SAFETY MANUAL



SH 3962-9 EN

Translation of original instructions



Type 3962-9 Solenoid Valve



Edition November 2020

Definition of signal words

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

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

Property damage message or malfunction

i Note

Additional information

-☆- **Tip** Recommended action

Purpose of this manual

The Safety Manual SH 3962-9 contains information relevant for the use of the Type 3962-9 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.

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

- → Refer to the Mounting and Operating Instructions EB 3962-9 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 3962-9.

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 3962: Data sheet
EB 3962-9: Mounting and operating instructions

i Note

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

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1 Scope

1.1 General

The Type 3962-9 Solenoid Valve consists of a pilot valve and a booster valve. It converts binary voltage signals into pneumatic control signals. It is used to control pneumatic rotary and linear actuators with spring-return mechanism.

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).

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

i Note

The architecture and the interval between proof tests must be changed accordingly for a higher safety integrity level.

1.3 Versions and ordering data

All versions of the solenoid valve marked with the prefix **SIL** are suitable for use in safetyinstrumented systems. The article code written on the nameplate (see next pages) provides details on the optional equipment of the solenoid valve.

Article code

Solenoid valve	Туре 3962-хххххххххххххххххх
Explosion protection	
Ex d	SIL 9
Nominal signal	
24 V DC	SIL 3 0
230 V AC/DC	SIL 4 0
115 V AC/DC	SIL 7 0
48 V AC	SIL 9 1
Type of protection	
II 2 G D ATEX Ex db IIC T3/T4/T5/T6 GI Ex tb IIC T85°C/T100°C/T	35°С/Т200°С Db SIL 2 1 0
IECEx Ex d IIC T*/DIP A21 T* (or	request) SIL 2 1 1
NEPSI Ex d IIC T3-T6 Gb/DIP A2	
EAC 1Ex d IIC T6/T5/T4/T3 G 1Ex d IIC T5 Gb X	X SIL 2 1 3
STCC II 2G Ex d IIC Ta* II 2D Ex tD A21 T* IP66	SIL 2 1 6
Manual override	
Without	SIL O
External pushbutton	2
External toggle switch	4
Switching function	
3/2-way function with spring-retur	mechanism SIL 0
5/2-way function with spring-retur	1 mechanism 1) 1
5/2-way function with two detent	ositions 2
5/3-way function with spring-cent 4 closed)	red mid-position (ports 2 and 3
5/3-way function with spring-cent 4 supplied with air)	red mid-position (ports 2 and 4
5/3-way function with spring-cent (ports 2 and 4 vented)	red mid-position 5

Solenoid valve Type 3962- x x x x x x	. x >	(x	хх	x	х	x	x	x	к х	x	x
Attachment				Τ	Τ						Γ
NAMUR interface according to VDI/VDE 3845 SIL	C										
Threaded connection for wall or pipe mounting SIL	1										
CNOMO interface, 30 mm (pilot valve as spare part) SIL	2	2									
K _{vs} ¹⁾											Γ
1.4 ³		3									
4.3 SIL		4									
0.05 (pilot valve as spare part) SIL		5									
2.9 4)		6									
2.0 SIL		7									
Enclosure material											T
Aluminum	SIL		0								
Stainless steel	SIL		1								
Pneumatic connection											Γ
G 1⁄4	SIL		0								
1/4 NPT	SIL		1								
G 1/2	SIL		2								
1/2 NPT	SIL		3								
Without threaded connections (pilot valve as spare part)	SIL		4								
Supply											
Internal pilot supply for actuators for on/off service		SIL		0							
External pilot supply for actuators for throttling service		SIL		1							
Electrical connection											Γ
Cable entry M20x1.5 (female)		SIL			0	0					
Cable gland M20x1.5, black polyamide		SIL			0	1					
Adapter M20x1.5 (male) to ½ NPT (female)		SIL			1	2					
Connector according to EN 175301-803, type A, black polyamide ⁵⁾		SIL			2	3					
Degree of protection											
IP 66		SIL					2				
Ambient temperature 6)											
-20 to +40 °C (max. +80 °C in T4)		SIL						2			
–45 to +40 °C (max. +80 °C in T4)		SIL						3			

Solenoid valve	Туре 3962-	х	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	х
Safety approval																					Τ	
Without																			0			
SIL										S	IL								1			
Special version																					Τ	
Without																				0	0	0

¹⁾ Not with NAMUR interface, K_{VS} 4.3

- 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} x 36.22 in m³/h.
- ³⁾ A distance plate is required with NAMUR interface/type of protection Ex d (> EB 3962-9).
- 4) On request
- ⁵⁾ The cable socket is not included in the scope of delivery. The degree of protection is only guaranteed when the cable socket and gasket underneath it are mounted.
- ⁶⁾ The permissible ambient temperature of the solenoid valve depends on the permissible ambient temperature of the components, type of protection and temperature class.

