SRD991 Intelligent Positioner

SRD960 Universal Positioner

Functional Safety

Safety **I**ntegrity **L**evel

SIL certified

acc. to IEC 61508 / IEC 61511

The SRD991 Intelligent Positioner and the SRD960 Universal Positioner are designed to operate pneumatic valve actuators from control systems or electrical controllers that are consistent with the special safety requirements according to IEC 61508 / IEC 61511-1. The considered safety related application of the positioner for pneumatic actuators is as a shutdown device with fail-safe single-acting (spring return) actuation.

Features

- Assessment of functional safety according to IEC 61508 / IEC 61511-1 by *exida.com* ®
- Suitable for applications up to SIL 3
- Continuous self-surveillance
- Electrical classification (depending on version)
- Electro-magnetic compatibility according to EN 61326 and NAMUR-recommendation NE21

Foxboro

by Schneider Electric

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1 RANGE OF APPLICATION

1.1 General

The range of application applies to the SRD991 Intelligent Positioner after Hardware-Revision 3.3 (HART and 4-20mA without communication) with single-acting pneumatic amplifier (Modelcode SRD991-BHxxx and SRD991-BDxxx); and the SRD960 Universal Positioner after Hardware-Revision 2.2 (HART and 4-20mA without communication) with single-acting pneumatic amplifier (Modelcode SRD960-BHxxx and SRD960-BDxxx) for operation of fail-safe single-acting (spring return) pneumatic actuators.

In the event of a loss of electrical- and/or pneumatic-supply the pneumatic output Y1 of the positioner will automatically be de-pressurized. In result the loss of output-pressure will automatically drive the actuator in the safe position, caused by the direction of the spring-force. If the positioner identifies any internal error, the output Y1 will also be de-pressurize and close the valve.

For functional safety applications the positioners can be operated in three different modes.

All three applications are based on the shutdown of the pneumatic amplifier unit by means of the positioner hardware with the before listed behavior. This ensures that the shutdown is achieved independent of any software settings and/or configurations such as cutoff, valve characteristics, control action, travel stops etc. Therefore all possible software settings are irrelevant for a safe shutdown.

1.1.1 Shutdown mode with shutdown threshold below 0,2mA

In the shutdown mode the positioner in this case is operated in a way that at least the input current (power supply) is less than the shutdown threshold of 0,2mA. For this case the failure rates as listed in chapter 5.2 are applicable.

1.1.2 Shutdown mode with shutdown threshold below 1,5/2mA

In the shutdown mode the positioner in this case is operated in a way that at least the input current (power supply) is less than the shutdown threshold of 1,5mA (Devices with HART-Communication) or 2mA (Devices without Communication). For this case the failure rates as listed in chapter 5.3 are applicable.

1.1.3 Positioner mode / Normal shutdown mode

In the positioner mode / normal shutdown mode the positioner in this case is operated in a way that at least the input current (power supply) is less than or equal the shutdown threshold of 3,8mA (also see reference [Ref. 6]). For this case the failure rates as listed in chapter 5.4 are applicable.

1.2 Requirements

For safety related applications according to the IEC 61508 / IEC 61511-1 the following requirements have to be observed:

- For applications of the positioner the technical data as specified in [Ref. 4], in specific regarding the application- and ambient-conditions, need to be observed.
- Only single-acting positioners are considered for these safety applications
- The actuator has to be designed that the valve is closed in the event of a depressurization, supported by the force of springs.
- The supplied instrument air has to be free of water, oil and dust according to ISO 8573-1, particle-size and –density based on class 2 and the oil-content based on class 3.
- Average ambient operating temperature over a longer period of time shall not exceed +40°C (+104°F)
- The SRD991 / SRD960 is only operated in applications where the demand rate Is low.
- The setpoint is only defined by its analog threshold. Because of this the HART-communication is rated as non safety relevant.
- After mounting, connection and start-up the positioner has to undergo a functional test as described in [Ref. 5]:
    - Apply a setpoint of 4 mA and check if the actuator/valve drives into the designated position.
    - Apply a setpoint of 20 mA and check if the actuator/valve drives into the designated position.
    - Apply a setpoint of 12 mA and check if the actuator/valve drives into the designated position of 50% (if a linear valve characteristic is applied).
    - Check the voltage across the connection terminals at 20 mA. The measured voltage should not exceed 6V DC for the model SRD991-BDxxx and 8 V DC for the model SRD991-BHxxx.
- A functional test should be carried out periodically (see chapter 4.2).

