner on the adapter housing (Fig. 6).

In positioners for rotary actuators, reassign the cam disk as shown in Fig. 9 and Fig. 10.

For details on changing the turnboard (7) refer to section 3.

5.3 Adjusting the limit contacts

The positioner version with inductive limit contacts has two adjustable tags mounted on a rotary shaft which operate the associated proximity switches (50).

The operation of the inductive limit contact requires switching amplifiers to be connected in the output circuit. Refer to section 4.2.1. When the tag (51) is located in the inductive field of the switch, the switch assumes a high resistance. When it moves outside the field, the switch assumes a low resistance.
The limit contacts are usually adjusted to issue a signal for both end positions. The switching points can also be adjusted to indicate intermediate positions.
The switches A and B must be assigned to the end positions of the control valve (valve OPEN or CLOSED) depending on the operating direction and the mounting position according to Table 8 and Table 9.

The terminals 41/42 and 51/52 can optionally be assigned to the switches A and B by turning the associated label on the terminal block (also see Fig. 12).

> **!** ***NOTICE***
> *The tags of the limit contacts cannot be turned by 360°. As a result, it is important to observe the correct assignment of switches A and B to the valve positions (valve CLOSED and valve OPEN), especially when the limit contacts are to be connected in safety circuits.*

The required switching function, i.e. whether the output relay is to be picked up or released when the tag enters the field, must be determined at the switching amplifier.

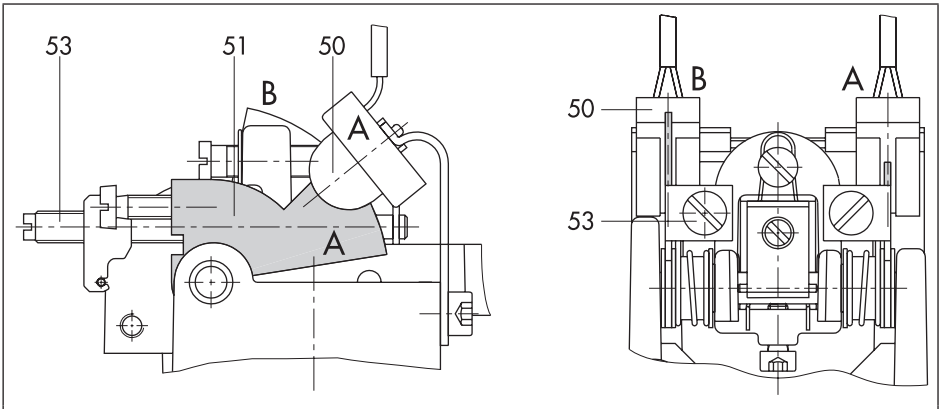


Fig. 14: *Limit contacts*

Adjusting the switching point

Move the valve to the switching point and adjust the tag by turning the adjustment screw (53) so that the switching point is reached and indicated by the LED on the switching amplifier.

To guarantee the switching under all ambient conditions, adjust the switching point approx. 2 % before the mechanical stop (OPEN/CLOSED).

> ***NOTICE***
> *After tuning the positioner, make sure that the vent plug of the housing cover faces downward when the valve is installed.*

Table 8: *Direct attachment to Type 3277 Actuator (Fig. 3)*

	Left attachment		Right attachment	
	Switch			
Valve position	Tag outside inductive field	Tag inside inductive field	Tag outside inductive field	Tag inside inductive field
Closed	B	A	A	B
Open	A	B	B	A

Table 9: *Right or left attachment according to NAMUR (Fig. 6) and attachment to rotary actuators (Fig. 8)*

Direction of action	**Valve position**	**Actuator stem extends (FA)**		**Actuator stem retracts (FE)**	
		Switch Tag		**Switch** Tag	
		Outside inductive field	Inside inductive field	Outside inductive field	Inside inductive field
>>	CLOSED OPEN	B A	A B	A B	B A
<>	CLOSED OPEN	A B	B A	B A	A B

5.4 Adjusting the position transmitter

> ***NOTICE***
> *The starting point (zero) and upper range value (span) must be set before adjusting the position transmitter.*

Depending on the position of the multi-pin connector (symbol on connector: >> or <>), the feedback signal can be set to either a range of 4 to 20 mA or 20 to 4 mA for 0 to 100 % travel.

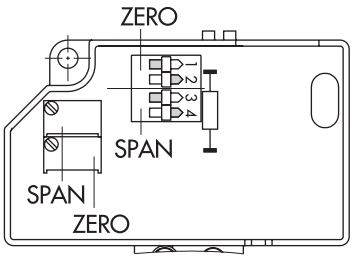


Fig. 15: *Position transmitter*

Zero point

Use the switches 1 and 2 to roughly set the zero point and the ZERO potentiometer for fine-tuning. The adjusted value is always based on a 4 mA signal.

Span

Use the switches 3 and 4 to roughly set the span, i.e. the upper range value, and the SPAN potentiometer for fine-tuning. The adjusted value is always based on a 20 mA signal.

Example:

Move the valve to the open position while observing the position transmitter signal. If the signal does not move in the desired direction, change the position of the multi-pin connector.

Adjust the zero point (4 mA) and span (20 mA) for the valve positions according to Table 10.

