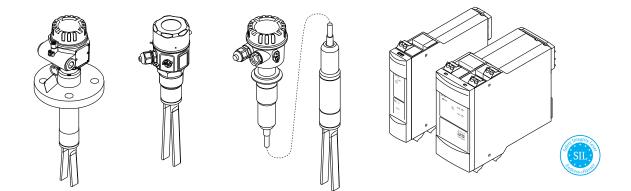
Special Documentation Soliphant M with electronic insert FEM57 + Nivotester FTL325P

Functional Safety Manual



Point level measuring system



Table of contents

Declaration of conformity General Other safety-related characteristic values Useful lifetime of electrical components	5 5
Certificate	13
Document information	14 14 14 15
Permitted devices types	16 16
Safety function	17 17 17
Use in safety instrumented systems Device behavior during operation Device configuration for safety-related applications Proof-testing	19 19 19 22
Life cycle	27 27 27 27 27 27 28 28
AppendixStructure of the measuring systemCommissioning or proof test reportFurther informationVersion history	29 30 30 31

Declaration of conformity

SIL_00072_01.15 Endress+Hauser People for Process Automation SIL-Declaration of Conformity Functional Safety according to IEC 61508 Supplement 1 / NE130 Form B.1 and IGR 49-02-15 Datasheet 1 Endress+Hauser GmbH+Co. KG, Hauptstraße 1, 79689 Maulburg being the manufacturer, declares that the product stated below Soliphant M with electronic insert FEM57 (+ Nivotester FTL325P) (Serial number XXXXXXXXXXX) is suitable for the use in safety-instrumented systems according to IEC61508, if the safety instructions and following parameters are observed. This declaration of conformity is only valid for the customer listed in the cover letter of the responsible Endress+Hauser sales center and for the listed products in delivery status. Maulburg, 4-November-2015 Endress+Hauser GmbH+Co. KG i. V. Q. Fm . i. V. 0 Dr. Dietmar Frühauf Dr. Arno Götz Dept. Manager Product Safety Dept. Manager Level Switches Research & Development **Research & Development** 1/2

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1) FIT = Failure In Time, Number of failures per 10 ⁹ h	1) FIT = Failure In Time, Number of failures per 10 ⁹ h 2) PTC = Proof Test Coverage (Diagnostic coverage for proof test)		ment system ensur	es information on safe	ety-related systematic fau	ilts which become
2) PTC = Proof Test Coverage (Diagnostic coverage for proof test)		1) FIT = Failure In Time, Number of failure	es per 10 ⁹ h	of test)	-+	

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General	The components can be operated as different versions: ■ Version II (→ 🗎 6)
	One Soliphant with a 1-channel Nivotester, for the activation of an actuator or a safety-related PLC via switching contacts, for instance
	• Version III ($\rightarrow \bigcirc 7$)
	One Soliphant with a 3-channel Nivotester, switching contacts are switched in series • Version IV ($\rightarrow \cong 8$)
	Two Soliphant devices with a 3-channel Nivotester, switching contacts are switched in series ■ Version V (→ 🗎 10)
	Three Soliphant devices with a 3-channel Nivotester; evaluation is performed in a safety-related PLC, for example • Version VI ($\rightarrow \cong 12$)
	Three Soliphant devices with a 3-channel Nivotester, only channel 1 has a SIL-specific monitoring function. Channels 2 and 3 are used for level control of the same level (e.g. Δ s). This level control may not then be considered as a safety measure as part of functional safety according to EN 61508.
	 NOTICE Measuring another, independent level (e.g. in a second tank) The remaining channels may not be used for other levels.
Other safety-related	Please note the following for the tables below: 10% has been accounted in the calculations in directed below:
characteristic values	 A common cause factor β = 10 % has been assumed in the calculations indicated below. For multi-channel systems, the PFD_{avg} values already contain common cause failures for the specific wiring scheme.
	 The PFD_{avg} values only apply to the particular wiring scheme for which the values have been calculated. They are not a suitable basis for making calculations for other wiring schemes. The use of NC contacts instead of NO contacts, in particular, is not permitted for operation according to SIL specifications. The wiring scheme indicates the number of devices and the circuitry of the level relay
	 The wining scheme indicates the number of devices and the circuity of the lever relay contacts (open when required (demand mode)). If there are several devices in a wiring scheme, all the devices have the same settings shown. The tables show safety-related values and wiring options for the measuring system. FIT = Failure in Time, 1 FIT = 10⁻⁹ l/h.

Specific functional safety parameters:

Characteristics as per IEC 61508	Value
Safety function	MAX
Example	\$ 200
Wiring scheme	A Other safety equipment e.g. actuator/safety-related PLC
SIL	2
HFT	0
Device type	В
Mode of operation	Low demand mode
SFF	94 %
MTTR	8 h
λ_{sd}^{1}	157 FIT
λ_{su}	817 FIT
λ_{dd}	40 FIT
λ _{du}	65 FIT
PFD_{avg} for $T_1 = 1$ year	2.83 x 10 ⁻⁴
MTBF	106 years
Diagnostic test interval ²⁾	≤60 s
Fault reaction time ³⁾	≤3 s
System reaction time ⁴⁾	Switching delay + :0.5 s (free > covered); 1 s (covered > free) Switching delay + :5 s (free > covered and covered > free)
PTC test sequence A ⁵⁾	97 %
PTC test sequence B ⁶⁾	63 %

1) This value takes into account failure types relevant to the function of the electronic components according to Siemens SN29500.

