

# Solenoid Valve Type 3966

with type of protection "Flameproof enclosure" Ex d and "Intrinsically safe" Ex ia for the control of pneumatic actuators



## General

The Type 3966 Solenoid Valve is used to control rotary actuators with NAMUR interface or linear actuators with NAMUR rib.

Intrinsically safe, low-power binary signals issued by automation or fieldbus systems can be used for controlling purposes.

Different nominal signals, switching functions and attachment types allow the solenoid valve to be tailor-made to the specific task. Special features of the Type 3966 Solenoid Valve include:

### General features

- Service life up to 20 million switching cycles
- Ambient temperature  $-45$  to  $+80$  °C
- Corrosion-resistant enclosure with degree of protection IP 66, Type 4X for humid and aggressive environments
- NAMUR interface acc. to VDI/VDE 3845 for rotary actuators or connection block with positioner for SAMSON Type 3277 Linear Actuators
- Adapter plate for linear actuators with NAMUR rib acc. to IEC 60534-6-1 as well as panel, wall or rail mounting

### Electric features

- E/P binary converter with flapper/nozzle assembly
- Types of protection
  - II 2 G Ex d IIC T6 (gases in zone 1),
  - II 2 D Ex td A21 IP66 T80°C (dusts in zone 21),
  - II 2 G Ex ia IIC T6 Gb (gases in zone 1),
  - II 2 D Ex ia IIIC T80°C Db IP66 (dusts in zone 21),
  - II 2 D Ex tb IIIC T85°C Db IP66 (dusts in zone 21),
  - II 3 G Ex ic IIC T6 Gc (gases in zone 2),
  - II 3 G nAc II T6 Gc (gases in zone 22),
  - II 3 D Ex tc IIIC T80°C Dc IP66 (dusts in zone 22)
 according to ATEX, additional certifications according to FM and GOST-R
- Nominal signal 6/12/24/120 V DC or 120/240 V AC
- Manual override (optional)
- Cable entry M 20  $\times$  1.5 (1/2 NPT)

### Pneumatic features

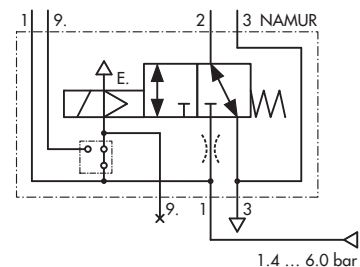
- Plug/seat valve with return spring
- 3/2-way function, connectable as Normally closed (NC) or Normally open (NO)
- $K_{VS}$  value 0.9
- Air supply pressure max. 6.0 bar
- Operating pressure max. 10.0 bar
- Threaded connection G 1/4 (1/4 NPT)



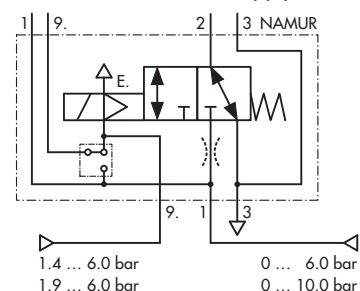
Fig. 1

## Switching functions

### Normally closed (NC) – Internal air supply



### Normally closed (NC) – External air supply



### Normally open (NO) – External air supply

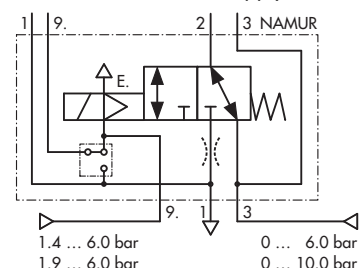


Fig. 2

## Applications

Attachment to rotary actuators with  
NAMUR interface acc. to VDI/VDE 3845



Fig. 3

Attachment to linear actuators with  
NAMUR rib acc. to IEC 60534-6-1



Fig. 4

Attachment to connection block with  
positioner for SAMSON Type 3277  
Linear Actuators

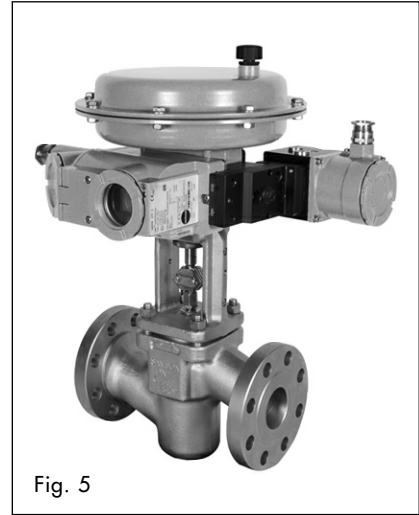


Fig. 5

Panel and wall mounting



Fig. 6

Rail mounting acc. to EN 60715



Fig. 7

## Function

The solenoid valve consists of an E/P binary converter ④ with manual override ⑤ and a 3/2-way booster valve ⑥ with return spring (Fig. 8).

