SAFETY MANUAL

SH 3967 EN

Translation of original instructions

Type 3967 Solenoid Valve

SIL/PL Capability

TÜVRheinland CERTIFIED

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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

Purpose of this manual

The Safety Manual SH 3967 contains information relevant for the use of the Type 3967 Solenoid Valve in safety-instrumented systems according to IEC 61508 and IEC 61511. The safety manual is intended for planners, constructors and operators of safety-instrumented systems.

NOTICE

Risk of malfunction due to incorrect mounting, connection or start-up of the device.

➔ *Refer to Mounting and Operating Instructions EB 3967 for details on how to mount the device, perform the electric and pneumatic connections as well as start up the device.*

➔ *Observe the warnings and safety instructions written in the Mounting and Operating Instructions EB 3967.*

Further documentation

The documents listed below contain descriptions of the start-up, functioning and operation of the solenoid valve. You can download these documents from the SAMSON website.

- T 3967: Data sheet
- EB 3967: Mounting and operating instructions

Note

In addition to the solenoid valve documentation, observe the documentation for the pneumatic actuator, valve and other valve accessories.

Contents

1 Scope

1.1 General

The Type 3967 Solenoid Valve converts binary voltage signals into pneumatic control signals. It is used to control pneumatic rotary and linear actuators with spring-return mechanism.

Operation with restrictor plate (solenoid valve version with K_{VS} 0.32)

The restrictor plate is used in combination with solenoid valve versions with K_{VS} 0.32 to adjust the actuating times of pneumatic actuators. It is suitable for attachment to rotary or linear actuators with spring-return mechanism. The safety function of the plate is emergency venting on demand.

1.2 Use in safety-instrumented systems

Observing the requirements of IEC 61508, the systematic capability of the solenoid valve for emergency venting as a component in safety-instrumented systems is given.

Use of the solenoid valve is possible on observing the requirements of IEC 61511 and the required hardware fault tolerance in safety-instrumented systems up to SIL 2 (single device/ HFT = 0) and SIL 3 (redundant configuration/HFT = 1).

The individual safety functions of the solenoid valve are to be regarded as Type A elements in accordance with IEC 61508-2.

1.3 Versions and ordering data

All versions of the solenoid valve marked with the prefix **SIL** are suitable for use in safety-instrumented systems. The article code written on the nameplate (see article code on page 6) provides details on the optional equipment of the solenoid valve.

Operation with restrictor plate (solenoid valve version with K_{VS} 0.32)

In safety-instrumented systems, only restrictor plates marked with **SIL** must be used. The construction of these restrictor plates ensures that the cross-sectional area of flow cannot be completely closed.

Article code

Solenoid valve		Type 3967-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Type of protection																								
Without explosion protection		**SIL**	0	0	0																			
ATEX	II 2G Ex ia IIC T6 Gb, II 2D Ex ia IIIC T80°C Db	**SIL**	1	1	0																			
NEPSI	Ex ia IIC T4~T6 Gb, Ex iaD 21 T80	**SIL**	1	1	1																			
IECEx	Ex ia IIC T6...T4 Gb, Ex ia IIIC T80 °C Db	**SIL**	1	1	2																			
EAC	1Ex ia IIC T6...T4 Gb, Ex ia IIIC T80 °C Db	**SIL**	1	1	3																			
TR CMU 1055	II 2G Ex ia IIC T6...T4 Gb, II 2D Ex ia IIIC T80 °C Db	**SIL**	1	1	6																			
ATEX	II 3G Ex nA II T6, II 3G Ex ic IIC T6, II 3D Ex tc IIIC T80°C IP65	**SIL**	8	1	0																			
IECEx	Ex nA II T6, Ex nL IIC T6, Ex tD A22 IP65 T80°C	**SIL**	8	1	2																			
EAC	2Ex nA IIC T6...T4 Gc X, 2Ex ic IIC T6...T4 Gc, Ex tc IIIC T80 °C Dc	**SIL**	8	1	3																			
TR CMU 1055	II 3G Ex nA II T6 Gc, II 3G Ex ic IIC T6 Gc, II 3D Ex tc IIIC T80 °C Dc IP65	**SIL**	8	1	6																			
Nominal signal																								
6 V DC		**SIL**				1																		
12 V DC		**SIL**				2																		
24 V DC		**SIL**				3																		
Manual override																								
Pushbutton underneath the enclosure cover		**SIL**					0																	
Pushbutton in the enclosure cover							1																	
Switch in the enclosure cover							2																	
Without		**SIL**					3																	
Switching function																								
3/2-way function with spring-return mechanism		**SIL**						0	0															