1.4 Types of attachment

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
- Pipe mounting

2 Technical data

General data fo	r pilot va	lve								
Туре			3962-9							
Design			Solenoid and poppet valve with return spring							
Degree of protec	tion		IP 66							
Material E	nclosure		Stainless steel, epoxy powder coated, red (spool housing) aluminum, hard anodized, black (CNOMO connection block)							
Ir	nternal po	arts	Stainless steel and	brass						
S	crews		Stainless steel							
S	ieals		FKM							
Mounting oriente	ation		Any desired positi	on						
Approx. weight			850 g							
Electrical data fo	or pilot vo	alve w	vith type of protection	on flameproof enclos	ure Ex d					
Туре			3962-930	3962-940	3962-960/-970	3962-980				
Nominal signal		U _N	24 V DC (±10 %)	230 V AC/DC (±10 %) 50 to 60 Hz	115 V AC/DC (±10 %) 50 to 60 Hz	24 V AC (±10 %) 50 to 60 Hz				
Power	In	rush	3 W	3 W	9.5 VA/3 W	9.5 VA				
consumption	Hol	ding	3 W	3 W	5 VA/3 W	5 VA				
Duty cycle			100 %							
Ambient tempere		T6	−60 to +40 °C	-	-	-				
temperature clas cable temperatur		T5	−60 to +55 °C	−60 to +55 °C	-60 to +55 °C (-970 only)	-				
		T4	-60 to +65 °C (85 °C) -60 to +80 °C (105 °C)	-	-60 to +40 °C (90 °C) (-960 only)	−60 to +40 °C (90 °C)				
	-		-	-	-60 to +55 °C (105 °C) (-960 only)	−60 to +55 °C (105 °C)				
Connection			Female thread M20x1.5							
Pneumatic data	for pilot	valve								
Туре			3962-9							
Supply air	Med	dium	Instrument air							
	Pres	sure	1.4 to 10 bar							
Output signal			Same pressure as pilot supply							
Air consumption			No air consumption							
K _{vs} coefficient			0.05							
Switching time			30 ms							
Control pressure	connectio	on	CNOMO interface							

Technical data

Booster val	ve, actuated on on	e side, K _{vs} 4.3, with threade	d connections					
Switching fu	unction	3/2-way function	5/2-way function	6/2-way function				
K _{vs} ¹⁾ (direc	tion of flow)	1.9 (4 \rightarrow 3), 1.5 (3 \rightarrow 4), 4.3 (3 \rightarrow 5), 4.7 (5 \rightarrow 3)						
Design		Poppet valve with diaphrag	m actuator, soft seated, with	return spring				
Material	Enclosure	Aluminum, powder coated,	gray beige RAL 1019 or sto	ainless steel 1.4404				
	Diaphragms	Chloroprene rubber (-20 to	+80 °C) or silicone rubber	(-45 to +80 °C)				
	Seals	Chloroprene rubber (-20 to	+80 °C) or silicone rubber	(–45 to +80 °C)				
	Springs	Stainless steel 1.4310						
	Screws	Stainless steel 1.4571						
Actuation		Controlled on one side with a pilot valve						
Operating r	medium		Instrument air (free from corrosive substances) or nitrogen ²⁾ , Instrument air (free from corrosive substances), air containing oil or non-corrosive aases ³⁾					
	d air quality o 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						
Max. opera	iting pressure 4)	10.0 bar						
Output sign	al	Operating pressure						
Pneumatic c	connection	G 1/2 or 1/2 NPT						
Ambient ter	nperature ⁵⁾	−20 to +80 °C, −45 to +80 °C						
Approx. we	eight	585 g	1100 g					

¹⁾ The air flow rate when $p_1 = 2.4$ bar and $p_2 = 1.0$ bar is calculated using the following formula: $\begin{array}{l} Q = K_{VS} \times 36.22 \text{ in } m^3/h. \\ \end{array}$

- 3) With external pilot supply
- ⁴⁾ To control the booster value in the reversed direction of flow $(3\rightarrow 4)$, the pilot supply pressure must be higher than the operating pressure.
- ⁵⁾ The permissible ambient temperature of the solenoid valve depends on the permissible ambient temperature of the components, types of protection and temperature class.