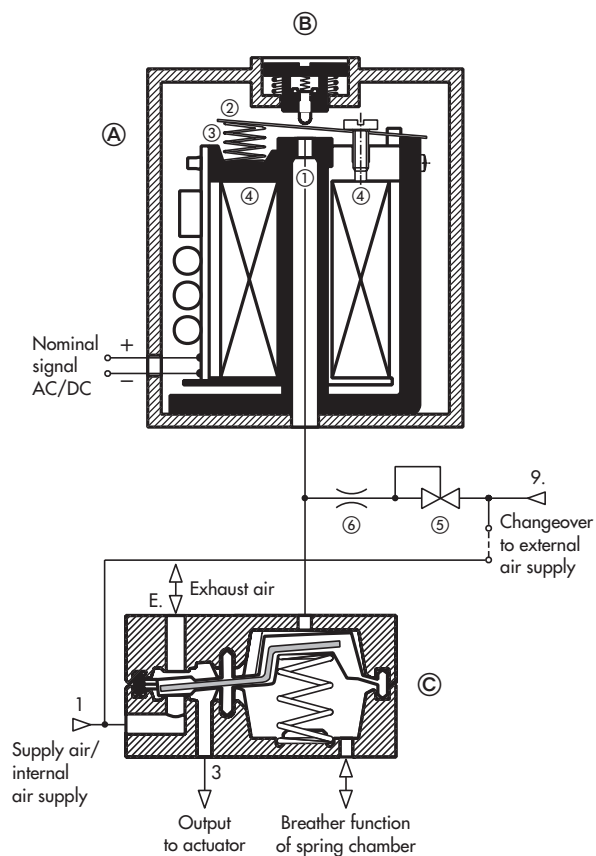
The air supply for the E/P binary converter ④ is connected internally over connection 1 or externally over connection 9. The air supply source can be changed by turning a flat gasket on the enclosure.

The pressure reducer ⑤ reduces the air supply pressure to 1.4 bar.

In the normal position the flapper ② is lifted off the outlet nozzle ① by the spring ③. As a result, a pressure lower than the switch-off pressure of the booster valve ⑥ builds up in the pressure divider that consists of the restriction ⑥ and the outlet nozzle ①. When the solenoid ④ is energized by an electrical binary signal, the outlet nozzle ① is closed by the flapper ② against the force of the spring ③. As a result, the pressure in the pressure divider rises above the switch-on pressure of the booster valve ⑥, thus switching it to the operating position. After de-energizing the electrical binary signal, the booster valve ⑥ is switched to the normal position by a return spring.

The 3/2-way booster valve ⑥ can be connected as Normally closed (NC) or Normally open (NO).

## Functional diagram



- ④ E/P binary converter
- ① Outlet nozzle
- ② Flapper
- ③ Spring
- ④ Solenoid
- ⑤ Pressure reducer
- ⑥ Restrictor
- ⑤ Manual override (optional)
- ⑥ 3/2-way booster valve

Fig. 8

## Technical data

General data	
Construction	Solenoid with flapper/nozzle and booster valve
Material Enclosure	Aluminum, powder-coated, grayish-beige RAL 1019 (pilot valve), aluminum, anodized, black (booster valve), stainless steel (optional)
Plate "air supply internal/external"	Aluminum, powder-coated, grayish-beige RAL 1019, stainless steel (optional)
Gaskets and diaphragms	Nitrile butadiene rubber (NBR), vinyl methyl silicone rubber (VMQ)
Exterior parts	Stainless steel
Elektromagnetic compatibility	Requirements acc. to EN 61000-6-2, EN 61000-6-3 and NAMUR Recommendation NE 21 are met
Degree of protection	IP 66, Type 4X
Explosion protection ATEX <sup>1)</sup>	II 2 G Ex d IIC T6/II 2 D Ex tD A21 IP66 T80°C
ATEX <sup>2)</sup>	II 2 G Ex ia IIC T6 Gb/II 2 D Ex ia IIIC T80°C Db IP66/II 2 D Ex tb IIIC T85°C Db IP66 II 3 G Ex ic IIC T6 Gc/II 3 G Ex nAc II T6 Gc/II 3 D Ex tc IIIC T80°C Dc IP66
GOST-R <sup>3)</sup>	1Ex d IIC T6; DIP A21 T80°C IP 66
FM <sup>4)</sup>	Class I, Division 1, Groups ABCD, T6 ... T4, Type 4X, Class II, Division 1, Groups EFG, T6 ... T4, Type 4X, Class III, Division 1, T6 ... T4, Type 4X, Class I, Zone 1, AEx d IIC T6 ... T4, Type 4X
Mounting position	As desired (see Mounting and Operating Manual EB 3966 EN)
Electrical connection Cable entry	M 20 × 1.5 (1/2 NPT) to a 2-pole screw terminal and two ground terminals (inside and outside)
Connecting cable	Conductor cross-section of 0.2 to 2.5 mm <sup>2</sup> (flexible) or 0.2 to 4 mm <sup>2</sup> (fixed)
Air connection	G 1/4 (1/4 NPT) and NAMUR interface 1/4" acc. to VDI/VDE 3845
Ambient temperature <sup>5)</sup>	-20 ... +80 °C, -45 ... +80 °C
Weight approx.	1.60 kg, 1.95 kg with adapter plate made of aluminum