Table 10: *Position transmitter*

Valve movement	Observed feedback signal	Direction of signal	Set zero/span to	
OPEN ↑ CLOSED	Signal increases ↑	OK	20 mA 4 mA	Valve OPEN Valve CLOSED
		Not OK → Change connector's position	4 mA 20 mA	Valve OPEN Valve CLOSED
	Signal drops ↓	OK	4 mA 20 mA	Valve OPEN Valve CLOSED
		Not OK → Change connector's position	20 mA 4 mA	Valve OPEN Valve CLOSED

Zero point adjustment

1. Use the input signal of the positioner to move the valve to closed position (valve CLOSED, travel 0 %).
2. The ammeter must now indicate approx. 4 mA.
3. Correct smaller deviations at the ZERO potentiometer until the meter shows exactly 4 mA.
   For larger deviations that cannot be corrected using the potentiometer (adjustment range of approx. 20 turns), set the switches 1 and 2 to indicate an mA value which is within the adjustment range of the ZERO potentiometer.
4. Set the zero point to exactly 4 mA using the ZERO potentiometer.

Adjusting the span

1. Use the input signal of the positioner to move the valve to closed position (valve CLOSED, travel 100 %).
2. The ammeter must now indicate approx. 20 mA.
3. Correct smaller deviations at the SPAN potentiometer until the meter shows exactly 20 mA. If deviations are too high, set the switches 3 and 4 to indicate an mA signal which is within the adjustment range of the SPAN potentiometer.
4. Turn the SPAN potentiometer until the ammeter shows exactly 20 mA.
   Since the zero point and span have a mutual influence on each other, repeat the correction procedure at both potentiometers until both values are correct.

Note:
The following applies to positioners with adapter housing for NAMUR attachment:
When the positioner and the position transmitter signal have different operating directions (<< and <>), it may be impossible to adjust the zero point of the transmitter signal due to the additional deflection caused by the bracket (28) of the adapter housing.
In this case, readjust the black pointer (section 3.2.2 on page 16) so that the sensor of the position transmitter reaches the control range.
Unscrew the clamp. For "actuator stem extends" (FA), shift the pointer upward towards the actuator; for "actuator stem retracts" (FE), shift the pointer downward towards the valve. For valves with rod-type yoke, slightly shift the positioner on the rod in the downward (FE) or upward (FA) direction.

NOTICE
Every time you make a change as described above, the zero point and span of the positioner must be readjusted before adjusting the position transmitter.
After tuning the positioner, make sure that the vent plug of the housing cover faces downward when the valve is installed.

6 Converting and retrofitting the positioner

NOTICE
Read instructions in section 7 for explosion-protected versions!

6.1 Converting from electropneumatic to pneumatic

The electropneumatic positioner can be converted into a Type 3766 Pneumatic Positioner with the following conversion kit:

Required conversion kit:
M20x1.5, order no.: 1400-7575

1. Remove the holder with the terminal block. Disconnect the cable to the i/p module.
2. Unscrew the fastening screws and remove the i/p module (6) including the seals (7, 8).
3. Place the connecting plate (3) with the seal on the housing bores and screw tight. The restriction must be seated in the seal above the right inner bore.
4. Replace the cable gland (5) with the pneumatic screw fitting (1).
5. Connect the silicone hose (2) and insert the guard plate (4) into the housing.
6. Remount the holder with terminal block.
7. Change type designation (model number) on the nameplate to Type 3766 Pneumatic Positioner.

Note:
For details on Type 3766 Positioners, refer to Mounting and Operating Instructions ▶ EB 8355-1.

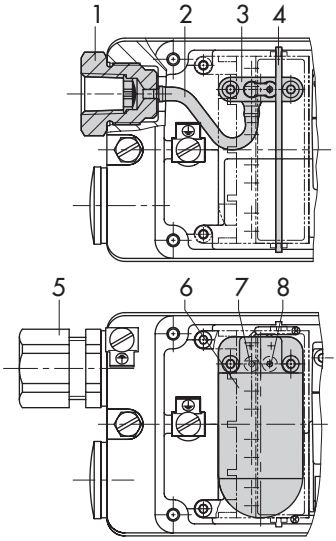


Fig. 16: *Converting the positioner*

6.2 Installing the limit contacts

Accessories: *Limit switch retrofit kit depending on model index 3767-xxxxxxxxxx.**04***
Order no. 1400-8810 for index .06 or higher
Order no. 1400-7573 for index .04/.05
Order no. 1400-6389 for index .03

1. Unscrew the bracket with plate (1).
2. Remove the screws (2) and replace the entire set point calibrator (3) with a calibrator including limit contacts. Make sure the O-ring is inserted into the housing.
3. Attach the terminal block for the limit signals 41/42 and 51/52 in the terminal base.
4. Guide the connecting cable to the terminals and fasten.
   (brown = +, blue = –)
5. Refasten the bracket with plate (1) and stick the adhesive label for the limit switches on the housing cover.
6. Screw additional cable gland onto the housing.

6.3 Installing a solenoid valve

Accessories: *Solenoid valve retrofit kit*
Order no. 1400-7712 for index .05 or lower
Order no. 1400-8808 for index .06

1. Push the plate (5) to one side.
2. Unscrew the four screws (7). Lift off the black cover with the rubber gasket and insert the solenoid valve (6). The rubber gasket with the restriction is located in the rear of the solenoid valve.
3. Unscrew the plate (1).