Solenoid valve	Type 3967- x x x x x x x x x x x x x x x x x x x x x x x x x x
Mounting	
NAMUR interface ¼" according to VDI/VDE 3845 for rotary actuators	**SIL** 0
NAMUR rib according to IEC 60534-6-1 for linear actuators or panel, wall or rail mounting	**SIL** 2
Mounting block with positioner for SAMSON Type 3277 Pneumatic Actuator	**SIL** 3
NAMUR interface ½" according to VDI/VDE 3845 for rotary actuators	**SIL** 4
K_{VS} [1]	
0.32	**SIL** 0
2.0	**SIL** 2
4.3	**SIL** 4
Material	
Polyamide and powder-coated aluminum	**SIL** 1
Polyamide and stainless steel	**SIL** 2
Pneumatic connection	
Two blanking plugs (connection to the adapter plate or on mounting block)	**SIL** 0
G ¼	**SIL** 1
¼ NPT	**SIL** 2
G ½	**SIL** 3
½ NPT	**SIL** 4
Pilot valve connection	
Two blanking plugs (connection on the adapter plate, booster valve or mounting block)	**SIL** 0
One G ¼ or ¼ NPT (with internal pilot supply)	**SIL** 1
Two G ¼ or ¼ NPT (with external pilot supply)	**SIL** 2
Without (with dummy plate – connection on the adapter plate, booster valve or mounting block)	**SIL** 4
Supply	
Internal pilot supply over port 1 (for actuators for on/off service)	**SIL** 0
External pilot supply over port 9 (for actuators for throttling service or mounting block with positioner)	**SIL** 1
Electrical connection	
Without cable gland	**SIL** 0 0
M16x1.5 cable gland made of black polyamide	**SIL** 0 1
M16x1.5 cable gland, blue polyamide	**SIL** 1 1
M16x1.5 cable gland (CEAG) made of black polyamide	**SIL** 1 3
M16x1.5 cable gland, nickel-plated brass	**SIL** 1 4
M16x1.5 cable gland, brass, blue	**SIL** 1 5
Degree of protection	
IP 65	**SIL** 0

Solenoid valve	Type 3967- x x x x x x x x x x x x x x x x x x x x x x x
Ambient temperature [2]	
–20 to +80 °C	**SIL** 0
–45 to +80 °C	**SIL** 1
Safety function	
Without	0
SIL [3] and PL	**SIL** 1
Special version	
Without	**SIL** 0 0 0

1) The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 bar is calculated using the following formula: $Q = K_{VS} \times 36.22$ in m³/h.
2) The maximum permissible ambient temperature depends on the permissible ambient temperature of the cable gland, type of protection and temperature class.
3) SIL according to IEC 61508 (see section 9)

Restrictor plates suitable for SIL applications

Accessories for K_{VS} 0.32	
Order no.	**Designation**
100087311	With exhaust air restrictor and safety plate, K_{VS} 0.002 to 0.27, adjustable; made of aluminum with Emaltal coating **SIL**
1402-0141	With exhaust air restrictor and lock nut, K_{VS} 0.01 to 0.28, adjustable; made of aluminum, powder coated, gray beige **SIL**
1402-0142	With exhaust air restrictor and lock nut, K_{VS} 0.01 to 0.28, adjustable; made of stainless steel 1.4404 **SIL**
100084935	With supply air restrictor and safety plate, K_{VS} 0.002 to 0.27, adjustable; made of aluminum with Emaltal coating **SIL**
1402-0139	With supply air restrictor and lock nut, K_{VS} 0.01 to 0.28, adjustable; made of aluminum, powder coated, gray beige **SIL**
1402-0140	With supply air restrictor and lock nut, K_{VS} 0.01 to 0.28, adjustable; made of stainless steel 1.4404 **SIL**

2 Mounting

The solenoid valve is suitable for the following types of attachment in combination with various mounting parts:

– Attachment to rotary actuators with NAMUR interface according to VDI/VDE 3845
– Attachment to linear actuators with NAMUR rib according to IEC 60534-6-1
– Direct attachment to SAMSON Type 3277 Linear Actuator using connection block
– Pipe mounting
– Panel, wall or rail mounting