1) Acc. to EC Type Examination Certificate PTB 08 ATEX 1024

2) Acc. to EC Type Examination Certificate PTB 08 ATEX 1021

3) Acc. to GOST-R Certificate of Compliance and Operating License

4) Acc. to FM Certificate of Compliance

5) The maximum permissible ambient temperature depends on the permissible ambient temperature of the cable gland, the type of protection and the temperature class.

Pneumatic data	
Construction	Plug/seat booster valve with return spring
Switching function	3/2-way function, connectable as Normally closed (NC) or Normally open (NO)
K <sub>VS</sub> value <sup>1)</sup> Normally closed (NC)	0.35 (supply from 1 to 2 with baffle plate), 0.90 (supply from 1 to 2 without baffle plate), 0.90 (venting from 2 to 3)
Normally open (NO)	0.90 (supply from 3 to 2), 0.90 (venting from 2 to 1 without baffle plate), 0.35 (venting from 2 to 1 with baffle plate)
Quality of compressed air according to ISO 8573-1	Particle size and density: Class 4, Oil contents: Class 3, Pressure dew point: Class 3 or at least 10 K below the lowest ambient temperature to be expected
Flow rate	Min. 1.6 times larger than the K <sub>VS</sub> coefficient of the device
Air supply pressure internal (1)	1.4 ... 6.0 bar
external (9)	1.4 ... 6.0 bar (at 0 ... 6.0 bar operating pressure), 1.9 ... 6.0 bar (at 0 ... 10.0 bar operating pressure)
Operating pressure	0 ... 6.0 bar <sup>2)</sup> , 0 ... 10.0 bar <sup>3)</sup>
Air consumption of the pilot valve at 1.4 bar air supply	≤ 25 l/h (actuated), ≤ 80 l/h (not actuated)

1) Air flow at p<sub>1</sub> = 2.4 bar and p<sub>2</sub> = 1.0 bar can be calculated according to the following equation: Q = K<sub>VS</sub> × 36.22, expressed in m<sup>3</sup>/h.

2) Internal connection of air supply.

3) External connection of air supply.

<b>Electrical data</b>							
<b>Type 3966</b>		<b>-0001</b>	<b>-0002</b>	<b>-0003</b>	<b>-0004</b>	<b>-0005</b>	<b>-0006</b>
Nominal signal	$U_N$	<b>6 V DC</b>	<b>12 V DC</b>	<b>24 V DC</b>	<b>120 V DC</b>	<b>240 V AC</b>	<b>120 V AC</b>
	$U_{max}$ <sup>1)</sup>	36 V	60 V	60 V	240 V	340 V	240 V
	$f_N$	-	-	-	-	50 ... 60 Hz	
Switching point "On"	$U_{min. +80^\circ C}$	$\geq 4.8$ V	$\geq 8.6$ V	$\geq 15.6$ V	$\geq 87$ V	$\geq 188$ V	$\geq 97$ V
	$I_N$	$\geq 1.4$ mA	$\geq 1.4$ mA	$\geq 1.4$ mA	$\geq 1.9$ mA	$\geq 2.0$ mA	$\geq 1.9$ mA
	$P_N$	$\geq 5.3$ mW	$\geq 10.4$ mW	$\geq 19.7$ mW	$\geq 209$ mW	$\geq 459$ mW	$\geq 225$ mW
	"Off"	$U_{max. -45^\circ C}$	$\leq 1.0$ V	$\leq 2.2$ V	$\leq 4.2$ V	$\leq 26$ V	$\leq 55$ V
<b>Type of protection Ex d IIC<sup>2)</sup></b>							
<b>Type 3966</b>		<b>-2101</b>	<b>-2102</b>	<b>-2103</b>			
Nominal signal	$U_N$	<b>6 V DC</b>	<b>12 V DC</b>	<b>24 V DC</b>			
Permissible ambient temperature see EC Type Examination Certificate PTB 08 ATEX 1024							
<b>Type of protection Ex ia IIC/Ex ia IIIC/Ex tb IIIC<sup>3)</sup></b>							
<b>Type 3966</b>		<b>-1101</b>	<b>-1102</b>	<b>-1103</b>			
Nominal signal	$U_N$	<b>6 V DC</b>	<b>12 V DC</b>	<b>24 V DC</b>			
Permissible maximum values for connection to a certified intrinsically safe input circuit see EC Type Examination Certificate PTB 12 ATEX 2021							
<b>Type of protection Ex ic IIC/Ex nAc II/Ex tc IIIC<sup>4)</sup></b>							
<b>Type 3966</b>		<b>-8101</b>	<b>-8102</b>	<b>-8103</b>			
Nominal signal	$U_N$	<b>6 V DC</b>	<b>12 V DC</b>	<b>24 V DC</b>			
Permissible maximum values for connection to a certified intrinsically safe input circuit see EC Type Examination Certificate PTB 12 ATEX 2021							