2 GENERAL

2.1 Relevant Regulatory

- DIN EN 61508 part 1 to 7: Functional safety for safety related electric/electronical/programmable systems.
- DIN IEC 61511 part 1 to 3: Functional safety – Safety systems for the process industry

2.2 Definitions

The listed definitions are based on [Ref. 1], part 4 and [Ref. 2], part 1.

Name	Description
Actuator	Part of the safety system that performs interactions with the process to achieve a safe condition.
Failure	Completion of the ability of a functional unit to perform a demanded function.
Diagnostic coverage factor	Relationship of the failure rate of the errors recognized by diagnostic tests to the failure rate of the component or subsystem. The degree of diagnostic does not contain errors determined at repeated inspections.
Fault	Abnormal condition, which can cause a reduction or a loss of the ability of a functional unit to perform a demanded function.
Functional safety	Part of the total safety, which refers to the process and the BPCS and the intended function of the SIS and other safety levels.
Functional unit	Unit from hardware or software or both, which are suitable for the execution of a fixed task.
Dangerous Failure	Loss with the potential to shift the safety-relevant system into a dangerous condition or a non functioning state.
Safety	Liberty of untenable risks
Safety function	Function, which is executed by a SIS, safety-related systems based on other technologies or from external installations and mechanisms for risk-reduction, with the goal of achieving or keeping up, under consideration of a fixed dangerous incident, a safe condition for the process.
Safety Integrity	Average probability that a safety-relevant system executes the demanded safety-relevant functions, in accordance with the required conditions within a fixed period of time.
Safety Integrity Level (SIL)	One out of four discrete levels to specify the requirements for the safety integrity of the safety functions, which are assigned to the safety-related system, whereby the safety integrity level 4 represents the highest degree of the safety integrity, the safety integrity level 1 the lowest.
Safety Instrumented System (SIS)	Safety-related system for the execution of one or several safety-related functions. A SIS consists of sensor(s), logic system and actuator(s).
Safe failure	failure without the potential to set the safety-related system into a dangerous or a nonfunctioning condition.

2.3 Abbreviation

Abbreviation	Description (English)	Description (German)
λ	Failure rate per hour	Ausfallrate pro Stunde
λ_D	Dangerous failure rate per hour	Rate gefahrbringender Ausfälle je Stunde
λ_{DD}	Detected Dangerous failure rate per hour	Rate erkannter gefahrbringender Ausfälle je Stunde
λ_{DU}	Undetected Dangerous failure rate per hour	Rate unerkannter gefahrbringender Ausfälle je Stunde
λ_S	Safe failure rate per hour	Rate ungefährlicher Ausfälle je Stunde
λ_{SD}	Detected Safe failure rate per hour	Rate erkannter ungefährlicher Ausfälle je Stunde
λ_{SU}	Undetected Safe failure rate per hour	Rate unerkannter ungefährlicher Ausfälle je Stunde
BPCS	Basic process control system	Betriebs- und Überwachungseinrichtungen als ein System
DC	Diagnostic coverage	Diagnose-Deckungsgrad
FIT	Failure in Time (1 x 10^{-9} per h)	Fehler pro Zeit (1 x 10^{-9} pro h)
HFT	Hardware fault tolerance	Hardware-Fehlertoleranz
PFD	Probability of failure on demand	Wahrscheinlichkeit eines Ausfalls bei Anforderung
PFD_{avg}	Average probability of failure on demand	Mittlere Wahrscheinlichkeit eines Ausfalls bei Anforderung
MooN	Architecture with M out of N channels	Architektur mit M aus N Kanälen
MTBF	Mean Time Between Failures	Mittlere Zeitdauer zwischen zwei Ausfällen
MTTR	Mean Time To Repair	Mittlere Zeitdauer zwischen dem Auftreten eines Fehlers und der Reparatur
SFF	Safe failure fraction	Anteil ungefährlicher Ausfälle
SIL	Safety integrity level	Sicherheits-Integritätslevel
SIS	Safety instrumented system	Sicherheitstechnisches System

2.4 Interpretation Tables

The following tables serve for the determination of the safety integrity level (SIL).