2) During this time, all diagnostic functions are executed at least once.

3) Time between error detection and error response.

4) Step response time as per DIN EN 61298-2.

5) Proof test coverage when the level is approached, or when the sensor is removed and the tines are immersed in a medium of similar density and granulation.

6) Proof test coverage when simulation is performed on the Nivotester by activating the test button.

Version II: Soliphant M/S; 1-channel Nivotester FTL325P

Characteristics as per IEC 61508	Value
Safety function	MAX
Example	
Wiring scheme	A Other safety equipment e.g. actuator/safety-related PLC B Possibility 1 C Possibility 2; 1002 assessment
SIL	2
HFT	0
Device type	В
Mode of operation	Low demand mode
SFF	97 %
MTTR	8 h
λ_{sd} ¹⁾	168 FIT
λ _{su}	1020 FIT
λ_{dd}	39 FIT
λ _{du}	34 FIT
PFD_{avg} for $T_1 = 1$ year	1.49 x 10 ⁻⁴
MTBF	91 years
Diagnostic test interval ²⁾	≤60 s
Fault reaction time ³⁾	≤3 s
System reaction time ⁴⁾	Switching delay \vdash :0.5 s (free > covered); 1 s (covered > free) Switching delay \vdash :5 s (free > covered and covered > free)
PTC test sequence A ⁵⁾	98 %
PTC test sequence B ⁶⁾	75 %

Version III: Soliphant M/S; 3-channel Nivotester FTL325P, CH2 and CH3 in series

1) This value takes into account failure types relevant to the function of the electronic components according to Siemens SN29500.

- 2) 3) During this time, all diagnostic functions are executed at least once.
- Time between error detection and error response.
- 4) Step response time as per DIN EN 61298-2.
- 5) Proof test coverage when the level is approached, or when the sensor is removed and the tines are immersed in a medium of similar density and granulation.
- 6) Proof test coverage when simulation is performed on the Nivotester by activating the test button.

Characteristics as per IEC 61508	Value
Safety function	MAX
Example	
Wiring scheme	B CH1 CH1 A CH2 A CH2 A CH3 CH3 CH3 CH3 A Other safety equipment e.g. actuator/safety-related PLC B Possibility 1 CPossibility 2; 1003 assessment
SIL	2
HFT	1
Device type	В
Mode of operation	Low demand mode
SFF	99 %
MTTR	8 h
$\lambda_{sd}^{1)}$	402 FIT
λ _{su}	1637 FIT
λ_{dd}	2 FIT
λ _{du}	12 FIT
PFD_{avg} for $T_1 = 1$ year	5.11 x 10 ⁻⁵
MTBF	56 years
Diagnostic test interval ²⁾	≤60 s
Fault reaction time ³⁾	≤3 s
System reaction time ⁴⁾	Switching delay \vdash :0.5 s (free > covered); 1 s (covered > free) Switching delay \vdash :5 s (free > covered and covered > free)
PTC test sequence A ⁵⁾	97 %
PTC test sequence B $^{\rm 6)}$	63 %

Version IV: 2 Soliphant M/S; 3-channel Nivotester FTL325P

1) This value takes into account failure types relevant to the function of the electronic components according to Siemens SN29500.

- During this time, all diagnostic functions are executed at least once. Time between error detection and error response. 2)
- 3)

4) Step response time as per DIN EN 61298-2.

- 5) Proof test coverage when the level is approached, or when the sensor is removed and the tines are immersed in a medium of similar density and granulation.
- 6) Proof test coverage when simulation is performed on the Nivotester by activating the test button.



The failure rates are based on an analysis in accordance with DIN EN 61508-6: 2011-02, Table D.4, "Using the β -factor to calculate the probability of failure in an E/E/PE safety-related system due to common cause failures". The calculation gives a β -factor of 10 %. This factor is based on the failure rates indicated above. If additional measures are implemented during installation to prevent common cause errors as defined in Table D.1, the β -factor can possibly be reduced to 5 %. Possible measures are:

- Sensors installed in a physically separate location
- Wiring routed separately between the Soliphant and Nivotester
- Separate protection from environmental influences: impact, sunshine, EMC protection and/or overvoltage
- Use of different sensor materials, and combination of high-temperature and normal version

Characteristics as per IEC 61508	Value
Safety function	MAX
Example	
Wiring scheme	A Other safety equipment e.g. actuator/safety-related PLC; 2003 assessment
SIL	2
HFT	1
Device type	В
Mode of operation	Low demand mode
SFF	99 %
MTTR	8 h
λ_{sd}^{1}	598 FIT
λ _{su}	1984 FIT
λ_{dd}	3 FIT
λ_{du}	14 FIT
PFD_{avg} for $T_1 = 1$ year	5.96 x 10 ⁻⁵
MTBF	44 years
Diagnostic test interval ²⁾	≤60 s
Fault reaction time ³⁾	≤3 s
System reaction time ⁴⁾	Switching delay \vdash :0.5 s (free > covered); 1 s (covered > free) Switching delay \vdash :5 s (free > covered and covered > free)
PTC test sequence A ⁵⁾	97 %
PTC test sequence B ⁶⁾	63 %

Version IV: 3 Soliphant M/S; 3-channel Nivotester FTL325P

1) This value takes into account failure types relevant to the function of the electronic components according to Siemens SN29500.