3 Technical data

Type 3967-xxxxxxxx0 Solenoid Valve (K_{VS} 0.32) [1]		
Switching function	3/2-way function with exhaust air feedback, actuated on one side	
K_{VS} [2]	0.32	
Safety function	SIL [3] and PL	
Design	Solenoid with flapper/nozzle assembly and plug/seat valve with return spring	
Material	Enclosure:	Black polyamide
	Connecting plate:	Aluminum, powder coated, black or stainless steel 1.4404
	Adapter plate:	Aluminum, powder coated, gray beige RAL 1019 or stainless steel 1.4404
	Screws:	Stainless steel A2-70
	Springs:	Stainless steel 1.4310
	Seals:	Silicone rubber
Supply	Instrument air (free from corrosive substances) or nitrogen	
Pilot supply pressure	1.4 to 10.0 bar [4], 1.4 to 6.0 bar [5] (with 0 to 6.0 bar operating pressure) [5], 1.9 to 10.0 bar [4] (with 0 to 10.0 bar operating pressure) [5]	
Operating medium	Instrument air (free from corrosive substances) or nitrogen [4], Instrument air (free from corrosive substances), air containing oil or non-corrosive gases [5]	
Compressed air quality acc. to ISO 8573-1	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	
Operating pressure	1.4 to 10.0 bar [3], max. 10.0 bar [5]	
Output signal	Operating pressure	
Air consumption (binary e/p converter)	≤25 l/h at 1.4 bar pilot air in operating position, ≤80 l/h at 1.4 bar pilot air in neutral position	
Switching time	65 ms	
Electrical connection	Screw terminal, 2-pole, with cable gland M16x1.5	
Pneumatic connection	G ¼ or ¼ NPT and NAMUR interface ¼" [6]	
Degree of protection	IP 65	
Ambient temperature [7]	–20 to +80 °C; –45 to +80 °C	
Weight	0.45 kg, 0.80 kg (with adapter plate)	

1) The solenoid valve version with K_{VS} 0.32 can be fitted with a restrictor plate to adjust the actuating time of the pneumatic actuator.
2) The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 bar is calculated using the following formula: $Q = K_{VS} \times 36.22$ in m³/h.
3) SIL according to IEC 61508 (certificate no. V 60.09/14)
4) With internal pilot supply
5) With external pilot supply
6) NAMUR interface according to VDI/VDE 3845
7) The maximum permissible ambient temperature depends on the permissible ambient temperature of the cable gland, type of protection and temperature class.

Type 3967-xxxxxxxx2 Solenoid Valve (K_{VS} 2.0)		
Switching function	3/2-way function with exhaust air feedback, actuated on one side	
K_{VS} [1] (in direction of flow)	2.0 (3 → 5), 1.1 (4 → 3)	
Safety function	SIL [2]	
Design	Solenoid with flapper/nozzle assembly and plug/seat valve with return spring	
Material	Enclosure:	Black polyamide, aluminum, powder coated, gray beige RAL 1019, or stainless steel 1.4404
	Connecting plate:	Aluminum, powder coated, black or stainless steel 1.4404
	Adapter plate:	Aluminum, powder coated, gray beige RAL 1019 or stainless steel 1.4404
	Screws:	Stainless steel A2-70
	Springs:	Stainless steel 1.4310
	Seals:	Chloroprene rubber (–20 to +80 °C) or silicone rubber (–45 to +80 °C)
	Diaphragm:	Chloroprene rubber (–20 to +80 °C) or silicone rubber (–45 to +80 °C)
Supply	Instrument air (free from corrosive substances) or nitrogen	
Pilot supply pressure	1.4 to 10.0 bar [3], 1.4 to 6.0 bar [4] (with 0 to 6.0 bar operating pressure), 1.9 to 10.0 bar [4] (with 0 to 10.0 bar operating pressure)	
Operating medium	Instrument air (free from corrosive substances) or nitrogen [3], Instrument air (free from corrosive substances), air containing oil or non-corrosive gases [4]	
Compressed air quality acc. to ISO 8573-1	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	
Operating pressure	Max. 10.0 bar	
Output signal	Operating pressure	
Air consumption (binary e/p converter)	≤25 l/h at 1.4 bar pilot air in operating position, ≤80 l/h at 1.4 bar pilot air in neutral position	
Switching time	65 ms	
Electrical connection	Screw terminal, 2-pole, with cable gland M16x1.5	
Pneumatic connection	Supply air: Exhaust air:	G ¼ or ¼ NPT and NAMUR interface ¼" [5] with G ⅜ G ½ or ½ NPT and NAMUR interface ¼" [5] with G ⅜
Degree of protection	IP 65	
Ambient temperature [6]	–20 to +80 °C; –45 to +80 °C	
Weight	1.65 kg, 1.95 kg (with adapter plate)	