2.4.1 Average probability of failure on demand (PFD_{avg})

This table shows the attainable safety integrity level (SIL) as a function of the average probability of a failure on demand. The here indicated failure-limit values are valid for a safety function that are operated in the mode with low requirement (see [Ref. 1] part 1, chapter 7.6.2.9).

Safety Integrity Level (SIL)	PFD_{avg} with low demand rate
4	$\geq 10^{-5}$ to $< 10^{-4}$
3	$\geq 10^{-4}$ to $< 10^{-3}$
2	$\geq 10^{-3}$ to $< 10^{-2}$
1	$\geq 10^{-2}$ to $< 10^{-1}$

2.4.2 Safety Integrity of the hardware

Based on [Ref. 1] part 2, chapter 7.4.3.1.2 and 7.4.3.1.3. it has to be differentiated between systems of type A and systems of type B.

To Type A – systems applies:

- The failure behavior of all assigned components is sufficiently defined and
- the behavior of the subsystem under fault conditions can be completely determined and
- sufficient and reliable data for the failure reasons based on field-experience for the subsystem exist to show that the accepted failure rates for dangerous identified and dangerous unidentified failures are achieved.

To Type B – systems applies:

- The failure behavior of at least one assigned component is not sufficiently defined or
- the behavior of the subsystem under fault conditions cannot be completely determined or
- no sufficiently reliable data for the failure reasons based on field-experience for the subsystem are available, in order to support the failure rates for dangerous identified and dangerous unidentified failures.

These following tables indicate the attainable safety integrity level (SIL) as a function of the fraction of the safe failures (SFF) and the fault tolerance of the hardware (HFT) for safety-related subsystems of type A and type B (see [Ref. 1] part 2, chapter 7.4.3.1.4).

Fraction of safe failures (SFF)	**Fault tolerance of hardware (HFT) for Type A**		
	0	**1**	**2**
< 60%	SIL 1	SIL 2	SIL 3
60% - < 90%	SIL 2	SIL 3	SIL 4
90% - < 99%	**SIL 3**	SIL 4	SIL 4
≥ 99%	SIL 3	SIL 4	SIL 4

Fraction of safe failures (SFF)	**Fault tolerance of hardware (HFT) for Type B**		
	0	**1 (0)**[1]	**2**
< 60%	Not allowed	SIL 1	SIL 2
60% - < 90%	SIL 1	**SIL 2**	SIL 3
90% - < 99%	SIL 2	SIL 3	SIL 4
≥ 99%	SIL 3	SIL 4	SIL 4

1) Based on [Ref. 2] part 1, chapters 11.4.4 it is possible for subsystems e.g. sensors and actuators to reduce the value for the hardware failure tolerance (HFT) by one (values in parentheses), if the used equipment fulfills all following conditions:

- The device is proven in operation
- The device only allows to change process-relevant parameters
- Changes of the process-relevant parameters is protected (e.g. password, Jumper, etc..)
- The function/application has a demanded safety integrity level of less than SIL 4.

These listed conditions apply to positioner SRD991/SRD960.