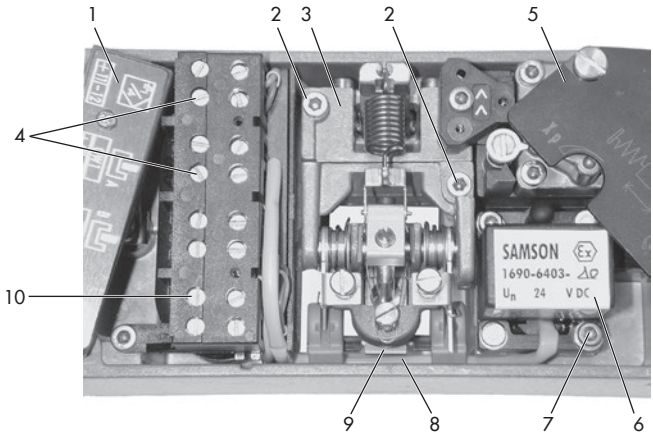


Fig. 17: *Installing the limit switches and solenoid valve*

4. Attach the terminal block (10) for the solenoid valve in the terminal base.
5. Insert the panel (9) at the rear of the positioner and attach it to the set point calibrator using two screws.
6. Guide the connecting cable down behind the mounted panel of the set point calibrator and up again to terminals 81/82 and fasten.
   (brown = +, blue = –)
7. Screw on the bracket with plate (1).
8. Screw additional cable gland onto the housing.

6.4 Removing the solenoid valve

Accessories: *Retrofit kit containing cover for solenoid valve opening: order no. 1400-6949*

1. Unscrew bracket with plate (1). Remove the connecting cable of the solenoid valve from terminals 81/82.
2. Unscrew the two screws (7) that are not sealed with paint and remove the solenoid valve with its connecting cable.
3. Place the rubber gasket on the spigot of the cover and screw it into the housing.
4. Screw on the bracket with plate (1).

7 Servicing explosion-protected devices

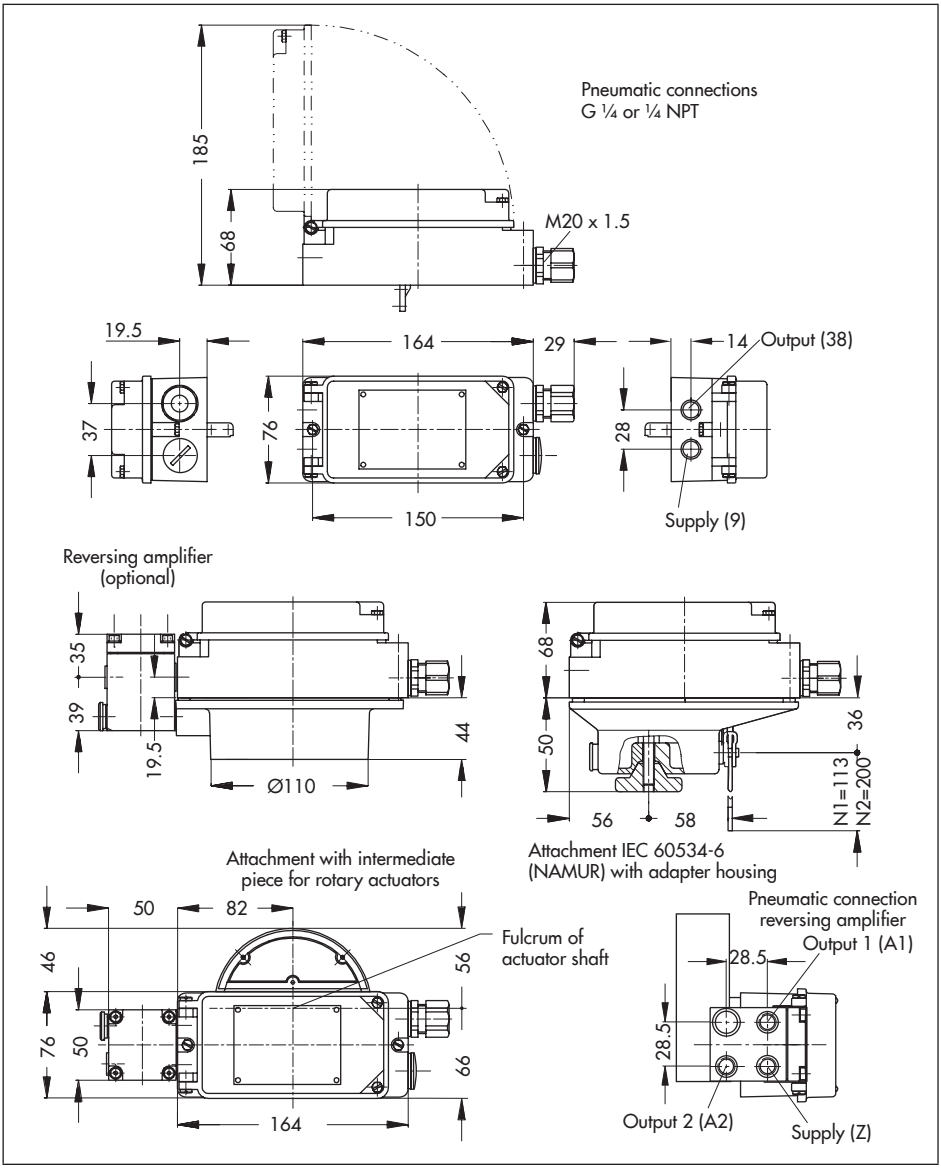
If a part of the device on which the explosion protection is based needs to be serviced, the device must not be put back into operation until a qualified inspector has assessed it according to explosion protection requirements, has issued an inspection certificate or given the device a mark of conformity.

Inspection by a qualified inspector is not required if the manufacturer performs a routine test on the device before putting it back into operation. Document the passing of the routine test by attaching a mark of conformity to the device.

Inspection by a qualified inspector is not required if the manufacturer performs a routine test on the device before putting it back into operation. Document the passing of the routine test by attaching a mark of conformity to the device. Replace explosion-protected components only with original, routine-tested components by the manufacturer.