1) The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 bar is calculated using the following formula: $Q = K_{VS} \times 36.22$ in m³/h.
2) SIL according to IEC 61508 (certificate no. V 60.09/14)
3) With internal pilot supply
4) With external pilot supply
5) NAMUR interface according to VDI/VDE 3845
6) The maximum permissible ambient temperature depends on the permissible ambient temperature of the cable gland, type of protection and temperature class.

Type 3967-xxxxxxxx4 Solenoid Valve (K_{VS} 4.3)		
Switching function	3/2-way function with exhaust air feedback, actuated on one side	
K_{VS} [1] (in direction of flow)	4.3 (3 → 5), 1.9 (4 → 3)	
Safety function	SIL [2]	
Design	Solenoid with flapper/nozzle assembly and plug/seat valve with return spring	
Material	Enclosure:	Black polyamide, aluminum, powder coated, gray beige RAL 1019, or stainless steel 1.4404
	Connecting plate:	Aluminum, powder coated, black or stainless steel 1.4404
	Adapter plate:	Aluminum, powder coated, gray beige RAL 1019 or stainless steel 1.4404
	Screws:	Stainless steel A2-70
	Springs:	Stainless steel 1.4310
	Seals:	Chloroprene rubber (–20 to +80 °C) or silicone rubber (–45 to +80 °C)
	Diaphragm:	Chloroprene rubber (–20 to +80 °C) or silicone rubber (–45 to +80 °C)
Supply	Instrument air (free from corrosive substances) or nitrogen	
Pilot supply pressure	1.4 to 10.0 bar [3], 1.4 to 6.0 bar [4] (with 0 to 6.0 bar operating pressure) [4], 1.9 to 10.0 bar [4] (with 0 to 10.0 bar operating pressure) [4]	
Operating medium	Instrument air (free from corrosive substances) or nitrogen [3], Instrument air (free from corrosive substances), air containing oil or non-corrosive gases [4]	
Compressed air quality acc. to ISO 8573-1	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	
Operating pressure	Max. 10.0 bar	
Output signal	Operating pressure	
Air consumption (binary e/p converter)	≤25 l/h at 1.4 bar pilot air in operating position, ≤80 l/h at 1.4 bar pilot air in neutral position	
Switching time	65 ms	
Electrical connection	Screw terminal, 2-pole, with cable gland M16x1.5	
Pneumatic connection	G ½ or ½ NPT and NAMUR interface ½" [5]	
Degree of protection	IP 65	
Ambient temperature [6]	–20 to +80 °C; –45 to +80 °C	
Weight	1.6 kg, 1.9 kg (with adapter plate)	

1) The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 bar is calculated using the following formula: $Q = K_{VS} \times 36.22$ in m³/h.
2) SIL according to IEC 61508 (certificate no. V 60.09/14)
3) With internal pilot supply
4) With external pilot supply
5) NAMUR interface according to VDI/VDE 3845
6) The maximum permissible ambient temperature depends on the permissible ambient temperature of the cable gland, type of protection and temperature class.

