SAFETY MANUAL

SH 3967-2 EN

Translation of original instructions

Restrictor plate

With supply air or exhaust air restrictors to adjust the actuating time of pneumatic actuators in safety-instrumented systems according to IEC 61508 and IEC 61511

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 safety manual

This Safety Manual SH 3967-2 contains information relevant for the use of the restrictor plate in safety-instrumented systems according to IEC 61508 and IEC 61511. It is aimed at staff who install, connect, start up and service the device.

NOTICE

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

➔ *Refer to the Mounting and Operating Instructions EB 3967 on how to mount the positioner, 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.*

Referenced documentation

The documents listed below contain descriptions on the start-up, functioning and operation of the Type 3967 Solenoid Valve. You can download these documents from the SAMSON website.

Type 3967 Solenoid Valve

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

Note

In addition to this safety manual, read and follow the mounting and operating instructions for the pneumatic actuator, control valve and other valve accessories. Only use the restrictor plate in combination with components supplied by SAMSON.

Contents

1 Scope

1.1 General

The restrictor plate is preferably used in combination with a Type 3967 Solenoid Valve 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 the emergency venting on demand.

1.2 Use in safety-instrumented systems

The restrictor plate is certified with a certificate for the use in safety-instrumented systems according to IEC 61508 and IEC 61511 (see section 9).

1.3 Versions and ordering data

The restrictor plate is fitted with either a supply air or exhaust air restrictor and is available in various materials (see table).

The order number and device index are specified on the nameplate.

Versions and ordering data	
Restrictor plate	**Order no.**
With supply air restrictor, made of AlMgSiPb, powder coated, gray beige RAL 1019, **SIL**	1402-0139
With supply air restrictor, made of stainless steel 1.4404, **SIL**	1402-0140
With exhaust air restrictor, made of AlMgSiPb, powder coated, gray beige RAL 1019, **SIL**	1402-0141
With exhaust air restrictor, made of stainless steel 1.4404, **SIL**	1402-0142

2 Attachment to rotary or linear actuators

The restrictor plate can be mounted onto rotary actuators with a NAMUR interface according to VDI/VDE 3845, onto an adapter plate for linear actuators with NAMUR rib according to IEC 60534-6-1 or onto a connection block for the Type 3277 Pneumatic Actuator (see table).

Accessories for attachment to linear actuators	
Adapter plate for linear actuators with NAMUR rib according to IEC 60531-6-1	**Order no.**
Made of AlMgSiPb, powder coated, gray beige RAL 1019, G ¼ connection	1400-9598
Made of AlMgSiPb, powder coated, gray beige RAL 1019, ¼ NPT connection	1400-9599
Stainless steel 1.4404, G ¼ connection	1400-9600
Stainless steel 1.4404, ¼ NPT connection	1400-9601
Connection block for Type 3277 Pneumatic Actuator	**Order no.**
G ¼ connection	1400-8817
¼ NPT connection	1400-8818

3 Technical data

Technical data	
Design	Restriction/check valve
Restriction function	Supply air or exhaust air
Safety function	SIL [1]
Material	Plate: AlMgSiPb, powder coated, gray beige RAL 1019, or stainless steel 1.4404 Seals: Nitrile butadiene rubber, silicone rubber External parts: stainless steel 1.4305, zinc-plated spring steel
K_{VS} [2]	0.01 to 0.28, adjustable
Operating medium	Instrument air, free from corrosive substances or neutral gases
Compressed air quality according 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
Mounting orientation	Any desired position
Operating pressure	Max. 10 bar
Pneumatic connection	NAMUR interface ¼" according to VDI/VDE 3845
Ambient temperature	–45 to +80 °C
Weight	0.190 kg

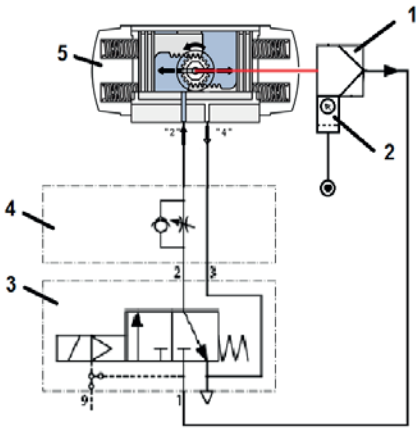
1) Safety integrity level (SIL) according to IEC 61508
2) The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 is calculated using the following formula: $Q = K_{VS} \times 36.22$ in m³/h.