Booster valv	ve, actuated on one	side, K _{vs} 2.0 or 4.3, with NAMUR interfa	ce					
Switching fu	nction	3/2-way function with exhaust air feedback						
K _{VS} ¹⁾ (direct	ion of flow)	1.1 (4→3) 2.0 (3→5)	1.9 (4→3) 4.3 (3→5)					
Design		Poppet valve with diaphragm actuator, so	Poppet valve with diaphragm actuator, soft seated, with return spring					
Material	Enclosure	Aluminum, powder coated, gray beige RA	AL 1019 or stainless steel 1.4404					
	Diaphragms	Chloroprene rubber (–20 to +80 °C) or si	licone rubber (-45 to +80 °C)					
	Seals	Chloroprene rubber (–20 to +80 °C) or si	licone rubber (-45 to +80 °C)					
	Springs	Stainless steel 1.4310						
	Screws	Stainless steel 1.4571						
Actuation		Controlled on one side with a pilot valve						
Operating m	nedium	Instrument air (free from corrosive substances) or nitrogen ²⁾ , Instrument air (free from corrosive substances), air containing oil or non-corrosive gases ³⁾						
Compressed according to	air quality 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						
Max. operat	ting pressure	10.0 bar						
Output signo	al	Operating pressure						
Pneumatic connection	Supply air	G ¼ or ¼ NPT and NAMUR interface ¼" 4) with G ¾ / ¾ NPT	G 1/2 or 1/2 NPT and NAMUR interface 1/2" 4)					
	Exhaust air	G ½ or ½ NPT and NAMUR interface ¼" 4) with G ¾ / ¾ NPT	G 1/2 or 1/2 NPT and NAMUR interface 1/2" 4)					
Ambient tem	nperature ⁵⁾	−20 to +80 °C, −45 to +80 °C						
Approx. wei	ight	1380 g	1500 g					

 $^{1)}$ The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 bar is calculated using the following formula: $Q=K_{VS}$ x 36.22 in m³/h.

²⁾ With internal pilot supply

³⁾ With external pilot supply

⁴⁾ NAMUR interface according to VDI/VDE 3845

⁵) The permissible ambient temperature of the solenoid valve depends on the permissible ambient temperature of the components, types of protection and temperature class.

Technical data

Booster va	lve, actuated or	n one side, K _{vs} 1.4 or 2.9 ¹⁾ , with threaded	connections or NAMUR interface				
Switching function		3/2-way function with exhaust air 5/2-way function feedback					
K _{VS} ²⁾		1.4 or 2.9 ¹					
Design		Spool, metal-to-metal seat, zero overlap,	with return spring				
Material	Enclosure	Aluminum, powder coated, gray beige RA	AL 1019 or stainless steel 1.4404				
	Seals	Silicone rubber					
	Filter	Polyethylene					
	Screws	Stainless steel 1.4571					
Actuation		Controlled on one side with a pilot valve					
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⁾					
	ed air quality 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					
Max. oper	ating pressure	10.0 bar					
Output sig	nal	Operating pressure					
Pneumatic connection		G $\frac{1}{4}$ or $\frac{1}{4}$ NPT and NAMUR interface $\frac{1}{4}$ " ⁵) (K _{VS} 1.4) G $\frac{1}{2}$ or $\frac{1}{2}$ NPT and NAMUR interface $\frac{1}{2}$ " ⁵) (K _{VS} 2.9)					
Ambient te	emperature ⁶⁾	-45 to +80 °C					
Approx. w	eight	485 kg (K _{vs} 1.4) 1760 kg (K _{vs} 2.9)					

¹⁾ On request, no SIL.