Electric data					
Type 3967			**-xxx1**	**-xxx2**	**-xxx3**
Nominal signal		U_N	6 V DC	12 V DC	24 V DC
		U_{max} [1]	27 V	40 V	60 V
Switching point	On	$U_{+80\ °C}$	≥4.8 V	≥9.6 V	≥18 V
		$P_{+20\ °C}$	≥5.47 mW	≥13.05 mW	≥26.71 mW
	Off	$U_{-25\ °C}$	≤1.0 V	≤2.3 V	≤4.6 V
Impedance		$R_{+20\ °C}$	2.6 kΩ	5.3 kΩ	10.5 kΩ
Temperature influence on R			0.4 %/°C	0.2 %/°C	0.1 %/°C
Type of protection Ex ia IIC [2]/Ex ia IIIC [3]					
Type 3967			**-1101**	**-1102**	**-1103**
Nominal signal		U_N	6 V DC	12 V DC	24 V DC
See EC type examination certificate PTB 06 ATEX 2027 for maximum permissible values when connected to a certified intrinsically safe circuit.					
Type of protection Ex nA II [4]/Ex tc IIIC [5]					
Type 3967			**-8101**	**-8102**	**-8103**
Nominal signal		U_N	6 V DC	12 V DC	24 V DC
See statement of conformity PTB 06 ATEX 2028 X for maximum permissible values when connected to a certified intrinsically safe circuit.					

1) Maximum permissible value at 100 % duty cycle. The maximum permissible value U_i applies to explosion-protected versions.
2) Marking II 2G Ex ia IIC T6 Gb
3) Marking II 2D Ex ia IIIC T80°C Db
4) Marking II 3G Ex nA II T6/II 3G Ex ic IIC T6
5) Marking II 3D Ex tc IIIC T80°C IP65

4 Safety-related functions

Emergency venting

The solenoid valve is energized by a binary voltage signal. Fail-safe action is triggered when no voltage signal (0 V DC) is applied to terminals + and –. The solenoid valve vents to the atmosphere and the actuator is vented as well (see Fig. 1 on page 14).

Restriction function (operation with restrictor plate for solenoid valve version with K_{VS} 0.32)

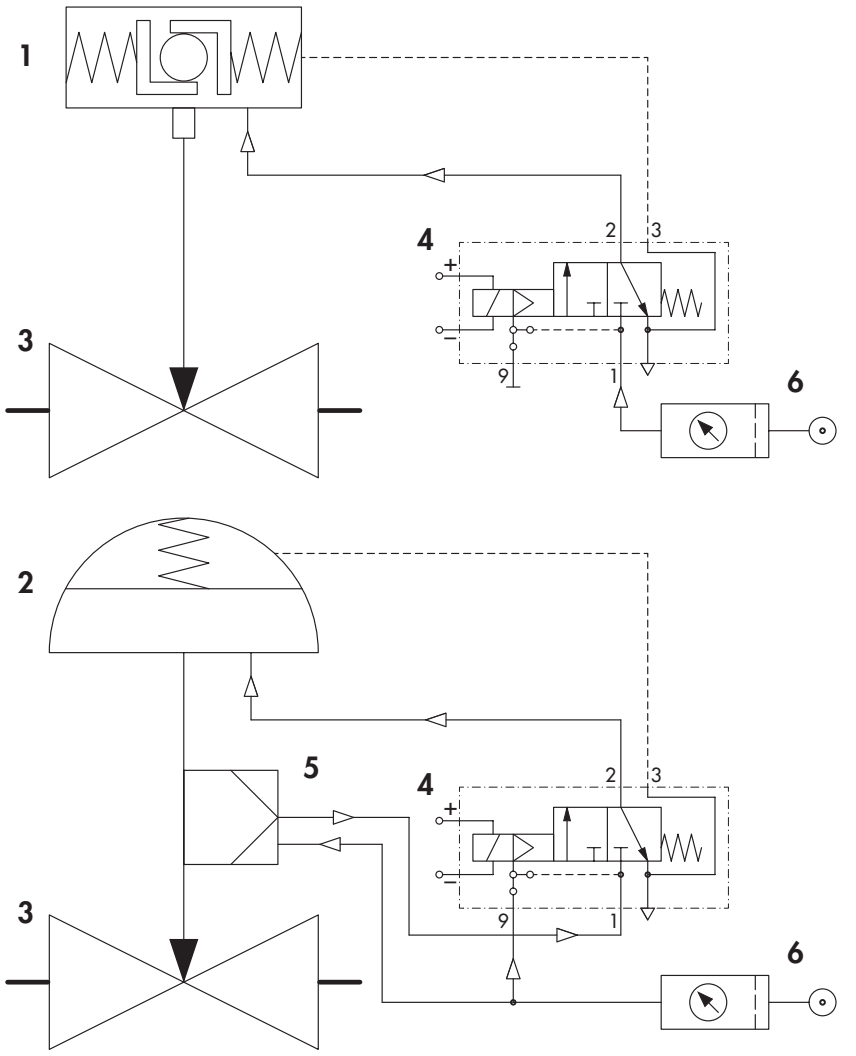
The restrictor plate consists of a manually adjustable supply air or exhaust air restrictor and a check valve connected in parallel. Depending on which restrictor version is used, either the supply air or exhaust air of the actuator is restricted.