Devices that have already been used outside hazardous areas and are intended for future use inside hazardous areas must comply with the safety requirements placed on serviced devices. Before being operated inside hazardous areas, test the devices according to the specifications for servicing explosion-protected devices. Observe EN 60079-17 during servicing.

8 Dimensions in mm



Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

PTB

TRANSLATION

(1) **EC TYPE EXAMINATION CERTIFICATE**

(2) Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres – **Directive 94/9/EC**

(3) EC Type Examination Certificate Number

PTB 01 ATEX 2167

(4) Equipment: Model 3767-1.. Positioner

(5) Manufacturer: SAMSON AG Mess- und Regeltechnik

(6) Address: Weismüllerstr. 3, 60314 Frankfurt am Main, Germany

(7) The equipment and any acceptable variations thereof are specified in the schedule to this certificate.

(8) The Physikalisch-Technische Bundesanstalt, notified body number 0102 according to Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the essential health and safety requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres specified in Annex II to the Directive.

(9) The essential health and safety requirements are satisfied by compliance with

EN 50014: 1997 + A1 + A2 EN 50020: 1994

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use as specified in the schedule to this certificate.

(11) According to the Directive 94/9/EC, this EC Type Examination Certificate relates only to the design and construction of the specified equipment. If applicable, further requirements of this Directive apply to the Manufacture and supply of this equipment.

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

PTB

(12) The marking of the equipment shall include the following:

II 2 G EEx ia IIC T6

Zertifizierungsstelle Explosionsschutz Braunschweig, 26 November 2001
By order

(Signature) (Seal)

Dr. Ing. U. Johannsmeyer
Regierungsdirketor

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Physikalisch-Technische Bundesanstalt Bundesallee 100 D-38116 Braunschweig
Ptb16-3767.doc

(13) **S c h e d u l e**

(14) **EC TYPE EXAMINATION CERTIFICATE No. PTB 01 ATEX 2167**

(15) **Description of Equipment**

The model 3767-1.. Positioner is intended for attachment to pneumatic control valves and serves for converting control signals of (0)4 to 20mA from a control device into a pneumatic signal pressure of 6 bar max. For pneumatic auxiliary power non-combustible media are used.

i/p-converter, indictive limit switches, solenoid valves and position indicator are passive two-terminal networks which may be connected to any certified intrinsically safe circuit, provided the permissible maximum values of U_i, I_i and P_i are not exceeded.

The device is intended for use inside and outside of hazardous areas.

The correlation between temperature classification, permissible ambient temperature ranges and maximum short-circuit currents is shown in the table below.

Temperature class	Permissible ambient temperature range	Maximum short-circuit current
T6	-45 °C ... 60 °C	85mA or
T5	-45 °C ... 70 °C	100mA or
T4	-45 °C ... 80 °C	120mA

Electrical data

Model 3767-1 . . .

i/p converter signal circuit (teminals 11/12)

Type of protection: Intrinsic safety EEx ia IIC intrinsically safe circuit

Maximum values

U_i = 28 V
I_i = 100 mA or 85 mA C_i negligible
P_i = 0,7 W L_i negligible or

U_i = 25 V
I_i = 120 mA C_i negligible
P_i = 0,7 W L_i negligible

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Braunschweig und Berlin

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Models 3767 – 11./..- 12. with inductive Limit Switches

Inductive limit switch (terminals 41/42 and 51/52)

Type of Protection: Intrinsic safety EEx ia IIC or EEx ia IIB respectively only for connection to a certified intrinsically safe circuit

Maximum values

U_i = 16 V
I_i = 52 mA
P_i = 169 mW

C_i = 30 nF L_i = 100 µH or

U_i = 16 V
I_i = 25 mA
P_i = 64 mW

C_i = 30 nF L_i = 100 µH

For positioners with inductive limit switches the correlation between temperature classification, permissible ambient temperature ranges and maximum short-circuit currents is shown in the table below.

Temperature class	Permissible ambient temperature range	Maximum short-circuit current
T6	-45 °C ... 45 °C	52 mA or
T5	-45 °C ... 60 °C	
T4	-45 °C ... 75 °C	
T6	-45 °C ... 60 °C	25 mA
T5	-45 °C ... 80 °C	
T4	-45 °C ... 80 °C	

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Model 3767-16 with Position Indicator

Signal Circuit (terminals 31/32)	Type of protection: Intrinsic safety EEx ia IIC
Maximum values:	U_i = 28 V I_i = 115 mA P_i = .1 W C_i = 5.3 nF, L_i = .negligible

Model 3767-1.2/ ..-1.3/..-1.4 with Solenoid Valve

Signal Circuit (terminals 81/82)	Type of protection: Intrinsic safety EEx ia IIC

The correlation between version, temperature classification, permissible ambient temperature ranges and maximum power dissipation is shown in the table below:

Version U_N		**6V**	**12 V**	**24 V**
Temperature class	**T6**	60 °C		
	T5	-45 °C ≤ **T_a** ≤ 70 °C		
	T4	80 °C		
Characteristic linear or rectangular	**P_i**	#	##	

C_i negligible L_i negligible

\# The permissible maximum power dissipation Pi in the 6 V version is 250 mW
\## The maximum values for connection to a certified intrinsically safe circuit are shown in the table below:

U_i	25 V	27 V	28 V	30 V	32 V
I_i	150 mA	125 mA	115 mA	100 mA	85 mA
P_i	**no limitation**				

C_i negligible L_i negligible

(16) **Test report** PTB Ex 01-21200

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

PTB

(17) **Special conditions for safe use**

None

(18) **Special health and safety requirements**

In compliance with the standards specified above.