1) Permissible maximum values during continuous duty.

2) Marking II 2 G Ex db IIC T6/II 2 D Ex tb IIIC T80°C IP66

3) Marking II 2 G Ex ia IIC T6 Gb/II 2 D Ex ia IIIC T80°C IP66/II 2 D Ex tb IIIC T85°C IP66

4) Marking II 3 G Ex ic IIC T6 Gc/II 3 G Ex nAc II T6 Gc/II 3 D Ex tc IIIC T80°C Dc IP66

**Type 3966 Solenoid Valve with NAMUR interface acc. to VDI/VDE 3845  
for rotary actuators or connection block with positioner for SAMSON Type 3277 Linear Actuators**

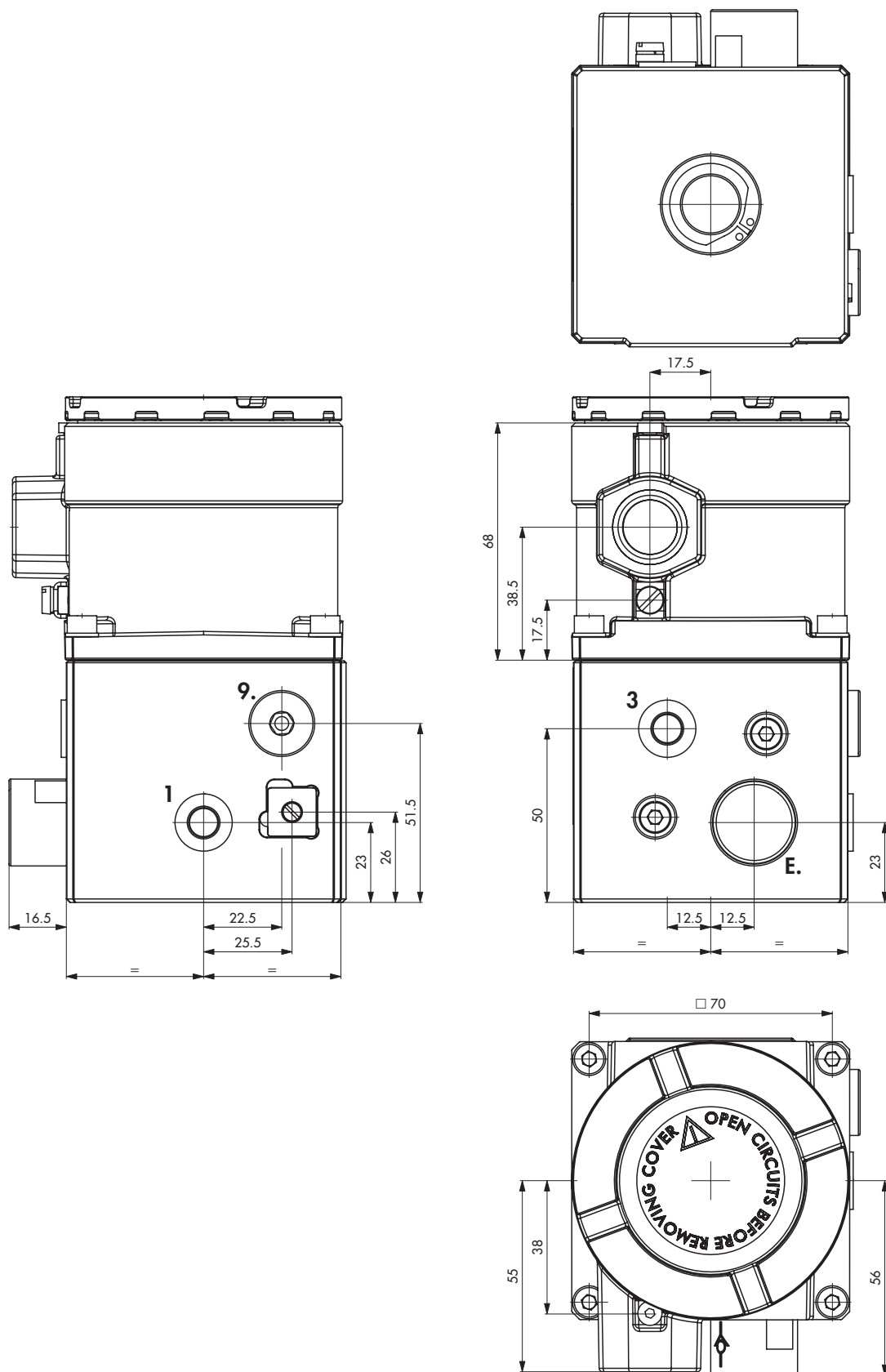
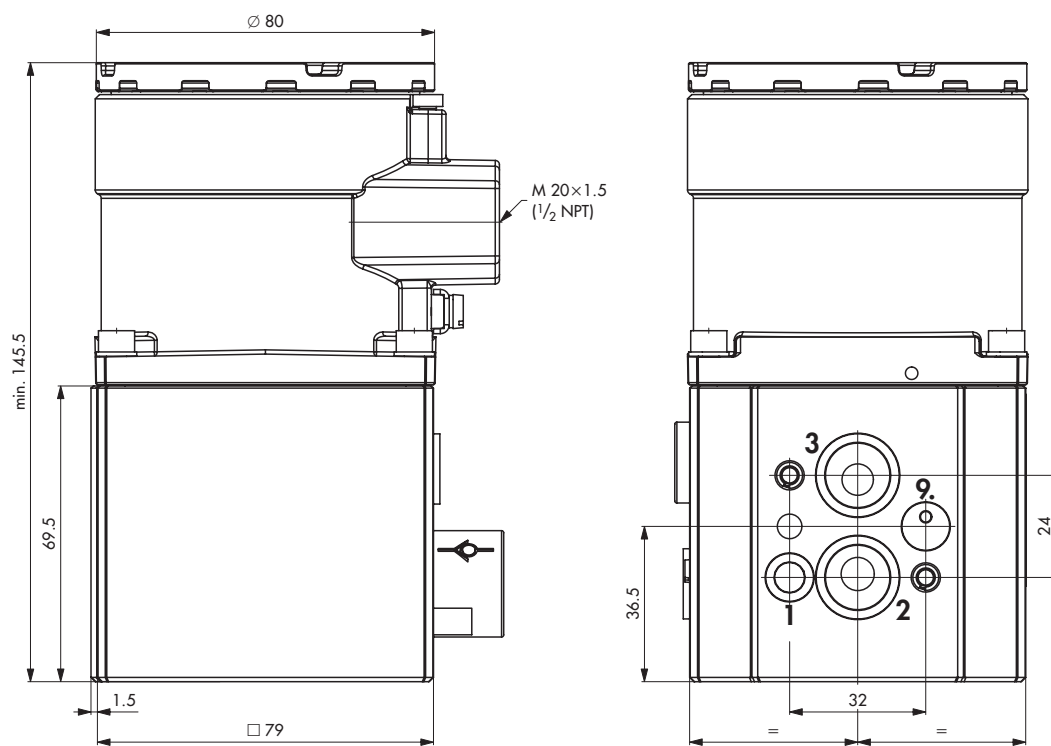