4.1 Fail-safe action

Fail-safe action is triggered by the solenoid valve and upon supply air failure.
The solenoid valve fully discharges its pneumatic output to the atmosphere, causing the mounted actuator to be vented. As a result, the valve moves to the fail-safe position. The fail-safe position depends on how the springs are arranged in the pneumatic actuator (air-to-close or air-to-open).

Restriction function (operation with restrictor plate for solenoid valve version with K_{VS} 0.32)

The restrictor plate is designed to ensure the emergency venting of the actuator on demand (the construction inhibits the blocking of the supply air in the actuator).
The check valve connected in parallel guarantees the emergency venting in the restrictor plate with supply air restrictor. In the restrictor plate with exhaust air restrictor, the restrictor spindle guarantees a minimum air flow and, as a result, prevents blocking. This also applies when the restrictor spindle is fully screwed in.



1 Rotary actuator
2 Linear actuator
3 Valve
4 Solenoid valve
5 Pneumatic positioner
6 Compressed air supply

Fig. 1: *Functional diagram showing emergency venting in actuators for on/off and throttling service*

5 Mounting, connection and start-up

Refer to Mounting and Operating Instructions ▶ EB 3967 on how to mount the solenoid valve, perform the electric and pneumatic connections as well as start up the solenoid valve. Only use original mounting parts and accessories.

6 Required conditions

⚠ WARNING

Risk of malfunction due to incorrect selection or wrong installation and operating conditions.

➔ *Only use control valves in safety-instrumented systems if the necessary conditions in the plant are fulfilled. This also applies to the mounted solenoid valve.*

6.1 Selection

➔ The required transit times of the control valve are observed.
The transit times to be implemented are determined by the process engineering requirements.
The solenoid valve version with K_{VS} 0.32 allows the actuating time of the pneumatic actuator to be decreased by operating it with a restrictor plate.

➔ The solenoid valve is suitable for the prevailing ambient temperature.

Versions	Temperature range
With diaphragm and seals made of chloroprene rubber	–20 to +80 °C
With diaphragm and seals made of silicone rubber	–45 to +80 °C
With plastic cable gland	–20 to +80 °C
With metal cable gland	–45 to +80 °C
The specifications in the test certificates additionally apply to explosion-protected versions.	

➔ The temperature limits are observed.

➔ A restrictor plate suitable for SIL applications is used when operated with a restrictor plate.

6.2 Mechanical and pneumatic installation

➔ The solenoid valve is mounted properly as described in the mounting and operating instructions and connected to the air supply.

➔ The maximum supply pressure does not exceed 10.0 bar.

➔ The supply air meets the instrument air specifications.

Particle size and quantity	Oil content	Pressure dew point
Class 4	Class 3	Class 3
≤5 µm and 1000/m³	≤1 mg/m³	–20 °C or at least 10 K below the lowest ambient temperature to be expected

Tip

We recommend installing a supply pressure regulator/filter upstream of the device. For example, Type 3999-009x Service Unit or Type 3999-0096 Filter Regulator can be used.

➔ The minimum required cross section of the connecting lines is observed: 4 mm inside diameter for the external pilot supply line (9) and 9 mm inside diameter for the internal pilot supply line (1) and output (2).
See "Sizing of the connecting line" in the mounting and operating instructions ▶ EB 3967.

➔ Select the cross section and length of the line to ensure that the supply pressure at the device on supplying air does not fall below the minimum limit of 1.4 (1.9) bar.

➔ The solenoid valve is mounted as prescribed.

➔ The exhaust opening at the solenoid valve remains open when the solenoid valve is installed on site.

Operation with restrictor plate (solenoid valve version with K_{VS} 0.32)

➔ The restrictor plate is installed properly as described in the mounting and operating instructions.

6.3 Electrical installation

➔ The solenoid valve is mounted properly as described in the mounting and operating instructions and connected to the electric power supply.

➔ Only cables whose outside diameters are suitable for the cable glands are used.

➔ The electrical cables in Ex i circuits comply with the data that planning was based on.