 $^{2)}$ The air flow rate when p_1 = 2.4 bar and p_2 = 1.0 bar is calculated using the following formula: Q = $K_{VS}\,x$ 36.22 in m³/h.

³⁾ With internal pilot supply

⁴⁾ With external pilot supply

- ⁵⁾ NAMUR interface according to VDI/VDE 3845
- ⁶⁾ The permissible ambient temperature of the solenoid valve depends on the permissible ambient temperature of the components, types of protection and temperature class.

3 Safety-related functions

Emergency venting

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

3.1 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).

4 Mounting, connection and start-up

Refer to Mounting and Operating Instructions ► EB 3962-9 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.

Safety-related functions



5 Required conditions

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.

5.1 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 is suitable for the prevailing ambient temperature.

Versions	Temperature range
With diaphragm and seals made of chloroprene rubber	-20 to +40 °C
With diaphragm and seals made of silicone rubber	-45 to +40 °C
With plastic cable gland	-20 to +40 °C
With metal cable gland	-45 to +40 °C
The specifications in the test certificates additionally app	ly to explosion-protected versions.

→ The temperature limits are observed.

5.2 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/m ³	-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 (4).

See "Sizing of the connecting line" in the mounting and operating instructions EB 3962-9.

- → 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 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.

5.3 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 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.

6 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.

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_{ava}).

6.1 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.

i Note

Record any device faults and e-mail (aftersalesservice@samsongroup.com) them to SAMSON.

→ In case of internal pilot supply, air with the permissible operating pressure from 1.4 to 8.0 bar is applied to port 4.

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 9. On using an upstream positioner, adjust it so that the maximum output pressure is available at the positioner output.

- \rightarrow 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.

6.2 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)

Risk of malfunction due to the use of unauthorized parts.

→ Only use original parts to replace worn parts.

7 Repairs

Only perform the work on the solenoid valve described in \triangleright EB 3962-9. Only use the specified original mounting parts.

8 Safety-related data and certificates

The Type 3962-9 Solenoid Valves with SIL marking consist of a Pneumatrol pilot valve EP000/d/TB and a SAMSON Type 3756 Booster Valve. The versions with 1/4 NAMUR interface (K_{VS} 2.0) and with 1/2 NAMUR interface (K_{VS} 4.3) as well as with 1/2 threaded connection for pipe mounting are suitable for use in safety-instrumented systems according to IEC 61508.

The devices have an HFT of 0 and can be used up to SIL 2 (single device, HFT = 0) according to IEC 61511.

Verification must be performed taking into account the following certificates:

- ENGINEERING SAFETY CONSULTANTS no. F127_CT001 rev. 4
- TÜV Rheinland® no. 968/V 1160.00/20



968/V 1160.00/20 - page 2



Holder: SAMSON AG Welemüllerstraße 3 60314 Frankfurt am Main Germany Product tested: Electromagnetic control, solenoid and booster valves of the types 3963, 3967, 3964, 3756, 3701, 3968⁴, 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 8	BO 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	λρυ	7.35 E-08 / h	74 FIT	
Average Probability of Fallure 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 Fallure on Demand ²	PFD _{ave} (T ₁)	3.67 E-	04		
Average Probability of Failure on Demand 1002 3	PFD _{ave} (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 F		
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 T₁ = 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 application from 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).

I

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, temeerature, time of imposit, and adequate test civels.

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



IEC 61508 Functional Safety Capability Statement Pneumatrol Ltd, C, E and T Series Solenoid Valve Series

Manufacturer: Product: Model:	Pneumatrol Ltd Blackburn Rd, Oswaldtwistle, Accrington BB5 4WZ Solenoid Valve C, E and T Series
Application: Safety Function:	Low Demand Mode Safety Instrumented Function Upon detection of a failure/fault, action is initiated to move valve to the designated safe state within the specified time for both De- Energise To Trip (DETT) and Energise To Trip (ETT) (Sensing, logic solver and additional final element subsystems not part of this analysis)
Applied standard: Systematic Capability: Applicable report:	IEC 61508 Ed2 2010 Parts 1-3 & IEC 61511 Ed1 Suitable up to SIL 2 Environmental Resources Management Ltd Report: F127_SV001 rev. 5
Assessment Route: Hardware Fault Tolerance: Type: Application restrictions:	1 _H 0 or 1 A None