Zertifizierungsstelle Explosionsschutz Braunschweig, 26 November 2001
By order

(Signature) (seal)

Dr. Ing. U. Johannsmeyer
Regierungsdirektor

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Ptb16-3767.doc

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

PTB

TRANSLATION

(1) **Statement of conformity**

(2) Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres – **Directive 94/9/EC**

(3) EC Type Examination Certificate Number

PTB 01 ATEX 2170 X

(4) Equipment: Model 3767-8 Positioner

(5) Manufacturer: Samson AG

(6) Address: Weismüllerstr. 3, D-60314 Frankfurt, Germany

(7) This equipment and any acceptable variation therefore are specified in the schedule to this certificate and the documents referred to therein.

(8) The Physikalisch-Technische Bundesanstalt, notified body number 0102 in according to Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive.

The examination and test results are recorded in confidential report **PTB Ex 01-21201**.

(9) The Essential Health and Safety Requirements are satisfied by compliance with

EN 50021: 1999

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) In compliance with the Directive 94/9/EC this Statement of Conformity relates only to the design and construction of the equipment specified. Further requirements of this Directive apply to manufacture and marketing of this equipment.

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

PTB

(12) The marking of the equipment shall include the following:

Ex II 3 G EEx nA II T6

Zertifizierungsstelle Explosionsschutz
By order

Braunschweig, 2002-03-07

(Signature) (Seal)

Dr. Ing. U. Johannsmeyer
Regierungsdirektor

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Physikalisch-Technische Bundesanstalt, Bundesallee 100, D-38116 Braunschweig

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Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

(13) # Schedule

(14) ## Statement of Conformity PTB 01 ATEX 2170 X

(15) **Description of Equipment**

The Model 3767-8... Positioner is intended for attachment to pneumatic control valves and serves for converting control signals of (0)4 . . .20mA from a control devices into a pneumatic signal pressure of 6bar max. For pneumatic auxiliary power non-combustible media are used. The inductive limit switches, position indicators and solenoid valves are passive two networks.

The device is intended for use inside and outside of hazardous areas...

The correlation between temperature classification and permissible ambient temperature ranges is shown in the table below:

Temperature class	Permissible ambient temperature range	Maximum short-circuit current
T6	60°C	85mA or
T5	-45°C ≤ Ta ≤ 70°C	100mA or
T4	80°C	120mA

Electrical data

Model 3767-8 . . .

Signal circuit (i/p-Converter) (terminals 11/12) — Type of protection: EEx nA II

Inductive limit switch (terminals 41/42 and 51/52) — Type of protection EEx nA II

Model 3767-86 with Position Indicator

Signal circuit (terminals 31/32) — Type of protection EEx nA II

The correlation between version and temperature classification is shown in the table below:

Version U_N		6V	12 V	24 V
Temperature class	T6	60°C		
	T5	-45°C ≤ Ta ≤ 70°C		
	T4	80°C		

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

(16) Test report: **PTB Ex 01-21201**

Schedule of the Statement of Conformity PTB 01 ATEX 2170 X

(17) **Special conditions for safe use**

The Model 3767-8 . . . Positioner shall be installed in an enclosure providing at least Degree of Protection IP 54 in compliance with the IEC Publication 60529:1989.
This requirement applies also to the cable entries and/or plug connectors.

The wiring shall be connected in such a manner that the connection facilities are not subjected to pull and twisting.

The signal circuit (terminals 11/12 i/p-converter) and the signal circuit (terminals 31/32 position indicator) shall be provided with a series-connected fuse outside of the hazardous area.
This fuse shall comply with IEC 127-2/II, 250V F, or with IEC 127-2/VI, 250V T, with a fuse nominal current I_N of ≤ 50mA max.

(18) **Basic health and safety requirements**

Are satisfied by compliance with the standard specified.

Zertifizierungsstelle Explosionsschutz — Braunschweig, 07 März 2002
By order

(Signature) (seal)

Dr. Ing. U. Johannsmeyer

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Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

ADDENDUM No. 1

to the Statement of Conformity PTB 01 ATEX 2170 X

Equipment: Model 3767-8.. Positioner

Marking: Ex II 3 G EEx nA II T6

Manufacturer: SAMSON AG

Address: Weismüllerstr. 3, D-60314 Frankfurt, Germany

Description of the additions and modifications

The coverage of the existing Statement of Conformity is supplemented by the electrical data of the model series 3767-8.2, -8.3, - 8.4 with solenoid valve module. The design of the equipment was not changed.

Electrical data

Model 3767-8..
Signal circuit (terminals 11/12) — Type of protection EEx nA II

Inductive proximity switch
(terminals 41/42 and 51/52) — Type of protection EEx nA II

Model 3767-86. with Position Indicator
Signal circuit (terminals 31/32) — Type of protection EEx nA II

Models 3767-8.2, -8.3, -8.4 with Solenoid Valve
Signal circuit, nominal signal (terminals 81/82) — Type of protection EEx nA II

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

Addendum No. 1 to the Statement of Conformity PTB 00 ATEX 2170 X

The correlation between equipment version and temperature classification is shown in the table below:

Version	Un	6V	12V	24V
Temperature class	T6	60°C		
	T5	-45°C ≤ Ta ≤ 70°C		
	T4	80°C		

All the other data apply unchanged also to this Addendum No. 1.