2) During this time, all diagnostic functions are executed at least once.

3) Time between error detection and error response.

4) Step response time as per DIN EN 61298-2.

5) Proof test coverage when the level is approached, or when the sensor is removed and the tines are immersed in a medium of similar density and granulation.

6) Proof test coverage when simulation is performed on the Nivotester by activating the test button.



The failure rates are based on an analysis in accordance with DIN EN 61508-6: 2011-02, Table D.4, "Using the β -factor to calculate the probability of failure in an E/E/PE safety-related system due to common cause failures". The calculation gives a β -factor of 10 %. This factor is based on the failure rates indicated above. If additional measures are implemented during installation to prevent common cause errors as defined in Table D.1, the β -factor can possibly be reduced to 5 %. Possible measures are:

- Sensors installed in a physically separate location
- Wiring routed separately between the Soliphant and Nivotester
- Separate protection from environmental influences: impact, sunshine, EMC protection and/or overvoltage
- Use of different sensor materials, and combination of high-temperature and normal version

	Characteristics as per IEC 61508	Value
	Safety function	MAX
	Example	
	Wiring scheme	A Other safety equipment e.g. actuator/safety-related PLC
		Δs level control (not SIL)
	SIL	2
	HFT	0
	Device type	B
	Mode of operation	Low demand mode
	SFF	94%
	$\frac{\text{MTTR}}{\lambda_{sd}^{-1)}}$	8 h
		157 FIT 817 FIT
	λ_{su}	40 FIT
	λ _{dd}	65 FIT
	λ_{du}	2.83 x 10 ⁻⁴
	$PFD_{avg} \text{ for } T_1 = 1 \text{ year}$ $MTBF$	106 years
	Diagnostic test interval ²⁾	≤60 s
	Fault reaction time ³⁾	≤3 s
	System reaction time ⁴⁾	Switching delay \vdash :0.5 s (free > covered); 1 s (covered > free) Switching delay \vdash :5 s (free > covered and covered > free)
	PTC test sequence A ⁵⁾	97 %
	PTC test sequence B ⁶⁾	63 %
	 to Siemens SN29500. During this time, all diag Time between error dete Step response time as pe Proof test coverage when immersed in a medium of 	ount failure types relevant to the function of the electronic components accordir mostic functions are executed at least once. ection and error response. er DIN EN 61298-2. In the level is approached, or when the sensor is removed and the tines are of similar density and granulation. In simulation is performed on the Nivotester by activating the test button.
etime of electrical nts	The established failure rate IEC 61508-2:2010 section	s of electrical components apply within the useful lifetime as per 7.4.9.5 note 3.
		8-2:2011 section 7.4.9.5 national footnote N3, appropriate measures and operator can extend the useful lifetime.

Version VI: Soliphant M/S; 3-channel Nivotester FTL325P (CH1 for SIL; CH2+CH3 e.g. for level control Δ S)

Certificate

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Certificate				
e alcis				
Nr./No.: 968/FSP	1148.00/15			
Prüfgegenstand	Füllstandswächter	Zertifikats-	Endress + Hauser GmbH +	
Product tested	Level monitor	inhaber Certificate holder	Co. KG Hauptstraße 1 79689 Maulburg	
		noider	Germany	
Typbezeichnung Type designation	Liquiphant M/S with FEL56/58/5 Soliphant M with FEM57 + Nivo Possible device combinations so	tester FTL 325 P		
Prüfgrundlagen Codes and standards	IEC 61508 Parts 1-7:2010			
Bestimmungsgemäße Verwendung Intended application	Die Geräte erfüllen die Anforder Sicherheitsintegrität SIL 2 nach IEC 61508) und können in Anwe nach IEC 61508 für die Sicherh	IEC 61508 und syste endungen bis SIL 2 (H eitsfunktionen MIN oc	matische Eignung SIL 3 nach IFT=0) bzw. SIL 3 (HFT=1)	
	Füllstandsüberwachung eingese The devices comply with the rec safety integrity SIL 2 acc. to IEC	uirements of the relevant		
	61508) and can be used in appl acc. to IEC 61508 for the safety	ications up to SIL 2 (H	HFT=0) resp. SIL 3 (HFT=1)	
Besondere Bedingungen Specific requirements	Die Hinweise in der zugehöriger sind zu beachten. The instructions of the associate			hany
Gültig bis / Valid until 2020-10	considered.			bin / Gem
-	ates liegt eine Prüfung zugrunde, de	ren Ergebnisse im Be	richt Nr. 968/ESP 1148.00/15	. 51105 H
vom 05.10.2015 dokumentiert s Dieses Zertifikat ist nur gültig fü jeglicher Änderung der Prüfgru	sind. Ir Erzeugnisse, die mit dem Prüfgeg ndlagen für den angegebenen Verw	enstand übereinstimm endungszweck.	en. Es wird ungültig bei	Service GmbH, Am Graven Stein, 51105 Köh / Germany
Report No. 968/FSP 1148.00/1 This certificate is valid only for	products which are identical with the	product tested. It bed		se GmbH, An
the codes and standards formin	ng the basis of testing for the intende			
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	Funktionale Siche Am Grauen Stein, 51	105 Köln	Diel les Steehen Häh	TÜV Rheinland Industrie
Köln, 2015-10-05	Cortification Dedute - FO	FIDDUCIS	DiplIng. Stephan Häb	Ę
Köln, 2015-10-05	Certification Body for FS			
Köln, 2015-10-05 www.fs-products.com		^	TÜV Rheinland®	