Fig. 9 · Dimensions in mm



**Type 3966 Solenoid Valve with adapter plate**  
**for linear actuators with NAMUR rib acc. to IEC 60534-6-1 as well as panel, wall or rail mounting**

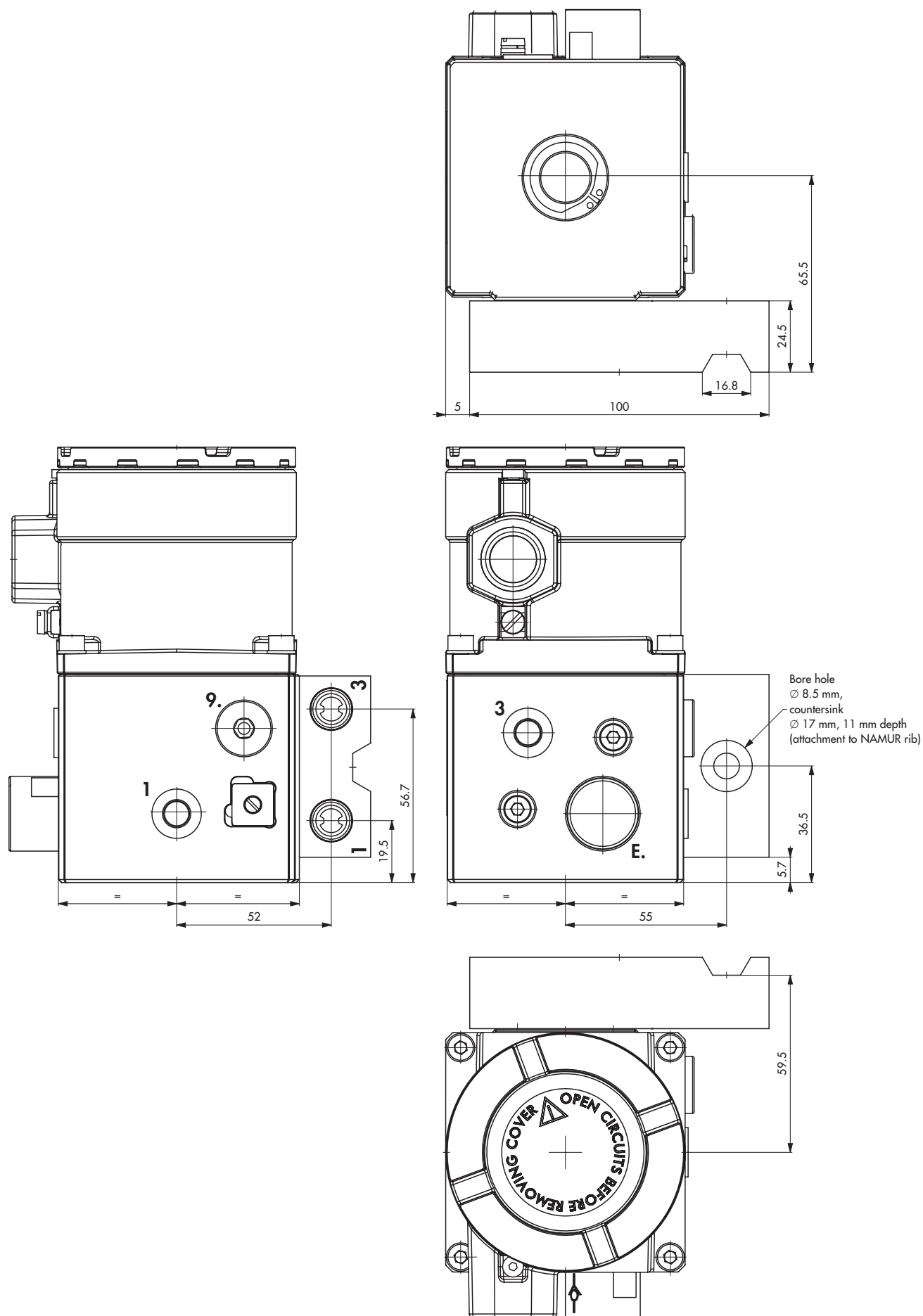
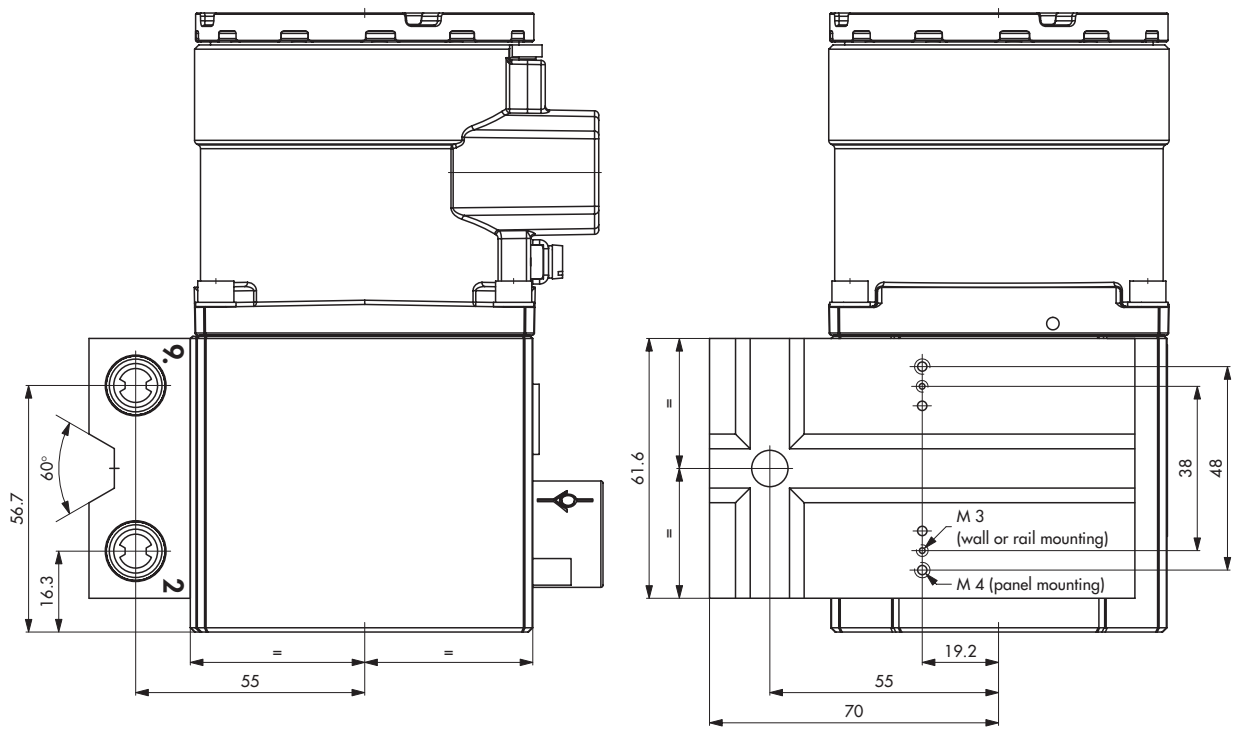


