FY01095F/00/EN/02.26-00
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2026-05-04

01.00.zz (Device firmware)

LENNTECH
WATER TREATMENT SOLUTIONS

Functional Safety Manual
Liquiphant FTL63 with electronic insert FEL67 and Nivotester FTL325P

Vibronic



Endress+Hauser
People for Process Automation

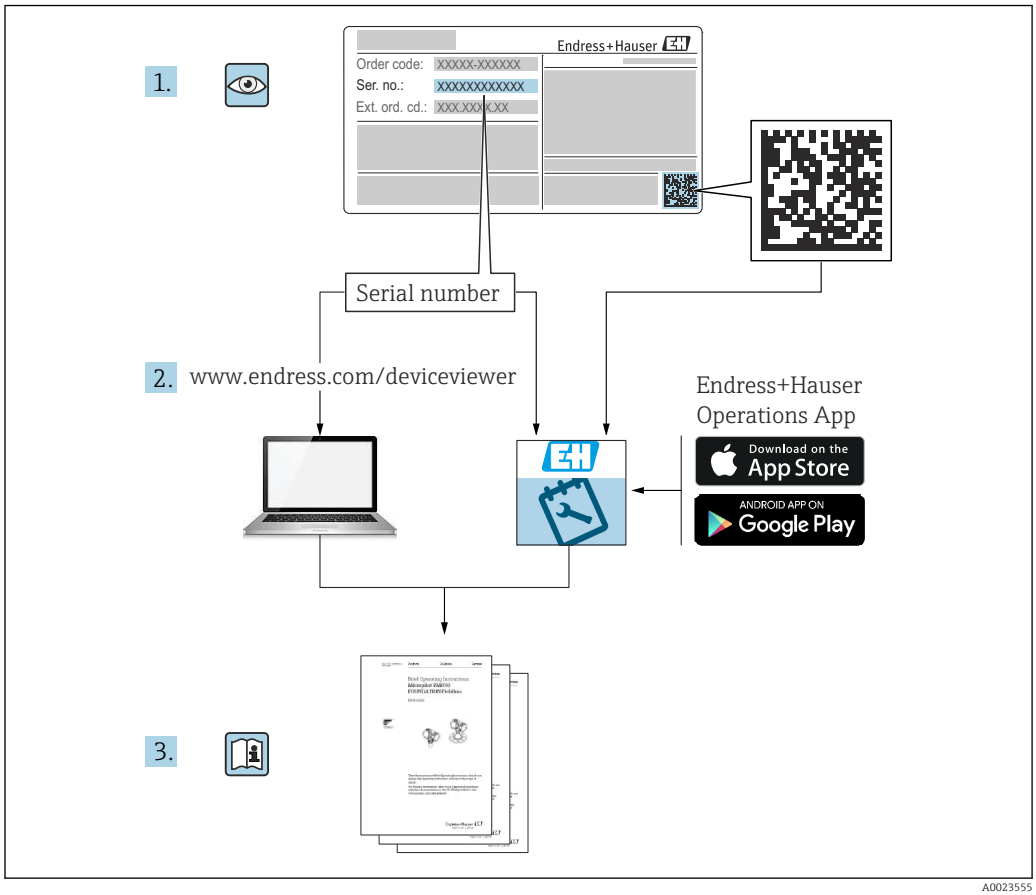

1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX XX XX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
A0023555

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1 Declaration of Conformity

SIL_00511_02.23

Endress+Hauser
People for Process Automation

Declaration of Conformity

Functional Safety according to IEC 61508
Based on NE 130 Form B.1

Endress+Hauser SE+Co. KG, Hauptstraße 1, 79689 Maulburg

being the manufacturer, declares that the product

Liquiphant FTL51B / FTL62 / FTL63 / FTL64 (FEL67)

is suitable for the use in safety-instrumented systems according to IEC 61508. The instructions of the corresponding functional safety manual must be followed.

This declaration of conformity is valid for variant I: One Liquiphant only (for connection to the appropriate Nivotester).

This declaration of conformity is exclusively valid for the listed products and accessories in delivery status.

Maulburg, April 25, 2023
Endress+Hauser SE+Co. KG

i. V.