Document information

Document function

The document is part of the Operating Instructions and serves as a reference for application-specific parameters and notes.

- General information about functional safety: SILGeneral information about SIL is available: -

In the Download Area of the Endress+Hauser Internet site: www.de.endress.com/SIL

Symbols used

Safety symbols

Symbol	Meaning
A DANGER	DANGER! This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
A WARNING	WARNING! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
	CAUTION! This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE	NOTE! This symbol contains information on procedures and other facts which do not result in personal injury.

Symbols for certain types of information

Symbol	Meaning
A0011193	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
1., 2., 3	Series of steps

Symbols in graphics

Symbol	Meaning
1, 2, 3,	Item numbers
1., 2., 3	Series of steps
A, B, C,	Views

Supplementary device documentation

Soliphant M FTM51, FTM51, FTM52

Documentation	Comment
Technical Information: TI00392F/00	The documentation is available on the Internet: \rightarrow www.endress.com
Operating Instructions: • KA00229F/00 (FTM50, FTM51) • KA00230F/00 (FTM52)	 The document is provided with the device. The documentation is available on the Internet: → www.endress.com
Safety instructions depending on the selected option "Approval".	Additional safety instructions (XA, ZE) are supplied with certified device version. Please refer to the nameplate for the relevant safety instructions.

Nivotester FTL325P

Documentation	Comment
Technical Information: TI00350F/00	The documentation is available on the Internet: \rightarrow www.endress.com
Operating Instructions: • KA00167F/00 (1-channel) • KA00168F/00 (3-channel)	 The document is provided with the device. The documentation is available on the Internet: → www.endress.com
Safety instructions depending on the selected option "Approval".	Additional safety instructions (XA, ZE) are supplied with certified device version. Please refer to the nameplate for the relevant safety instructions.



This supplementary Safety Manual applies in addition to the Operating Instructions, Technical Information and ATEX Safety Instructions. The supplementary device documentation must be observed during installation, commissioning and operation. The requirements specific for the protection function are described in this Safety Manual.

Permitted devices types

The details pertaining to functional safety in this manual relate to the device versions listed below and are valid as of the specified firmware and hardware versions. Unless otherwise specified, all the following versions can also be used for protective systems. A modification process according to IEC 61508 is applied for device changes.

Ordering feature	Designation	Option
010	Approval	All
020	Process connection	All
030	Material; surface refinement	All
040	Fork; bulk density	All
050	Electronics; output	7 FEM57; 2-wire PFM
060	Type of probe	All
070	Housing	All
080	Cable entry	All
090	Additional options 1	 R Glass cover, SIL Declaration of Conformity S SIL Declaration of Conformity
100	Additional options 2	All
995	Marking	All

• Valid firmware version: 01.01.00 and higher

Valid hardware version: 01.00 and higher

Valid device versions for safety-related use: Nivotester FTL325P

Ordering feature	Designation	Option			
010	Approval	 G ATEX II 3(1)G Ex nC/A [ia] IIC T4, SIL, IECEx Zone 2 H ATEX II (1)GD [EEx ia] IIC, WHG, SIL, IECEx [Ex ia] IIC N NEPSI [Ex ia] IIC, SIL P FM IS CI. I, II, III Div. 1 Gr. A-G, SIL T CSA IS CI. I, II, III Div. 1 Gr. A-G, SIL W TIIS Ex ia IIC, SIL, labeling in Japan 2 INMETRO [Ex ia Ga] IIC, SIL 8 EAC [Ex ia Ga] IIC SIL; EAC [Ex ia Da] IIC, SIL 			
020	Housing	1 Rail mounting, 22.5 mm, 1-channel3 Rail mounting, 45mm, 3-channel			
030	Power connection	All			
040	Switch output	 1 1x SPDT level + 1x SPST alarm 3 3x SPDT level + 1x SPST alarm 			
995	Marking	All			