2.4.3 Safety-related System

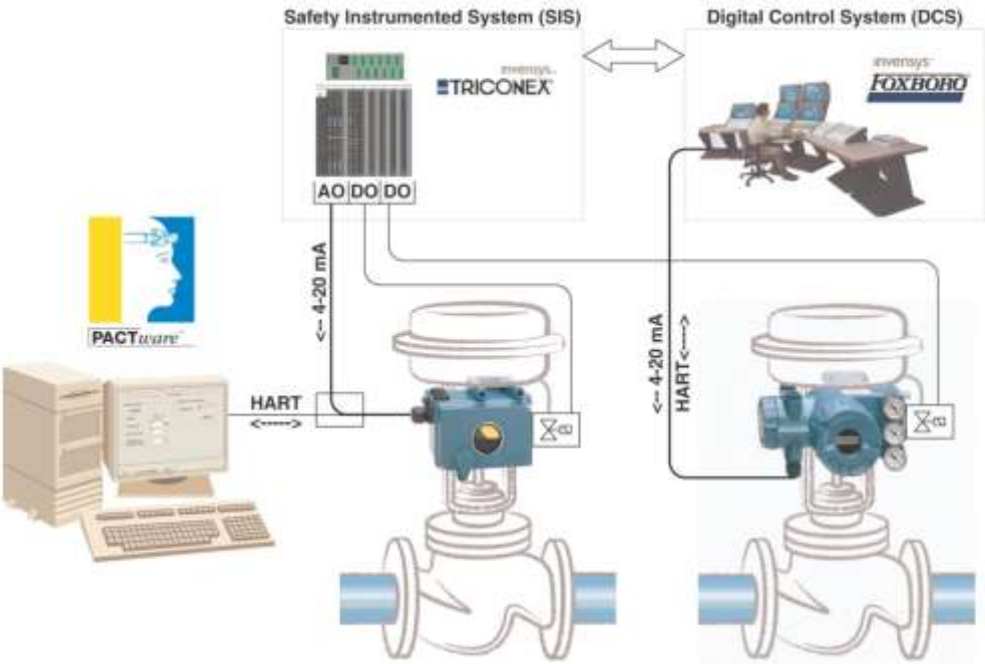
Safety-related systems usually consist of three subsystems, the input subsystem (sensor), logic subsystem (SPS or control system) and output system (control valve consisting of positioner, actuator and valve). The average probability of a failure on demand is usually divided as follows:

Input-subsystem (Sensor)	Logic-subsystem (e.g. DCS)	Output-subsystem (Actuator)
≤ 35%	≤ 15%	≤ 50%

Example of a connection of the positioner SRD with HFT=1

• into a safety-related system by means of AO-modules with energetic decoupled HART-communication e.g. by using a HART-multiplexers and additional control of a solenoid valve by means of a DO module.

• into a control system by means of an analog control signal as well as HART-communication and additional control of a solenoid valve by means of a DO module.



3 BEHAVIOR IN OPERATION AND FAULT STATE

The behavior during operation and fault state is described in the Master Instruction MI EVE0105 E [Ref. 5] for SRD991 and/or MI EVE0109 A [Ref. 9] for SRD960.

4 RECURRING EXAMINATIONS OF THE POSITIONER

4.1 Security Examination

In accordance with IEC 61508/61511 the safety function of the entire safety circuit is to be examined regularly. The therefore necessary test intervals are determined for the respective safety circuit.

4.2 Functional Examination

The functional examination / inspection has to be performed regularly according the chosen proof test interval to ensure a normal operability of the positioner. Therefore the following functions need to be checked:

- Examine the indicated status and diagnostic messages via LED, LCD or HART-communication.
- Examine the supply air filter and if necessary exchange in accordance with MI EVE0105 E for SRD991 chapters 10.2 ([Ref. 5]) and/or MIEVE0109 A for SRD960 chapter 10.2 ([Ref. 9]).
- Restart (Reset) of the positioner by simultaneously pushing all 3 keys (M, UP and DOWN) for the SRD991 (4 keys Menu, UP, DOWN and Enter/Store for the SRD960) or by brief interruption of the input current.
- Activate an endpoint calibration (Autostart-Endpoints) to re-determine the final mechanical stops.
- Apply an input signal value of 4 mA and examine whether the valve-/actuator-combination drives into the correct end position.
- Apply an input signal value of 20 mA and examine whether the valve-/actuator-combination drives into the correct end position.
- Apply an input signal value of 12 mA and examine whether the valve-/actuator-combination drives into the correct position (e.g. 50% with linear characteristic).
- Examine the voltage across the two connection terminals. The voltage at 20 mA input signal value should not exceed the value of 6 VDC for the device type SRD991/SRD960-BDxxx and 8,4 VDC for the device type SRD991/SRD960-BHxxx.