4 Functions

4.1 Restriction function

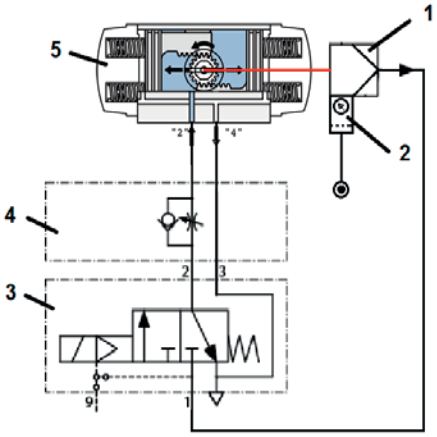
The restrictor plate consists of a manually adjustable supply air or exhaust air restrictor and a check valve connected in parallel. Depending on which restrictor version is used, either the supply air or exhaust air of the actuator is restricted (see Fig. 1 to Fig. 4).

4.2 Restriction of the supply air or exhaust air in a rotary actuator



1 Pneumatic positioner
2 Compressed air supply
3 Solenoid valve
4 Restrictor plate with supply air restrictor
5 Rotary actuator

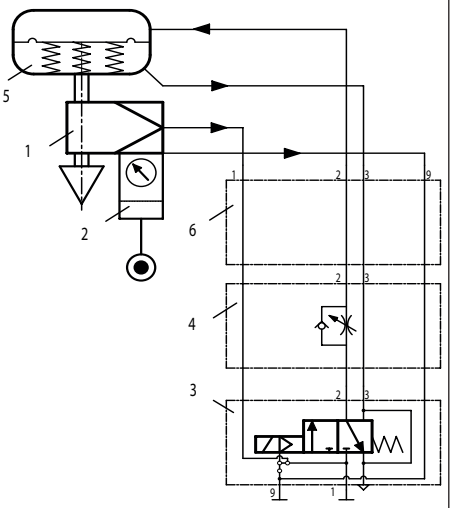
Fig. 1: *Supply air restriction in a rotary actuator*



1 Pneumatic positioner
2 Compressed air supply
3 Solenoid valve
4 Restrictor plate with exhaust air restrictor
5 Rotary actuator

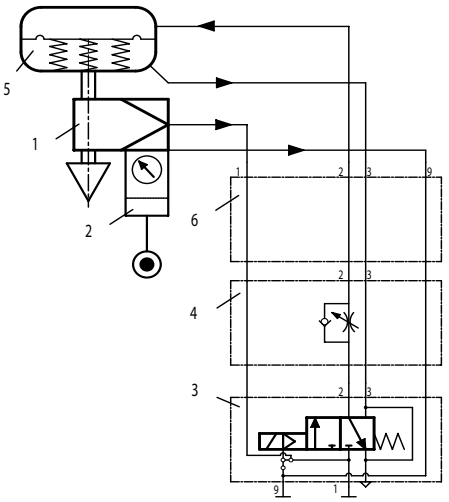
Fig. 2: *Exhaust air restriction in a rotary actuator*

4.3 Restriction of the supply air or exhaust air in a linear actuator



1 Pneumatic positioner
2 Compressed air supply
3 Solenoid valve
4 Restrictor plate with supply air restrictor
5 Linear actuator
6 Adapter plate

Fig. 3: *Supply air restriction in a linear actuator*



1 Pneumatic positioner
2 Compressed air supply
3 Solenoid valve
4 Restrictor plate with exhaust air restrictor
5 Linear actuator
6 Adapter plate

Fig. 4: *Exhaust air restriction in a linear actuator*

4.4 Safety function

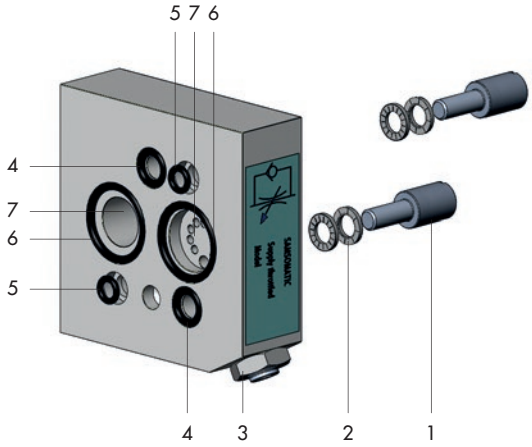
The restrictor plate is designed to ensure the emergency venting of the actuator on demand (the construction inhibits the blocking of the supply air in the actuator).

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.

5 Attachment

The restrictor plate can be mounted onto rotary actuators with a NAMUR interface according to VDI/VDE 3845, onto an adapter plate for linear actuators with NAMUR rib according to IEC 60534-6-1 or onto a connection block for the Type 3277 Pneumatic Actuator.

The restrictor plate is fastened using two slotted-head screws (1) each with two washers (2). Each slotted-head screw (1) is secured by an O-ring (5) to prevent it from falling out. On mounting the restrictor plate, make sure the O-rings (4) and (6) are seated properly (see Fig. 5).