Valid hardware version: 02.00 and higher

SIL label on the nameplate

SIL certified devices are marked with the following symbol on the nameplate: 🗐

Safety function

Definition of the safety	The measuring system's safety functions are:			
function	Maximum point level monitoring (overfill protection)			
	For information on the choice of operating mode, see $\rightarrow \cong 19$.			
Restrictions for use in safety- related applications	 The measuring system must be used correctly for the specific application, taken into account the medium properties and ambient conditions. Carefully follow instructions pertaining to critical process situations and installation conditions from the Operating Instructions. The application-specific limits must be observed. The specifications from the Operating Instructions must not be exceeded, (→ ¹ 15). 			
	Density of the medium			
	 Operation is only permitted with bulk solids: Depending on the configured density setting and the fork length, the density of the bulk material must be as follows: Over 50 g/l with standard fork and with switch position "high bulk density" •. Over 10 g/l with standard fork and with switch position "low bulk density" •. Over 200 g/l with short fork and with switch position "high bulk density" •. Over 50 g/l with short fork and with switch position "low bulk density" •. 			
	 There is no maximum density for the bulk solids. Recommendation: for heavy bulk solids, select the "high bulk density" setting to reduce the risk of false alarms. For more information on the levels of diagnostic coverage, refer to IEC 61508-2:2010 Appendix A.2, Comment 2 and Table A.1. 			
	Gas phase			
	There must be a gas phase or a vacuum above the bulk solids. The detection of boundary layers, e.g. to liquids, is not permitted!			
	Wall distance			
	Recommendation: select the clearance to the wall such that bulk solids cannot get jammed between the vessel wall and the fork. This prevents the system from not quitting the demand mode.			

Corrosion

The device may only be used in media to which the wetted parts used are resistant. Corrosion can have the effect that the demand mode of the safety function is not detected and the device will not switch as intended.

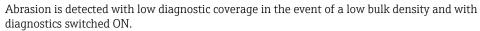
Corrosion is detected with low diagnostic coverage in the event of a low bulk density and with diagnostics switched ON.

If coated sensors are used, measures must be taken to ensure there is no damage during installation and operation.

Abrasion

The device may not be used or cleaned in abrasive media. Material removal can have the effect that the demand mode is not detected.





External vibration

In systems exposed to strong external vibrations, e.g. in the 50 to 600 Hz range (acceleration spectral density >1 $(m/s^2)^2/Hz$) or ultrasound with cavitation, the safety function must be verified by simulating a demand mode prior to operation. Accidental switchings may sporadically occur if a strong frequency from an external source is superimposed on the frequency of the tuning fork.

EMC compatibility

The device is certified in accordance with IEC 61326-3-2 and is therefore suitable for safety-related, industrial applications in a specified electromagnetic environment. If the specified electromagnetic ambient conditions are exceeded, the switch status might not be reliably detected. An unshielded cable up to 1000 m (3281 ft) long can be used between the devices in these environmental conditions. Electromagnetic interference immunity can be further improved by using shielded cables.

Mounting the Soliphant M FTM51 with sliding sleeve

Particular care is required when mounting the device with a pipe extension in conjunction with a sliding sleeve. The operator must implement appropriate measures is to ensure that the switch point is not tampered with or that any tampering is reliably detected.

Device behavior during	Behavior of d	evice during p	ower-up			
operation	The behavior of the device during power-up is described in the relevant Operating Instructions ($\rightarrow \cong 15$).					
	Device behavi	or in safety fu	nction demand m	ode		
	The safety-rela Channel 1: ter		nal consists of one	switching contact per channel:		
	 Channel 2: t 	annel Nivoteste erminal 22 ane erminal 26 ane	d 23			
				t current safety; they are closed in the GOOD state.		
	In demand rIf a fault is d	The switching contacts are de-energized in the following situations: In demand mode If a fault is detected If the supply voltage fails 				
	Behavior of d	evice in event	of alarms and wa	rnings		
	The behavior of Instructions (-		alarms or warnings	s occur is described in the relevant Operating		
Device configuration for	The device cor	figuration may	y not be changed if	SIL operation is in progress.		
safety-related applications		Recommendation: perform a proof test after configuring to ensure that the safety function is working correctly.				
	Configuring t	Configuring the Soliphant				
	${f D}$ Switch to switch the self-test on and off					
	Switch representatio n	Function	Switch position	Start behavior		
	O∕t.ª ₩	OFF	Тор	~ 1 s 0 Hz		
		ON	Bottom	 ~ 3 s 0 Hz ~ 4 s 150 Hz (covered = demand mode) ~ 3 s 50 Hz (free = potentially dangerous) 		

Use in safety instrumented systems

WARNING

A0025600

The safety function is disabled during the self-test!

A potentially dangerous output signal is output temporarily.

• Measures must be taken to guarantee the safety function during this period.