The positioner does not require a regular maintenance. For maintenance or repairs refer to chapter 10 of the Master Instruction MI EVE0105 E ([Ref. 5]) and/or MI EVE0109 A ([Ref. 9]).

4.3 Repairs

Defective devices should be returned to the service & repair department of Foxboro Eckardt, under indication and description of the possible failure reason.

5 SAFETY RELEVANT CHARACTERISTICS

With respect to the safety-relevant characteristics it has to be differentiated between the two in chapter 1.1 described ways of application "shutdown" and "normal operation". Further information, beyond this summary, is contained in chapter 8.

5.1 Assumptions

The characteristics indicated in the following sub-chapters apply to the following assumption:

- The requirements from chapter 1.2 are fulfilled.
- The repair time (MTTR) after a device failure amounts to 8 hours.
- Testing-interval: ≤ 1 year.
- The diagnostic time of the internal tests amounts to testing-interval: ≤ 20 minutes.
- A dangerous failure for both ways of a shutdown is defined as a failure, in the case of which the device does not react to the requirement of a shutdown below the respective threshold.
- A dangerous failure for a normal shutdown is defined as a failure, in the case of which the device does not react to the requirement of a shutdown below the respective threshold (input signal value <3,8 mA).

5.2 Shutdown mode with shutdown threshold below 0,2mA

Device-Type	Category	HFT	SFF	PFD_{avg}	λ_{du}	λ_{dd}	λ_{su}	λ_{sd}
A	SIL 3	0	94%	$8,8x10^{-5}$	20 FIT	0 FIT	327 FIT	0 FIT

5.3 Shutdown mode with shutdown threshold below 1,5/2mA

Device-Type	Category	HFT	SFF	PFD_{avg}	λ_{du}	λ_{dd}	λ_{su}	λ_{sd}
A	SIL 2	0	93%	$1,2x10^{-4}$	27 FIT	1 FIT	342 FIT	0 FIT

5.4 Positioner mode / normal shutdown mode

Device-Type	Category	HFT	SFF	PFD_{avg}	λ_{du}	λ_{dd}	λ_{su}	λ_{sd}
B	SIL 2	0	90%	$3,2x10^{-4}$	73 FIT	73 FIT	572 FIT	43 FIT

6 BIBLIOGRAPHY

[Ref. 1] DIN EN 61508 Teil 1-7
Beuth-Verlag, Berlin

[Ref. 2] DIN IEC 61511 Teil 1-3
Beuth-Verlag, Berlin

[Ref. 3] Functional safety and IEC 61508 – A basic guide, November 2002
IEC

[Ref. 4] SRD991 Intelligent Positioner
Product Specification Sheet
Foxboro Eckardt GmbH, PSS EVE0105 E

[Ref. 5] SRD991 Intelligent Positioner
Master Instruction
Foxboro Eckardt GmbH, MI EVE0105 E

[Ref. 6] Namur-Empfehlung NE 43
NAMUR Geschäftsstelle, Leverkusen.

[Ref. 7] Failure Modes, Effects and Diagnostics Analysis for Intelligent Positioner SRD991 and SRD960
exida, Report No. Foxboro 04/08-16 R001.