Spare parts			
Item	**pcs**	**Designation**	**Order no.**
1	2	Slotted-head screw M5	0180-1462
2	2	Pair of washers	8392-3057
3	1	M8 nut	8350-2779
4	2	O-ring 6x2	8421-0263
5	2	O-ring 4x1.5	8421-0028
6	2	O-ring 16x2	8421-0364
7	2	Filter ¼" (not shown)	0550-0213

Fig. 5: *Mounting the restrictor plate*

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 restrictor plate.*

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 OPEN and CLOSED transit times can be adjusted manually at the supply air or exhaust air restrictor.

6.2 Mechanical and pneumatic installation

➔ The restrictor plate is attached properly (see section 5).

➔ The pneumatic air supply meets the instrument air specifications (see table).

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

➔ We recommend installing a supply pressure regulator/filter upstream of the device.

➔ The permissible operating pressure of max. 10 bar has been observed.

❗ *NOTICE*

Risk of failure of the safety function due to contaminated compressed air (e.g. dirt particles from the actuator spring chamber).

➔ *We recommend installing filters into the threaded connections of the solenoid valve and actuator.*

6.3 Operation

➔ The restrictor spindle on the restrictor plate is secured by a nut (3) (see section 5).

7 Proof testing (periodic)

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 checklist.

⚠ WARNING

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

➔ *Only use devices in safety-instrumented systems which have passed the proof test.*

Diagnostic option

Check the proper functioning by connecting a positioner with integrated EXPERTplus diagnostics (e.g. Type 3730-6).

7.1 Visual inspection to avoid systematic failure

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

– Corrosion (destruction primarily of metals due to chemical and physical processes)
– 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 (see Fig. 5).*

7.2 Function test of the safety-instrumented system

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

Safety test of the emergency venting function

Perform the safety test on a regular basis according to the test plan drawn up by the operator.

Perform the safety test as follows:

1. Move the valve clearly away from the fail-safe position (e.g. set point at 50 % in control valves or to the operating position of on/off valves).
2. De-energize (e.g. 0 mA signal) the input at the + and – terminals.
3. Check the effect:

   – Does the valve move to the fail-safe position within the required time?

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.

i ***Note***

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.

Certificate

SIL/PL Capability

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ID 0000000000

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

Köln, 2021-09-13

Certification Body Safety & Security for Automation & Grid

Dipl.-Ing. (FH) Wolf Rückwart

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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.

TÜV Rheinland Industrie Service GmbH, Am Grauen Stein, 51105 Köln / Germany

Revision List
referred to on Certificate No.: 968/V 1160.02/21
Certified Product: Electromagnetic control, solenoid, booster valves and electrical position feedback

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Safety related modules / components

Type Designation	Description	Report–No.:	Certification Status
3963	Solenoid valve	968/V 1160.00/20	*Valid*
3967	Solenoid valve	968/V 1160.00/20	*Valid*
3964	Solenoid valve	968/V 1160.00/20	*Valid*
3756	Solenoid valve	968/V 1160.00/20	*Valid*
3701	Solenoid valve	968/V 1160.00/20	*Valid*
3968	Solenoid valve	968/V 1160.00/20	*Valid*
3776	Limit switch (with option solenoid valve as well as safe indication of end positions)	968/V 1160.00/20	*Valid*

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Automation - Functional Safety (A-FS)
Am Grauen Stein
51105 Köln / Germany

Revision List
referred to on Certificate No.: 968/V 1160.02/21
Certified Product: Electromagnetic control, solenoid, booster valves and electrical position feedback

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Manufacturing locations

Type Designation	Description	Report–No.:	Certification Status
SAMSON AG	Weismüllerstraße 3 60314 Frankfurt am Main	968/V 1160.00/20	*Valid*
SAMSON REGULATION S.A.S.	1 rue Jean Corona 69120 Vaulx-en-Velin France	968/V 1160.02/21	*Valid*

Safety Manual

Document No.	Description	Report–No.:	Certification Status
SH_3963.pdf	Safety manual for type 3963	968/V 1160.00/20	*Valid*
SH_3967.pdf	Safety manual for type 3967	968/V 1160.00/20	*Valid*
SH_3701.pdf	Safety manual for type 3701	968/V 1160.00/20	*Valid*
e3756sde.pdf	Safety manual for type 3756	968/V 1160.00/20	*Valid*
e3964sde.pdf	Safety manual for type 3964	968/V 1160.00/20	*Valid*
e3776sde.pdf	Safety manual for type 3776	968/V 1160.00/20	*Valid*
e3968sde.pdf	Safety manual for type 3968	968/V 1160.00/20	*Valid*

The content of this Revision List has been agreed between Manufacturer and Certification Body.

Revision List
referred to on Certificate No.: 968/V 1160.02/21
Certified Product: Electromagnetic control, solenoid, booster valves and electrical position feedback

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Revision:

Date	Rev.	Description / Changes	Author
2021-09-08	1.0	Initial creation, based on Report-No.: 968/V 1160.02/21	JCz/A-FS

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