➔ The cable glands and enclosure cover screws are fastened tightly to ensure that the degree of protection is met.

➔ The installation requirements for the applicable explosion protection measures are observed.

➔ The special conditions specified in the explosion protection certificates are observed.

7 Proof testing

The proof test interval and the extent of testing lie within the operator's responsibility. The operator must draw up a test plan, in which the proof tests and the interval between them are specified. We recommend summarizing the requirements of the proof test in a check-list.

⚠ WARNING

Risk of dangerous failure due to malfunction in the event of emergency (actuator is not vented or the valve does not move to the fail-safe position).

➔ *Only use devices in safety-instrumented systems that have passed the proof test according to the test plan drawn up by the operator.*

Regularly check the safety-instrumented function of the entire SIS loop. The test intervals are determined, for example on calculating each single SIS loop in a plant (PFD_{avg}).

7.1 Visual inspection to avoid systematic failure

To avoid systematic failure, inspect the solenoid valve regularly. The frequency and the scope of the inspection lie within the operator's responsibility. Take application-specific influences into account, such as:

– Dirt blocking the pneumatic connections
– Corrosion (destruction primarily of metals due to chemical and physical processes)
– Material fatigue
– Aging (damage caused to organic materials, e.g. plastics or elastomers, by exposure to light and heat)
– Chemical attack (organic materials, e.g. plastics or elastomer, which swell, leach out or decompose due to exposure to chemicals)

! *NOTICE*

Risk of malfunction due to the use of unauthorized parts.

➔ *Only use original parts to replace worn parts.*

Operation with restrictor plate (solenoid valve version with K_{VS} 0.32)

➔ Check that the lock nut or safety plate is mounted firmly.

7.2 Function testing

Regularly check the safety function according to the test plan drawn up by the operator.

Refer to the SIL proof test when large deviations occur or any other irregularities. The necessary documentation for this is provided by SAMSON.

The SIL proof test can be performed by SAMSON on request.

Note

Record any faults in the device and inform SAMSON of them in writing.

➔ For the internal pilot supply, the permissible operating pressure from 1.4 to 10.0 bar must be applied to port 1.
In case of external pilot supply, air with the maximum operating pressure of 10.0 bar or the maximum available operating pressure must be applied to port 1. On using an upstream positioner, adjust it so that the maximum output pressure is available at the positioner output.

➔ Apply the nominal voltage U_N specified on the nameplate to the solenoid valve.

➔ Check whether the valve moves to its end position on demand.

➔ De-energize the solenoid valve.

Check whether the actuator is fully vented within the demanded time (fail-safe position).

Tip

Connect a pressure gauge to check that the actuator has completely vented.

➔ Record the valve transit time and compare it to the time the valve took at start-up and during proof tests.

Proof test

A full stroke test must be performed as the proof test. The following value can be used for Proof Test Coverage to calculate PFD_{avg}:

PTC (Proof Test Coverage) = 95 % for a proof test

8 Maintenance and repair

Only perform the work on the solenoid valve described in ▶ EB 3967.

Only use the specified original mounting parts.

NOTICE

Safety function impaired due to incorrect repair.

➔ *Only allow trained staff to perform service and repair work.*

For devices operated in the low demand mode, a useful lifetime of 11 years (plus 1.5 years storage time) is confirmed by TÜV Rheinland® from the date of manufacture while taking into account the specific conditions of use specified in the Safety Manual and the Mounting and Operating Instructions.

The results of the proof test must be assessed and the maintenance scheduled based on it. In particular, after changes (e.g. signs of aging in elastomers, changed switching times or leakage etc.), it is essential that the manufacturer performs maintenance or repair work on the device.

MTC (Maintenance Coverage) > 99 %

9 Safety-related data and certificates

The safety-related data are listed in the following certificate.

i Note

The listed safety-related data also apply to operation of the solenoid valve version with K_{VS} 0.32 using a restrictor plate with lock nut.
The safety-related data when the solenoid valve is used with a restrictor plate with safety plate are available on request.