[Ref. 8] SRD960 Universal Positioner
Product Specification Sheet
Foxboro Eckardt GmbH, PSS EVE0109 E

[Ref. 9] SRD960 Universal Positioner
Master Instruction
Foxboro Eckardt GmbH, MI EVE0109 E

7 DECLARATION OF CONFORMITY

SIL Konformitätserklärung
Declaration of conformity

invensys
ECKARDT

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Stuttgart, 05.2.2007

Funktionale Sicherheit nach IEC 61508 / IEC 61511
Functional Safety according to IEC 61508 / IEC 61511

Wir erklären, dass die Geräte
We declare, that the devices

SRD991-BHxxx, SRD991-BDxxx
SRD960-BHxxx, SRD960-BDxxx

für den Einsatz in einer sicherheitsgerichteten Anwendung entsprechend der IEC 61511-1 geeignet sind, wenn die Sicherheitshinweise und die nachfolgenden Parameter beachtet werden:
are suitable for use in a safety related application according IEC 61511-1,
if the safety instructions and the following parameters are observed:

Einsatzart Usage	Stromabschaltung unter Schwelle 0,2mA Shutdown device, threshold 0,2mA	Stromabschaltung unter Schwelle 1,5/2mA Shutdown device, threshold 1,5/2mA	Normalabschaltung Smart positioner
SIL	3	2	2
Prüfintervall / Proof test interval	≤ 1 Jahr / year		
Gerätetyp / Device Type	A	A	B
HFT	0 [1] (einkanalige Verwendung / single channel usage)		
SFF	94%	93%	90%
PFG_{avg}	$8{,}8 \times 10^{-5}$	$1{,}2 \times 10^{-4}$	$3{,}2 \times 10^{-4}$
λ_{du}	20 FIT	27 FIT	73 FIT
λ_{dd}	0 FIT	1 FIT	73 FIT
λ_{su}	327 FIT	342 FIT	572 FIT
λ_{sd}	0 FIT	0 FIT	43 FIT
DC_S	0%	0%	7%
DC_D	0%	4%	50%

[1] gemäß Kapitel / according to chapter 11.4.4 of IEC 61511-1

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8 MANAGEMENT SUMMARY

exida FMEDA

Failure Modes, Effects and Diagnostics Analysis

Project:
Intelligent Positioner SRD 991 and SRD 960

Customer:
Foxboro Eckardt GmbH
Stuttgart
Germany

Contract No.: Foxboro 04/08-16
Report No.: Foxboro 04/08-16 R001
Version V1, Revision R1, July 2007
Rainer Faller

Management summary

This report summarizes the results of the hardware assessment according to IEC 61508 carried out on the intelligent positioner SRD 991 / SRD 960. The considered safety-related application of the intelligent positioner SRD 991 / SRD 960 is as a shutdown device with fail-safe single-acting (spring return) actuation.

The intelligent positioners differ by their explosion protection, SRD 991: EEx ia and SRD 960: EEx d / EEx ia. For functional safety applications, the intelligent positioner SRD 991 / SRD 960 can be operated in three modes:

- 0..20 mA shutdown mode, shutdown threshold: 0,2 mA
- 0..20 mA shutdown mode, shutdown threshold: 1,5 mA
- 4..20 mA positioner mode, shutdown threshold: 3,8 mA.

In shutdown mode, an input current of less than the shutdown threshold (0,2 mA or 1,5 mA) leads to a shutdown of the corresponding pressure output. The different levels of shutdown threshold are to compensate possible leakage currents of the driving output.
In positioner mode, an input current of less than 3,8 mA leads to a shutdown of the corresponding pressure output, provided the positioner is configured per the Safety Manual TI EVE 0105 S. All other possible input variants or electronics are not covered by this report.

The hardware assessment consists of a Failure Modes, Effects and Diagnostics Analysis (FMEDA). A FMEDA is one of the steps taken to achieve functional safety assessment of a device per IEC 61508. From the FMEDA, failure rates are determined and consequently the Safe Failure Fraction (SFF) is calculated for the device. For full assessment purposes all requirements of IEC 61508 must be considered.

The failure rates used in this analysis are the basic failure rates for electronic components from the Siemens standard SN 29500. For mechanical components experience-based *exida* data and field failure evaluations from Eckardt S.A.S. France were used.

The control electronics of the intelligent positioner SRD 991 / SRD 960 are considered to be a Type B[1] subsystem with a hardware fault tolerance of 0. The pneumatics of the intelligent positioner SRD 991 / SRD 960 are considered to be a Type A[2] subsystem with a hardware fault tolerance of 0.