Test report: PTB EX 03-23230

Zertifizierungsstelle Explosionsschutz
By order

Braunschweig, 28. May 2003

(Signature) (Seal)

Dr. Ing. U. Johannsmeyer
Regierungsdirektor

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Ptb16Ex n Add-1.doc

Installation Manual for apparatus certified by CSA for use in hazardous locations.

Electrical rating of intrinsically safe apparatus and apparatus for installation in hazardous locations.

Table 1: Maximum values

	i/p-circuit	Position-indicator	Limit switches (inductive)	Solenoid valve
Circuit No.	1	2	3 and 4	5
Terminal No.	11 / 12	31 / 32	41 / 42 and 51 / 52	81 / 82
U_i or V_{max}	28V	28V	16V	28V
I_i or I_{max}	115mA	115mA	25/52 mA	115mA
P_i or P_{max}	0,7W	1W	64/169mW	250mW (##)
C_i	0nF	5.3nF	30nF	0nF
L_i	0µH	0µH	100µH	0µH

Notes: Entity parameters must meet the following requirements:
(##) Solenoid valve 12V and 24V version P_i or P_{max} no limited

U_o or $V_{oc} \leq U_i$ or V_{max} / I_o or $I_{oc} \leq I_i$ or I_{max} / $P_o \leq P_i$ or P_{max}; $C_a \geq C_i$ and $L_a \geq L_i$

Table 2: CSA– certified barrier parameters of circuit 1, 2 and 5

Barrier	Supply barrier		Evaluation barrier	
	V_{max}	R_{min}	V_{max}	
circuit 1	≤ 28V	≥ 280Ω	≤ 28V	Diode Return
circuit 2	≤ 28V	≥ 280Ω	≤ 28V	Diode Return
circuit 5 (#)	≤ 28V	≥ 280Ω	≤ 28V	Diode Return
circuit 5 (##)	≤ 28V	≥ 280Ω	≤ 28V	Diode Return

circuit 5: (#) = 12V and 24V version; (##) = 6V version.

Table 3: The correlation between temperature classification and permissible ambient temperature ranges is shown in the table below:

Temperature class	Permissble ambient temperature range
T6	- 45°C ... 60°C
T5	- 45°C ... 70°C
T4	- 45°C ... 80°C

Table 4: For the Model 3767 – 3 Positioner the correlation between temperature classification, permissible ambient temperature ranges and maximum short- circuit current is shown in the table below:

Temperature class	Permissible ambient temperature range	Maximum short-circuit current
T6	- 45°C ... 45°C	52mA
T5	- 45°C ... 60°C	
T4	- 45°C ... 75°C	
T6	- 45°C ... 60°C	25mA
T5	- 45°C ... 80°C	
T4	- 45°C ... 80°C	

Intrinsically safe if installed as specified in manufacturer's installation manual.

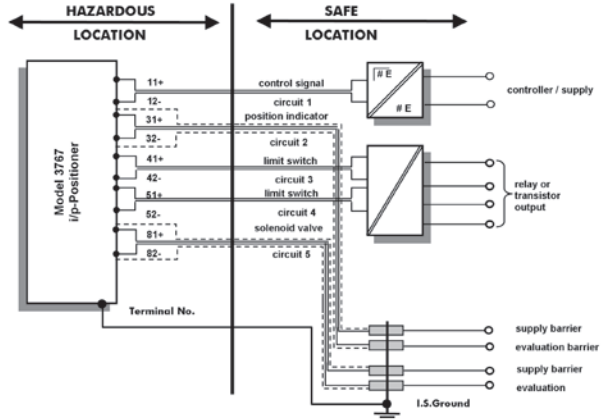
CSA- certified for hazardous locations

Ex ia IIC T6; Class I, Zone 0 **Type 4 Enclosure**
Class I; Groups A, B, C, D
Class II; Groups E, F + G; Class III

Notes:
1.) Max. two cable entries per positioner

2.) Each pair of I.S. wires must be protected by a shield that is grounded at the I.S. Ground. The shield shall extend as close to the terminal as possible.

3.) The installation shall be in accordance with the Canadian Electrical Code Part 1.



Version: Model 3767-3 with i/p-converter, solenoid valve and inductive limit switches.
Model 3767-36 with i/p-converter and position indicator.

Circuit 1:Controller CSA- certified or CSA– certified barriers

Relay or transistor output 3 or 4 channel(s) resp. CSA certified.

Supply and evaluation barrier CSA- certified

Position indicator channel 2 only version 3767-36

For the permissible maximum values for the intrinsically safe circuits see Table 1
For the permissible barrier parameters for the circuits 2 and 5 see Table 2

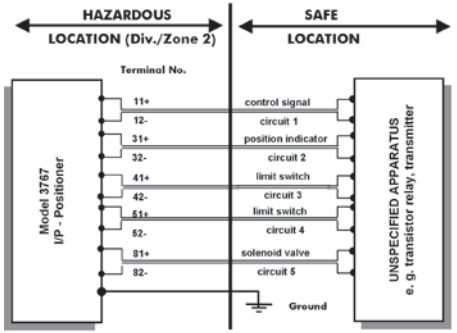
Cable entry M 20 x 1.5 or metal conduit according to drawing No. 1050 – 0539 T
or 1050 – 0540 T

On interconnection to form ground- free signal circuits, only evaluation barriers shall be installed in the return line. Correct polarity shall be ensured.

CSA- certified for hazardous locations

Class I; Div. 2, Groups A, B, C, D **Type 4 Enclosure**
Class II, Div. 2, Groups, E, F + G, Class III

I/P - Positioner with position indicator, solenoid valve and limit switches.