⊿t Switch for switching delay

Switch representatio n	Function	Switch position	Switching delay
D⊿t Å %	н	Тор	0.5 s (free > covered); 1 s (covered > free)
		Bottom	5 s (free > covered and covered > free)

🖞 Switch	for	bulk	density /	densitv
	, 0,	Duun	acrustry /	acribity

Switch representatio n	Function	Switch position	Standard fork density	Short fork density
	•	Тор	Over 50 g/l	Over 200 g/l
ON ● ON A0025583 A0025583	•	Bottom	Over 10 g/l	Over 50 g/l

The switch position depends on the individual medium ($\rightarrow \square 17$). \mathbf{f}

 $\ensuremath{\mathbb{W}}$ Switch for diagnosis for abrasion

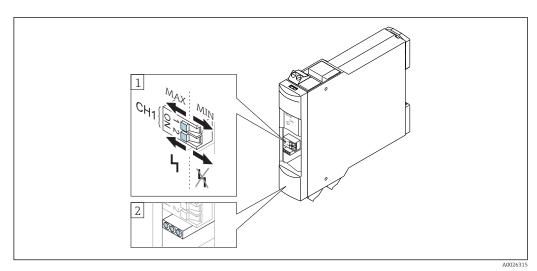
Switch representatio n	Function	Switch position	High bulk density $ullet$	Low bulk density •
D⊿tễ 🎦	OFF	Тор	Off	Off
OFF OFF ON ON A0025581	ON	Bottom	Off (only indicated by LED on electronic insert)	On (relay de-energizes in the event of an error)

H

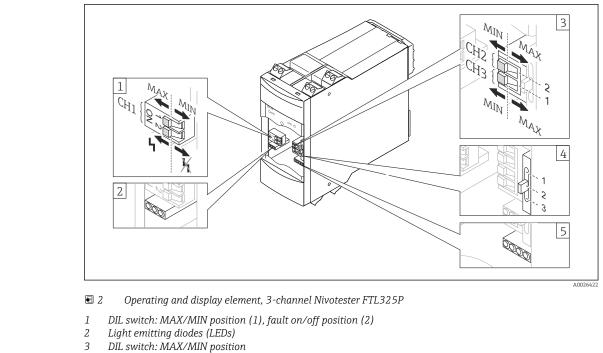
Configuring the Nivotester

		Switch					
		Channel 1	Fault message	Channel 2 ¹⁾	Channel 3 ¹⁾	MODE 1)	
Mode of operation	Version	1	2	2	1		
MAX	II	MAX	With	Not applicable			
	III		None	MAX	MAX	2	
	IV		With			2	
	V					3	
	VI					1	

1) Only for 3-channel Nivotester FTL325P



- 1 Operating and display element, 1-channel Nivotester FTL325P
- 1 DIL switch: MAX/MIN position (1), fault on/off position (2)
- 2 Light emitting diodes (LEDs)



- 4 Switch for functions: Δs , e.g. pump control (1), two level relays (2), individual channels (3)
- 5 Light emitting diodes (LEDs)

Check the operativeness and safety of safety functions at appropriate intervals! The operator must determine the time intervals.

The values and figures in the "Additional safety-related characteristic values" section can be used to this end, $\rightarrow \cong 5$. The check must be carried out in such a way that it is proven that the protective system functions perfectly in interaction with all components.

Proof-testing can be performed as follows:

- Test sequence A:
- Approach the bulk solid or remove and immerse in a medium of similar density and granulation. • Test sequence B:
- Activate simulation by pressing the test button on the Nivotester.

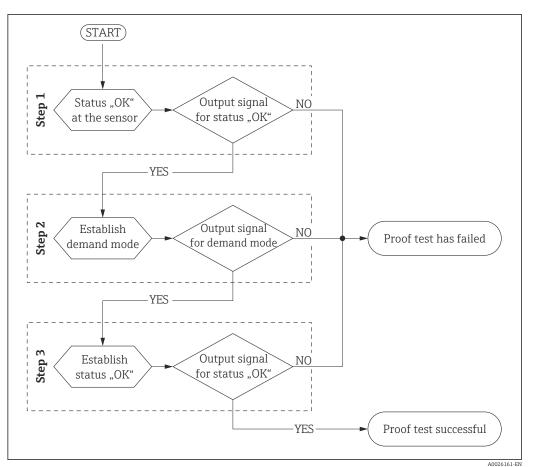
NOTICE

Ensuring correct device sealing!

▶ You must also check and ensure that all cover seals and cable entries are sealing correctly.

Proof-testing

Procedure of the proof-test



A demand mode or a fault takes absolute precedence over the proof test and in the measuring system safety path. For this reason, the demand mode must first be ended or the fault rectified before the proof test can commence. It is advisable to also check that the alarm relay (terminal 15 and 16) has not de-energized (no fault is present) at the start of the proof test (step 1).

The proof test can and may only be performed if the device state is GOOD.

The status of the individual output signal is indicated by a measuring device or a downstream component of the safety path (e.g. safety-related PLC, actuator). For more information, $\rightarrow \cong 29$.



It is advisable to document the steps of the proof test ($\rightarrow \square$ 30).

	Mode of operation
	MAX
Approach the level	Test sequence A ($\rightarrow \square 24$)
Remove and immerse in a medium of similar density and viscosity	
Activate simulation by pressing the test button on the Nivotester.	Test sequence B ($\rightarrow \square 26$)

Test sequence A

- Approach the level or
- Remove and immerse in a medium of similar density and granulation.