Table 1: Summary for SRD 991 / SRD 960 as shutdown device, threshold 0,2 mA – Type A device, IEC 61508 failure rates

λ_{sd}	λ_{su}	λ_{dd}	λ_{du}	SFF	DC_S[3]	DC_D
0 FIT	327 FIT	0 FIT	20 FIT	94%	0%	0%

These failure rates do not include failures resulting from incorrect use of the intelligent positioner, in particular humidity entering through incompletely closed housings or inadequate cable feeding through the PG inlets.

A user of the intelligent positioner SRD 991 / SRD 960 can utilize these failure rates in a probabilistic model of a safety instrumented function (SIF) to determine suitability in part for safety instrumented system (SIS) usage in a particular safety integrity level (SIL).

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[1] Type B component: "Complex" component (using micro controllers or programmable logic); for details see 7.4.3.1.3 of IEC 61508-2.

[2] Type A component: "Non-complex" component (all failure modes are well defined); for details see 7.4.3.1.2 of IEC 61508-2.

[3] DC means the diagnostic coverage (safe or dangerous).

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The failure rates are valid for the useful life of the instrument. According to section 7.4.7.4 note 3 of IEC 61508-2, experience has shown that the useful lifetime often lies within a range of 8 to 12 years.

Table 2: Summary for SRD 991 / SRD 960 as shutdown device, threshold 0,2 mA – PFD_{AVG} values

T[Proof] = 1 year	T[Proof] = 2 year	T[Proof] = 5 years	T[Proof] = 10 years
8,8E-05	1,8E-04	4,4E-04	8,8E-04

The boxes marked in yellow ( ) mean that the calculated PFD_{AVG} values are within the allowed range for SIL 3 according to table 2 of IEC 61508-1 but do not fulfill the requirement to not claim more than 20% of this range, i.e. to be better than or equal to 2,0E-04. The boxes marked in green ( ) mean that the calculated PFD_{AVG} values are within the allowed range for SIL 3 according to table 2 of IEC 61508-1 and table 3.1 of ANSI/ISA–84.01–1996 and do fulfill the requirement to not claim more than 20% of this range, i.e. to be better than or equal to 2,0E-04.

Table 3: Summary for SRD 991 / SRD 960 as shutdown device, threshold 1,5 mA – Type A device, IEC 61508 failure rates

λ_{sd}	λ_{su}	λ_{dd}	λ_{du}	SFF	DC_S	DC_D
0 FIT	342 FIT	1 FIT	27 FIT	93%	0%	4%

Table 4: Summary for SRD 991 / SRD 960 as shutdown device, threshold 1,5 mA – PFD_{AVG} values

T[Proof] = 1 year	T[Proof] = 2 year	T[Proof] = 5 years	T[Proof] = 10 years
1,2E-04	2,4E-04	5,9E-04	1,2E-03

Table 5: Summary for SRD 991 / SRD 960 as smart positioner, shutdown threshold: 3,8 mA – Type B device, IEC 61508 failure rates

λ_{sd}	λ_{su}	λ_{dd}	λ_{du}	SFF	DC_S	DC_D
43 FIT	572 FIT	73 FIT	73 FIT	90%	7%	50%

Table 6: Summary for SRD 991 / SRD 960 as smart positioner, shutdown threshold: 3,8 mA – PFD_{AVG} values

T[Proof] = 1 year	T[Proof] = 2 year	T[Proof] = 5 years	T[Proof] = 10 years
3,2E-04	6,4E-04	1,6E-03	3,2E-03

The boxes marked in yellow ( ) mean that the calculated PFD_{AVG} values are within the allowed range for SIL 2 according to table 2 of IEC 61508-1 but do not fulfill the requirement to not claim more than 20% of this range, i.e. to be better than or equal to 2,0E-03. The boxes marked in green ( ) mean that the calculated PFD_{AVG} values are within the allowed range for SIL 2 according to table 2 of IEC 61508-1 and table 3.1 of ANSI/ISA–84.01–1996 and do fulfill the requirement to not claim more than 20% of this range, i.e. to be better than or equal to 2,0E-03.

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