Certificate

No.: 968/V 1160.02/21

Product tested	Electromagnetic control, solenoid, booster valves and electrical position feedback	**Certificate holder**	SAMSON AG Weismüllerstr. 3 60314 Frankfurt / Main Germany
Type designation	3963, 3967, 3964, 3756, 3701, 3968, 3776 (with option solenoid valve as well as safe indication of end positions)		
Codes and standards	IEC 61508 Parts 1-2 and 4-7:2010		
Intended application	Safety Function: Safe venting (and safe indication of end positions) The test items are suitable for use in a safety instrumented system up to SIL 2 (low demand mode). Under consideration of the minimum required hardware fault tolerance HFT = 1 the valves may be used in a redundant architecture up to SIL 3 according to IEC 61508 and IEC 61511-1:2016 + AMD1:2017.		
Specific requirements	The instructions of the associated Installation, Operating and Safety Manual shall be considered.		

Summary of test results see back side of this certificate.

The issue of this certificate is based upon an evaluation in accordance with the Certification Program CERT FSP1 V1.0:2017 in its actual version, whose results are documented in Report No. 968/V 1160.02/21 dated 2021-09-08. This certificate is valid only for products, which are identical with the product tested.

TÜV Rheinland Industrie Service GmbH
Bereich Automation
Funktionale Sicherheit
Certification Body Safety & Security for Automation & Grid

Köln, 2021-09-13

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Holder: **SAMSON AG**
Weismüllerstraße 3
60314 Frankfurt am Main
Germany

Product tested: **Electromagnetic control, solenoid and booster valves of the types**
3963, 3967, 3964, 3756, 3701, 3968 [4],
3776 (with option "solenoid valve" as well as "safe indication of end positions")

Results of Assessment

Route of Assessment		2_H / 1_S
Type of Sub-system		Type A
Mode of Operation		Low Demand Mode

Safe venting - Type 3701, 3963, 3967, 3776 (with option solenoid valve)

Hardware Fault Tolerance	HFT	0	
Lambda Dangerous Undetected [1]	λ_{DU}	8.02 E-08 / h	80 FIT
Average Probability of Failure on Demand [2]	**$PFD_{avg}(T_1)$**	**3.51 E-04**	

Safe indication of end positions - Type 3776 (only with inductive proximity switches)

Hardware Fault Tolerance	HFT	0	
Lambda Dangerous Undetected [1]	λ_{DU}	7.35 E-08 / h	74 FIT
Average Probability of Failure on Demand [2]	**$PFD_{avg}(T_1)$**	**3.22 E-04**	

Safe venting - Type 3756

Hardware Fault Tolerance	HFT	0 (1 as variant, see report)	
Lambda Dangerous Undetected [1]	λ_{DU}	8.38 E-08 / h	84 FIT
Average Probability of Failure on Demand [2]	**$PFD_{avg}(T_1)$**	**3.67 E-04**	
Average Probability of Failure on Demand 1oo2 [3]	**$PFD_{avg}(T_1)$**	**3.69 E-05**	

Safe venting - Type 3964 pilot valve

Hardware Fault Tolerance	HFT	0	
Lambda Dangerous Undetected [1]	λ_{DU}	5.12 E-09 / h	5 FIT
Average Probability of Failure on Demand [2]	**$PFD_{avg}(T_1)$**	**2.24 E-05**	

[1] assumed Diagnostic Coverage DC = 0 %

[2] assumed Proof Test Interval T_1 = 1 year

[3] assumed Proof Test Interval T_1 = 1 year and β_{1oo2} = 10 %

[4] The solenoid valve manifold of type 3968 is a combination of the control valves 3756 and the pilot valves 3964. The failure rates must be determined for each individual applicationfrom the given characteristic values of the single components.

Origin of values

The stated failure rates are the result of an FMEDA with tailored failure rates for the design and manufacturing process.
Furthermore the results have been verified by qualification tests and field-feedback data of the last 5 years.
Failure rates include failures that occur at a random point in time and are due to degradation mechanisms such as ageing.
The stated failure rates do not release the end-user from collecting and evaluating application-specific reliability data.

Systematic Capability

The development and manufacturing process and the functional safety management applied by the manufacturer in the relevant lifecycle phases of the product have been audited and assessed as suitable for the manufacturing of products for use in applications with a maximum Safety Integrity Level of 3 (SC 3).

Periodic Tests and Maintenance

The given values require periodic tests and maintenance as described in the Safety Manual.
The operator is responsible for the consideration of specific external conditions (e.g. ensuring of required quality of media, max. temperature, time of impact), and adequate test cycles.

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SH 3967 EN

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