Step 1

- 1. Lower the level or remove the tuning fork of the sensor that has been removed out of the medium until the tuning fork is completely free.
 - ↓ If it is not possible to do this with the original medium, a medium of a similar density and granulation must be used.
- 2. Check the status of the safety contacts.

	Version					
Terminal	п п г г г г					
4+5	Closed	Not applicable	Closed	Closed	Closed	
22+23	Not applicable	Closed	Closed	Closed	Not applicable	
26+27	Not applicable	Closed	Closed	Closed	Not applicable	

If one or more safety contacts are open, a fault has occurred in the safety path. The proof test has not been passed and must be aborted.

Step 2

1. Raise the level or immerse the tuning fork of the sensor that has been removed into the medium until the tuning fork is fully covered.

In the event of a switching delay → once the fork is covered (plus a response time of approx. 1 s), check the status of the safety contacts (→
 19).

3. In the event of a switching delay I once the fork is covered (plus a response time of approx. 5 s), check the status of the safety contacts (→ 🖺 19).

	Version					
Terminal	II III IV VI					
4+5	Open	Not applicable	Open	Open	Open	
22+23	Not applicable	Open	Open	Open	Not applicable	
26+27	Not applicable	Open	Open	Open	Not applicable	

If one or more safety contacts are closed, a fault has occurred in the safety path. The proof test has not been passed and must be aborted.

Step 3

H

1. Re-install the sensor that was removed.

- 2. Restore the GOOD state by fully exposing the tuning fork.
- 3. Once the fork is exposed, in the event of a switching delay (plus a response time of approx. 1 s) or in the event of a switching delay (plus a response time of approx. 5 s), check the status of the safety contacts.
- 4. Once the voltage is restored when the self-test is OFF (plus a response time of approx. 3 s) or once the voltage is restored when the self-test is ON (plus a response time of approx. 10 s), check the status of the safety contacts.

	Version					
Terminal	II III IV VI					
4+5	Closed	Not applicable	Closed	Closed	Closed	
22+23	Not applicable	Closed	Closed	Closed	Not applicable	
26+27	Not applicable	Closed	Closed	Closed	Not applicable	

If one or more safety contacts are open, a fault has occurred in the safety path. The proof test has not been passed and must be aborted.

Test sequence B

Activate simulation by pressing the test button on the Nivotester.

Step 1

• Check the status of the safety contacts.

	Version					
Terminal	II III IV V VI					
4+5	Closed	Not applicable	Closed	Closed	Closed	
22+23	Not applicable	Closed	Closed	Closed	Not applicable	
26+27	Not applicable	Closed	Closed	Closed	Not applicable	



If one or more safety contacts are open, a fault has occurred in the safety path. The proof test has not been passed and must be aborted.

Step 2

1. Press and hold the test button on the Nivotester.

2. Check the status of the safety contacts.

	Version					
Terminal	п	VI				
4+5	Open	Not applicable	Open	Open	Open	
22+23	Not applicable	Open	Open	Open	Not applicable	
26+27	Not applicable	Open	Open	Open	Not applicable	

If one or more safety contacts are closed, a fault has occurred in the safety path. The proof test has not been passed and must be aborted.

Step 3

1. Release the test button on the Nivotester.

2. The safety contacts switch once the voltage is restored when the self-test is OFF (plus a response time of approx. 3 s) or once the voltage is restored when the self-test is ON (plus a response time of approx. 10 s).

	Version					
Terminal	п	VI				
4+5	Closed	Not applicable	Closed	Closed	Closed	
22+23	Not applicable	le Closed		Closed	Not applicable	
26+27	Not applicable	Closed	Closed	Closed	Not applicable	

i

If one or more safety contacts are open, a fault has occurred in the safety path. The proof test has not been passed and must be aborted.

Requirements for personnel	 The personnel for installation, commissioning, diagnostics, repair and maintenance must meet the following requirements: Trained, qualified specialists must have a relevant qualification for this specific function and task Are authorized by the plant owner/operator Are familiar with federal/national regulations Before beginning work, the specialist staff must have read and understood the instructions in the manuals and supplementary documentation as well as in the certificates (depending on the application) Follow instructions and comply with basic conditions 					
	 The operating personnel must meet the following requirements: Are instructed and authorized according to the requirements of the task by the facility's owner-operator Follow the instructions in this manual 					
Installation	The installation of the device is described in the relevant Operating Instructions ($ ightarrow$ [$ ightarrow$ 15).					
	As the application conditions affect the reliability of the measurement, please pay attention to the notes in the Technical information and Operating Instructions ($\Rightarrow \square 15$).					
Operation	Mandatory settings and information for the safety function ($\rightarrow \square$ 19).					
Maintenance	Maintenance information, .					
	Alternative monitoring measures must be taken to ensure process safety during configuration, proof-testing and maintenance work on the device.					
Repair	Repair means a one-to-one replacement of components. Repairs on the devices must always be carried out by Endress+Hauser. Safety functions cannot be guaranteed if repairs are carried out by anybody else.					
	Exceptions:					
	Qualified personnel may replace the following components on the condition that original spare parts are used and the relevant Installation Instructions are observed:					

Component	Installation Instructions	Checking the device after repair
Electronic insert	EA01050F	Proof-testing, see the "Proof-testing" section
Housing cover T13	 EA01049F/00 (electronics) EA01049F/00 (inspection glass) EA01050F/00 (connection) 	(→ 🗎 22) ¹⁾
Housing cover F13	EA01046F/00	
Housing cover F15	EA01034F/00	
Housing cover F16	EA01035F/00	
Housing cover F17	EA01036F/00	
Housing cover F27	EA01047F/00	
Cover seal F15	KA00620F/00	
Sensor	KA00628F/00	

1) Additional country-specific regulations and tests must be observed.