Fig. 10 · Dimensions in mm





## Versions and ordering data

Type 3966 Solenoid Valve		Order no.-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>Type of protection</b>	Without explosion protection	0 0 0	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	
	II 2 G Ex ia IIC T6 Gb/II 2 D Ex ia IIIC T80°C Db IP66/II 2 D Ex tb IIIC T85°C Db IP66 (ATEX)	1 1 0	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
	II 2 G Ex d IIC T6/II 2 D Ex tD A21 IP66 T80°C (ATEX)	2 1 0	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
	1Ex d IIC T6; DIP A21 T80°C IP 66 (GOST-R)	2 1 3	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
	AEx d IIC T6 ... T4 (FM)	2 3 0	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
	II 3 G Ex ic IIC T6 Gc/II 3 G Ex nAc II T6 Gc/II 3 D Ex tc IIIC T80°C Dc IP66 (ATEX)	8 1 0	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
<b>Nominal signal</b>	6 V DC		1																
	12 V DC		2																
	24 V DC		3																
	120 V DC		4																
	240 V AC		5																
	120 V AC		6																
<b>Manual override</b>	None		0																
	Pusbutton underneath the enclosure cover		1																
<b>Switching function</b>	None (pilot valve as spare part)		0																
	3/2-way function with spring return		1																
<b>Attachment</b>	None (pilot valve as spare part)		0																
	Rotary actuators with NAMUR interface acc. to VDI/VDE 3845		1																
	Linear actuators with NAMUR rib acc. to IEC 60534-6-1 as well as panel, wall or rail mounting		2																
	Connection block with positioner for SAMSON Type 3277 Linear Actuators		3																
<b>K<sub>VS</sub> value<sup>2)</sup></b>	None (pilot valve as spare part)		0 0																
	0.9		0 1																
<b>Material of the enclosure</b>	Aluminum													1					
	Stainless steel													2					
<b>Air connection</b>	None (pilot valve as spare part)																	0	
	G 1/4																	1	
	1/4 NPT																	2	
<b>Air supply</b>	None (pilot valve as spare part)																	0	
	Internal connection over connection 1 (for attachment to on-off actuators)																	1	
	External connection over connection 9 (for attachment to actuators for modulating service or connection block with positioner)																	2	
<b>Electrical connection</b>	Cable entry M 20 × 1.5																	0 0	
	Cable entry 1/2 NPT																	0 1	
	Cable gland M 20 × 1.5 made of polyamide, black																	1 0	
	Cable gland M 20 × 1.5 made of polyamide, blue																	1 1	
	Cable gland M 20 × 1.5 made of polyamide, black (manufactured by CEAG)																	1 3	
	Cable gland M 20 × 1.5 made of brass, nickel-plated																	1 4	
	Cable gland M 20 × 1.5 made of brass, nickel-plated, blue																	1 5	
Cable gland M 20 × 1.5 made of polyamide, blue (manufactured by CEAG)																	1 6		
<b>Degree of protection</b>	None (pilot valve as spare part)																	0	
	IP 66																	1	
	Type 4X																	2	
<b>Ambient temperature<sup>2)</sup></b>	-20 ... +80 °C																	0	
	-45 ... +80 °C																	1	
<b>Safety function</b>	None																	0	

<sup>1)</sup> Air flow at  $p_1 = 2.4$  bar and  $p_2 = 1.0$  bar can be calculated according to the following equation:  $Q = K_{VS} \times 36.22$ , expressed in  $m^3/h$ .

<sup>2)</sup> The maximum permissible ambient temperature depends on the permissible ambient temperature of the cable gland, the type of protection and the temperature class.