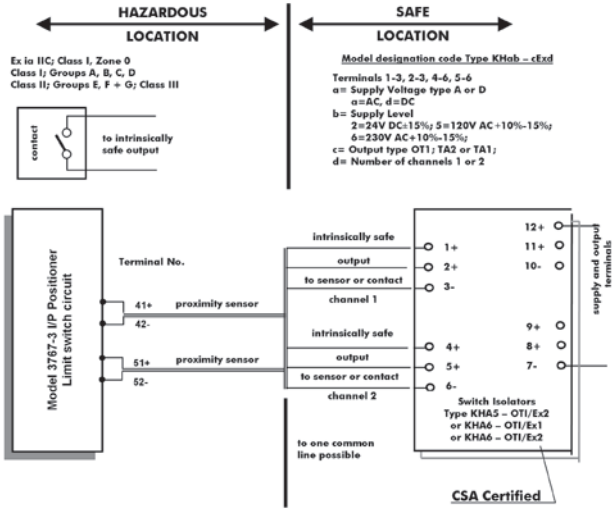
1.) The installation shall be in accordance with the Canadian Electrical Code Part 1.

2.) For the maximum values for the individual circuits see Table 1 and 2.

3.) The cables shall be protected by conduits.

4.) Cable entry only rigid metal conduit according to drawing No. 1050-0539 T and 1050-0540 T

Installation drawing Control Relay KHA5–OTI/Ex2, KHA6–OTI/Ex1 or KHA6–OTI/Ex2 with Model SJ-b-N Proximity Sensors



The total series inductance and shunt capacitance of shield wiring shall be restricted to the following maximum values

maximum capacitance of each inductive sensor 30nF
maximum inductance of each inductive sensor 100µH

System parameters

Control Relay Terminal No.	Groups	L [mH]	C [µF]	Voc [V]	Isc [mA]	Vmax [V]	Rmin [Ω]
1-3; 2-3 4-6; 5-6	A + B	84.88	1.273	↑	↑	↑	↑
	C + D	298.7	3.82	12.6	19.8	12.6	650
	E, F, G	744.4	10.18	↓	↓	↓	↓

Division 2 wiring method shall be in accordance to the Canadian Electrical Code Part 1.

Installation Manual for apparatus approved by FM for use in hazardous locations

Electrical rating of intrinsically safe apparatus and apparatus for installation in hazardous locations.

Table 1: Maximum values

	i/p-circuit	Position-indicator	Limit switches inductive	Solenoid valve
Circuit No.	1	2	3 and 4	5
Terminal No.	11 / 12	31 / 32	41 / 42 and 51 / 52	81 / 82
U_i or V_{max}	28V	28V	16V	28V
I_i or I_{max}	115mA	115mA	25/52 mA	115mA
P_i or P_{max}	0,7W	1W	64/169mW	250mW (##)
C_i	0nF	5.3nF	30nF	0nF
L_i	0µH	0µH	100µH	0µH

Notes: Entity parameters must meet the following requirements:
(##) Solenoid valve 12V and 24V version P_i or P_{max} no limited
(##)Solenoid valve 6V version P_i or P_{max} 250mW

U_o or V_{oc} or $V_t \leq U_i$ or V_{max} / I_o or I_{oc} or $I_t \leq I_i$ or I_{max} / P_o or $P_{max} \leq P_i$ or P_{max}
$C_a \geq C_i + C_{cable}$ and $L_a \geq L_i + L_{cable}$

Table 2: FM/CSA – approved barrier parameters of circuit 2 and 5

Barrier	Supply barrier				Evaluation barrier		
	Voc	Rmin	Ioc	Pmax	Voc	Rmin	Isc
circuit 1	≤ 28V	≥ 280Ω	≤ 115mA	≤ 0,7W	≤ 28V	#	0mA
circuit 2	≤ 28V	≥ 196Ω	≤ 115mA	≤ 1W	≤ 28V	#	0mA
circuit 5 (#)	≤ 28V	≥ 200Ω	≤ 115mA	(#)	≤ 28V	#	0mA
circuit 5 (##)	≤ 28V	≥ 785Ω	≤ 115mA	(##)	≤ 28V	#	0mA

circuit 5: (#) = 12V and 24V version; (##) = 6V version.

Table 3: The correlation between temperature classification and permissible ambient temperature ranges is shown in the table below:

Temperature class	Permissble ambient temperature range
T6	60°C
T5	- 40°C ≤ ta ≤ 70°C
T4	80°C

Table 4: For the Model 3767 – 3 Positioner the correlation between temperature classification, permissible ambient temperature ranges and maximum short- circuit current is shown in the table below:

Temperature class	Permissible ambient temperature range	Maximum short-circuit current
T6	45°C	52mA
T5	- 40°C ≤ ta ≤ 60°C	
T4	75°C	
T6	60°C	25mA
T5	- 40°C ≤ ta ≤ 80°C	
T4	80°C	

FM- approved for hazardous locations

Class I, Zone 0 AEx ia IIC T6 **NEMA Type 4X**
Class I, II, III Division 1, Groups A, B, C, D; E, F + G

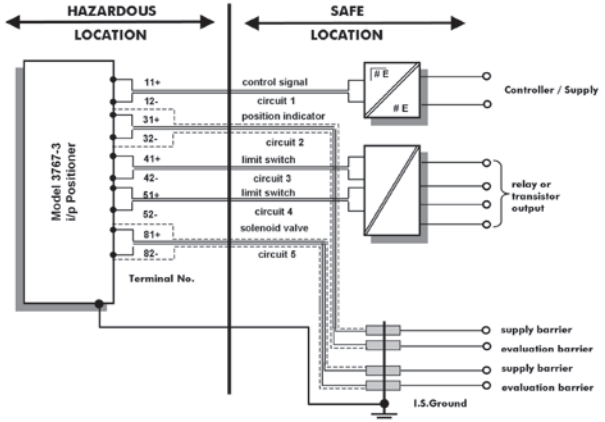
Notes:

1.) The apparatus may be installed in intrinsically safe circuits only when used in conjunction with the FM approved apparatus. For maximum values of
Ui or V_{max} ; Ii or I_{max}; Pi or P_{max} ; Ci and Li of the various apparatus see Table 1.