In the event of failure of a SIL-labeled Endress+Hauser device, which has been operated in a protection function, the "Declaration of Contamination and Cleaning" with the corresponding note "Used as SIL device in protective system" must be enclosed when the defective device is returned. Please refer to the "Return" section of the relevant Operating Instructions $\rightarrow \square 15$.

Life cycle

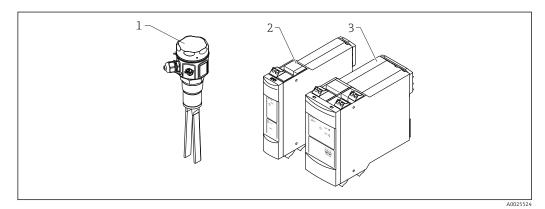
Modification	Modifications are changes to devices with SIL capability already delivered or installed.
	Modifications to devices with SIL capability are usually performed in the Endress+Hauser manufacturing center.
	Modifications to devices with SIL capability onsite at the user's plant are possible following approval by the Endress+Hauser manufacturing center. In this case, the modifications must be performed and documented by an Endress+Hauser service technician.
	Modifications to devices with SIL capability by the user are not permitted.
Decommissioning	For detailed information on decommissioning, see the relevant Operating Instructions \rightarrow 🗎 15

Appendix

Structure of the measuring system

System components

The measuring system's devices are displayed in the following diagram (example):



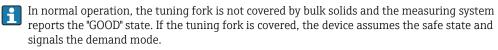
- 1 Soliphant M/S
- 2 1-channel Nivotester FTL325P
- 3 3-channel Nivotester FTL325P

Description of use as a protective system

The sensor's tuning fork vibrates at its intrinsic frequency. When the fork is covered by a bulk solid, the amplitude decreases. This loss of energy causes the current signal to change. The Maximum Detection operating mode can be selected.

MAX detection

The measuring system is used to protect against a level that is too high (e.g. overfill prevention).



The switch point depends on the installation. It is in the area of the tuning fork.



Correct installation is a prerequisite for safe operation of the device.

Commissioning or proof test report	Ι	Report					
System-specific data							
Company							
Measuring point/TAG no.							
Facility							
Device type/Order code							
Serial no. Soliphant(en)							
Serial no. Nivotester							
Name							
Date							
Signature							
Operating mode, density	range and v	version (please	tick appropria	te box)			
Bulk density High bulk density • over 50 g/l for standard fork, over 200 g/l for short fork						k	
	Low bulk	density • over 1	10 g/l for stand	lard fork, over 50	g/l for short fork		
Version	п	One Soliphant	on one channe	el (1001)			
	III	One Soliphant	(1001), output	relay CH2 and CH	H3 switched in seri	es (1002)	
	IV	Two Soliphant (1003)					
	v	Three Soliphar					
	VI	Three Soliphar	nt devices, 1 x S	SIL, 2 x level contr	ol (∆s)		
Commissioning or proof t	est report						
Test sequence	A	Approach the l	evel				
		Remove and immerse in a medium of similar density and granulation					
	В	Perform simula	ation on Nivote	ester by pressing t	est button		
		Version					
Test step	Termin al	П	ш	IV	v	VI	Actual value
Step 1	4+5	Ł	1)	Ł	Ł		
(GOOD state)	22+23	1)	Ł	Ł	Ł	2)	
Switch is closed	26+27	1)	Ł	Ł	L	2)	
Step 2	4+5	~-	1)	~-	~-	~-	
(demand mode)	22+23	1)	~-	~-	~-	2)	
Switch is open	26+27	1)		~-	~-	2)	
Step 3	4+5	Ł	1)				
(GOOD state)	22+23	1)		Ł	Ł	2)	
Switch is closed	26+27	1)			Ł	2)	
Conclusion		Passed 🗆			Failed 🗆		

1) Not applicable as channel is not used.

2) Not relevant for SIL, is used for level control (Δs).

Further information

General information on functional safety (SIL) is available at:

www.de.endress.com/SIL (Germany) or www.endress.com/SIL (English) and in the Competence Brochure CP01008Z/11 "Functional Safety in the Process Industry- Risk Reduction with Safety Instrumented Systems".

Version history	Version	Changes	Valid for hardware version
	SD00207F/00/EN/01.06	First version	01.00
	SD00207F/00/EN/13.15	Nivotester Update to IEC 61508-2011	02.00



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