## Spare parts and accessories

Spare parts	
Order no.	Designation
0070-0799	Blanking plug 1/4" made of stainless steel
0070-0804	Blanking plug 1/4" made of brass, nickel-plated
8421-0070	O-ring 14 × 1.5 made of NBR (for blanking plug 1/4")
0520-1428	Switching diaphragm made of VMQ (for booster valve)
0550-0213	Sieve 1/4" (to screw into the connections)
0570-0390	Baffle plate made of stainless steel (to screw into connection 1)
8421-0273	O-ring 7.5 × 2 made of NBR (for NAMUR interface, 2 pcs. required!)
8421-0364	O-ring 16 × 2 made of NBR (for NAMUR interface, 2 pcs. required!)
8421-1002	O-ring 40 × 2 made of NBR (inner seal between pilot valve and booster valve)
8421-0124	O-ring 56 × 2 made of NBR (middle seal between pilot valve and booster valve)
0520-0099	O-ring 70 × 2 made of NBR (outer seal between pilot valve and booster valve)
8333-1265	Hexagon socket head screw ISO 4762 – M 5 × 20 made of stainless steel (for fixing the pilot valve on the booster valve, 4 pcs. required!)
8390-0061	Washer ISO 7089 – 5 made of stainless steel (for hexagon socket head screw, 4 pcs. required!)
8804-0320	Clamping bracket made of brass, nickel-plated (for ground terminals)
8330-0688	Slotted pan head screw ISO 1580 – M 4 × 8 made of brass, nickel-plated (for ground terminals)
8392-0654	Split washer DIN 128 – form B 4 made of stainless steel (for ground terminals)
8333-0774	Hexagon socket head screw DIN 7984 – M 4 × 10 made of stainless steel (for fixing the enclosure cover)
0430-1151	Reversible gasket made of NBR (changeover "air supply internal/external")
0360-2785	Fastening plate made of aluminum, powder-coated (for reversible gasket)
0360-3693	Fastening plate made of stainless steel (for reversible gasket)
8333-0095	Slotted cheese head screw ISO 1207 – M 3 × 8 made of stainless steel (for fastening plate)

Accessories	
Order no.	Designation
8808-1011	Cable gland (without explosion proof, Ex i, Ex nA)
8808-1012	M 20 × 1.5 made of polyamide, black
8808-0178	M 20 × 1.5 made of polyamide, blue
8808-0178	M 20 × 1.5 made of polyamide, black (manufactured by CEAG)
8808-0179	M 20 × 1.5 made of polyamide, blue (manufactured by CEAG)
1890-4875	M 20 × 1.5 made of brass, nickel-plated
1890-4876	M 20 × 1.5 made of brass, nickel-plated, blue
0310-2149	Adapter M 20 × 1.5 to 1/2 NPT made of aluminum, powder-coated, grayish-beige RAL 1019
1400-9598	Adapter plate for NAMUR rib according to IEC 60534-6-1 as well as panel, wall or rail mounting, including mounting material made of stainless steel, filters in the connections and screw plug made of stainless steel with O-ring made of NBR in connection 9,
1400-9599	made of aluminum, powder-coated, grayish beige RAL 1019, connection G 1/4
1400-9600	made of aluminum, powder-coated, grayish beige RAL 1019, connection 1/4 NPT
1400-9601	made of stainless steel, connection G 1/4
1400-9601	made of stainless steel, connection 1/4 NPT
1400-5930	Mounting base according to EN 60715 including mounting material made of stainless steel, for G profile G 32 (2 pcs. required!)
1400-5931	for top hat rail TH 35 (2 pcs. required!)
1400-6726	Mounting plate for wall mounting including mounting material made of stainless steel
1790-7253	Filter-check valve with noise reduction by the filter plate made of polyethylene, connection 1/4", made of stainless steel, degree of protection IP 66
1790-9646	connection 1/4", made of stainless steel, degree of protection NEMA 4

Connection blocks and accessories for SAMSON Type 3277 Linear Actuators		
Order no.	Designation	
<b>1400-8817</b>	Connection block for SAMSON Type 3277 Linear Actuators, connection G $\frac{1}{4}$	
<b>1400-8818</b>		connection $\frac{1}{4}$ NPT
<b>1400-6950</b>	Pressure gauge build-on block, 1 × "Output" and 1 × "Supply", made of stainless steel/brass (for connection block)	
<b>1400-6444</b>	Piping kit for actuator "Stem retracts", actuator size 240 cm <sup>2</sup> , made of steel, zinc-coated	
<b>1400-6445</b>		actuator size 240 cm <sup>2</sup> , made of stainless steel
<b>1400-6446</b>		actuator size 350 cm <sup>2</sup> , made of steel, zinc-coated
<b>1400-6447</b>		actuator size 350 cm <sup>2</sup> , made of stainless steel
<b>1400-6448</b>		actuator size 700 cm <sup>2</sup> , made of steel, zinc-coated
<b>1400-6449</b>		actuator size 700 cm <sup>2</sup> , made of stainless steel

(Specifications subject to change without notice.)

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