Model	No.	λDU (/hr)	λDD (/hr)	λS (/hr)	SFF	SIL AC (HFT = 0)	SIL AC (HFT = 1)	SIL SC
C Series	DETT	7.2E-08	0.0E+00	3.9E-07	85%	SIL 2	SIL 3	SC 2
Terminal Box EXN	ETT	3.7E-07	0.0E+00	7.6E-09	2%	SIL 1	SIL 2	SC 1
C Series	DETT	7.2E-08	0.0E+00	4.0E-07	85%	SIL 2	SIL 3	SC 2
Terminal Box EXM	ETT	3.7E-07	0.0E+00	8.6E-09	2%	SIL 2	SIL 2	SC 1
C Series + Terminal Box IA	DETT	7.2E-08	0.0E+00	4.0E-07	85%	SIL 2	SIL 3	SC 2
	ETT	3.7E-07	0.0E+00	9.6E-09	3%	SIL 1	SIL 2	SC 1
E Series + Terminal Box EXN	DETT	8.9E-08	0.0E+00	5.1E-07	85%	SIL 2	SIL 3	SC 2
	ETT	3.7E-07	0.0E+00	7.6E-09	2%	SIL 1	SIL 2	SC 1

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Model	No.	λDU (/hr)	λDD (/hr)	λS (/hr)	SFF	SIL AC (HFT = 0)	SIL AC (HFT = 1)	SIL SC
E Series	DETT	8.9E-08	0.0E+00	5.1E-07	85%	SIL 2	SIL 3	SC 2
Terminal Box EXM	ETT	3.7E-07	0.0E+00	8.6E-09	2%	SIL 1	SIL 2	SC 1
E Series	DETT	8.9E-08	0.0E+00	5.1E-07	85%	SIL 2	SIL 3	SC 2
Terminal Box IA	ETT	3.7E-07	0.0E+00	9.6E-09	3%	SIL 1	SIL 2	SC 1
T Series	DETT	1.1E-07	0.0E+00	4.9E-07	82%	SIL 2	SIL 3	SC 2
Terminal Box EXN	ETT	3.7E-07	0.0E+00	7.6E-09	2%	SIL 1	SIL 2	SC 1
T Series	DETT	1.1E-07	0.0E+00	4.9E-07	82%	SIL 2	SIL 3	SC 2
Terminal Box EXM	ETT	3.7E-07	0.0E+00	8.6E-09	2%	SIL 1	SIL 2	SC 1
T Series	DETT	1.1E-07	0.0E+00	4.9E-07	82%	SIL 2	SIL 3	SC 2
Terminal Box IA	ETT	3.7E-07	0.0E+00	9.6E-09	3%	SIL 1	SIL 2	SC 1

SIL AC (Architectural Constraints): Represents the maximum allowable SIL of each hardware element, assuming Hardware Fault Tolerance (HFT) =0 or 1.

SIL SC (Systematic Capability): A measure of confidence (expressed on a scale of SC 1 to SC 4) of the confidence that the systematic safety integrity of a device meets the requirements of the specified SIL.

It should be noted that for a device to meet a required SIL that the SIL AC and SIL SC of the device needs to both be met. In addition to this, the required Probability of Failure on Demand (PFD) value for the complete Safety Instrumented Function (SIF) needs to adhere to the SIL PFD ranges.

IMPORTANT: It should be noted that this assessment considers only the Pneumatrol Ltd, C, E and T Series Solenoid Valve Series. It does not cover opening and closing time requirements and a random hardware failures assessment must be conducted for the entire safety function for each application as per the appropriate Safety Requirements Specification.

The Pneumatrol Ltd, C, E and T Series Solenoid Valve Series has been assessed and is considered capable for use in a low demand mode safety function up to (and including) SIL 1 (ETT) / SIL 2 (DETT) with regards to random hardware failures, architectural constraints and Systematic Capability.

Note 1: The SIL of a complete SIF (sensor, logic solver and final element subsystems) must be verified to calculate the required PFD / Probability of Failure per Hour (PFH), considering any



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redundancy, Proof Test Interval (PTI), Proof Test Coverage (PTC), Mission Time and Mean Time To Restoration (MTTR) for all elements included in the SIF. Each subsystem should be verified to ensure compliance with the minimum HFT requirements.

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