2.) The apparatus may be installed in intrinsically safe circuits only when used in conjunction with the FM approved intrinsically safe barrier.
For barrier selection see Table 2.

3.) Installation must be in accordance with the National Electrical Code ANSI/NFPA 70 and ANSI/ISA RP 12.06.01

4.) Use only supply wires suitable for 5°C above surrounding temperature.



Version: Model 3767-3 with i/p-converter, solenoid valve and inductive limit switch(es).
Model 3767-36 with i/p-converter and position indicator.

Circuit 1:Controller FM/CSA- approved or FM/CSA – approved barriers

Relay or transistor output 3 or 4 channel(s) resp. FM/CSA approved.
Supply and evaluation barrier FM/CSA- approved.
Position indicator channel 2 only version 3767-36

For the permissible maximum values for the intrinsically safe circuits see Table 1
For the permissible barrier parameters for the circuits 2 and 5 see Table 2

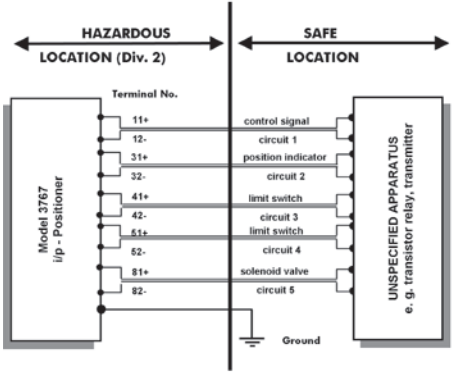
Cable entry M 20 x 1.5 or metal conduit according to drawing No. 1050 – 0539 T or 1050 – 0540 T

FM- approved for hazardous locations

Class I, Division 2, Groups A, B, C, D
Class II Division 2, Groups F + G; Class III

NEMA Type 4X

i/p - positioner with position indicator, solenoid valve and limit switches.



Notes:

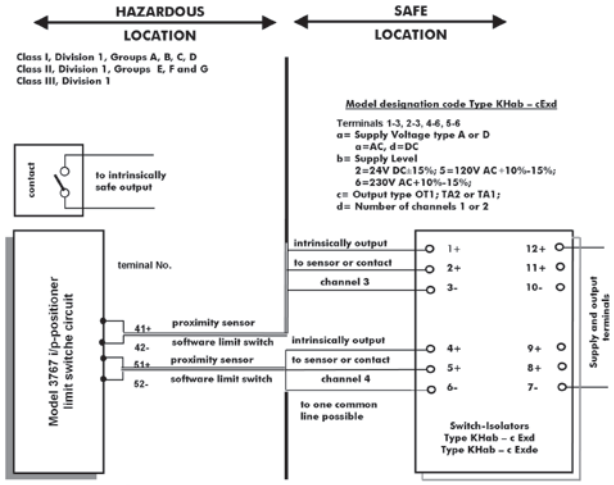
1.) The installation must be in accordance with the National Electrical Code ANSI/NFPA 70

2.) For the maximum values for the individual circuits see Table 1 and 2.

3.) The cables shall be protected by conduits.

4.) Cable entry only rigid metal conduit according to drawing No. 1050-0539 T and 1050-0540 T

Installation drawing Control Relay KHab-cEx de with Model SJ-b-N Proximity Sensors



Model designation code Type KHab – cExd

Terminals 1-3, 2-3, 4-6, 5-6
a= Supply Voltage type A or D
a=AC, d=DC
b= Supply Level
2=24V DC±15%; 5=120V AC +10%-15%;
6=230V AC+10%-15%
c= Output type OT1; TA2 or TA1;
d= Number of channels 1 or 2

maximum capacitance of each inductive sensor 30nF
maximum inductance of each inductive sensor 100µH

Model designation code Type KHab – cExde

a= Supply Voltage type A or D
a=AC, d=DC
b= Supply Level
2=24V DC±15%; 5=120V AC +10%-15%;
6=230V AC+10%-15%;
c= Output type RTA/; RW1/; SS1/; SS2/; RS1/; SR/; ST-or SOT
d= Number of channels 1 or 2
e= Power rail designation, P, 2S.P or GS.P (includes Model KHD2-EB-PB Power Feed Module) or Blank

The total series inductance and shunt capacitance of shield wiring shall be restricted to the following maximum values

Control Relay Terminal No.	Groups	L [mH]	C [µF]	V_{OC} [V]	I_{SC} [mA]
1-3; 2-3 4-6; 5-6	A + B	84,8	1,27	12,9	19,8
	C + E	299	3,82		
	D, F, G	744	10,2		

SAMSON AG · MESS- UND REGELTECHNIK
Weismüllerstraße 3 · 60314 Frankfurt am Main, Germany
Phone: +49 69 4009-0 · Fax: +49 69 4009-1507
samson@samson.de · www.samson.de

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