E-SIGNED by Thorsten Springmann
on 25 April 2023 05:47:32 GMT

Thorsten Springmann
Dept. Man. R&D Devices Level Limit
Research & Development

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E-SIGNED by Manfred Hammer
on 25 April 2023 05:31:16 GMT

Manfred Hammer
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Research & Development

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1.1 Safety-related characteristic values

SIL_00511_02.23

Endress+Hauser
People for Process Automation

General			
Device designation and permissible types [1]	Liquiphant FTL51B / FTL62 / FTL63 / FTL64 ** A7 * * * * * * ** ** *** + [LA] (FEL67)		
Safety-related output signal	For connection to dedicated Nivotester only		
Fault signal	For connection to dedicated Nivotester only		
Process variable/function	Level switch for liquids		
Safety function(s)	MIN / MAX		
Device type acc. to IEC 61508-2	☐ Type A	☒ Type B	
Operating mode	☒ Low Demand Mode	☒ High Demand Mode	
Valid hardware version	FEL67: 01.00.ww (ww: any double number)		
Valid software version	FEL 67: 01.01.zz (zz: any double number) / FTL325P without SW		
Safety manual	FTL51B: FY01001F / FTL62: FY01018F / FTL63: FY01095F / FTL64: FY01023F		
Type of evaluation (check only one box)	☒	Complete HW/SW evaluation parallel to development incl. FMEDA and change request acc. to IEC 61508-2, 3	
	☐	Evaluation of "proven in use" performance for HW/SW incl. FMEDA and change request acc. to IEC 61508-2, 3	
	☐	Evaluation of HW/SW field data to verify „prior use" acc. to IEC 61511	
	☐	Evaluation by FMEDA acc. to IEC 61508-2 for devices w/o software	
Evaluation through – report/certificate no.	TÜV Rheinland 968/FSP 1388		
Test documents	Development documents	Test reports	Data sheets
SIL – Integrity			
Systematic safety integrity		☐ SC 2	☒ SC 3
Hardware safety integrity	Single channel use (HFT = 0)	☒ SIL 2 capable	☐ SIL 3 capable
	Multi channel use (HFT ≥ 1)	☐ SIL 2 capable	☒ SIL 3 capable

FMEDA			
Safety function	MIN	MAX	RANGE
λ_{DU} [2),3)]	28 FIT	13 FIT	/
λ_{DD} [2),3)]	140 FIT	106 FIT	/
λ_S [2),3)]	138 FIT	190 FIT	/
SFF	91%	96%	/
PFD_{avg} (T_1 = 1 year)[3)] (single channel architecture)	$1.24 \cdot 10^{-4}$	$5.67 \cdot 10^{-5}$	/
PFH	$2.83 \cdot 10^{-8}$ 1/h	$1.29 \cdot 10^{-8}$ 1/h	/
PTC [4)] A / B	94% / 8%	94% / 17%	/
Diagnostic test interval [5)]	≤ 60 s, RAM check ≤ 10 min	≤ 60 s, RAM check ≤ 10 min	/
Fault reaction time [6)]	≤ 3 s	≤ 3 s	/

Comments
Please note limitation of the demand rate due to the diagnostic test interval.

Declaration	
☒	Our internal company quality management system ensures information on safety-related systematic faults which become evident in the future

[1)] Valid order codes and order code exclusions are maintained in the E+H ordering system
[2)] FIT = Failure In Time, number of failures per 10^9 h
[3)] Valid for average ambient temperature up to +40 °C (+104 °F)
For continuous operation at ambient temperature close to +60 °C (+140 °F), a factor of 2.1 should be applied
[4)] PTC = Proof Test Coverage
[5)] All diagnostic functions are performed at least once within the diagnostic test interval
[6)] Maximum time between error recognition and error response

A0052144

2 About this document

2.1 Document function

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

General information on functional safety (SIL) is available at:
www.endress.com/SIL

2.2 Symbols

2.2.1 Safety symbols

DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

WARNING
This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

CAUTION
This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE
This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

2.2.2 Symbols for certain types of information and graphics

Tip
Indicates additional information

Reference to documentation

Reference to graphic

▶
Notice or individual step to be observed

1., 2., 3.
Series of steps

Result of a step

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

2.3 Supplementary device documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following document types are available in the download area of the Endress+Hauser website (www.endress.com/downloads):

2.3.1 Further applicable documents

- TI01713F
- BA02287F
- KA01642F
- SD02874F (Heartbeat Verification + Monitoring application package)

2.3.2 Technical Information (TI)

Planning aid
The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.

2.3.3 Operating Instructions (BA)

Reference document
These Operating Instructions contain all the information that is required in the various life cycle phases of the device: from product identification, incoming acceptance and storage, to installation, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.

2.3.4 Brief Operating Instructions (KA)

Guide that takes you quickly to the 1st measured value
The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

2.3.5 Heartbeat Technology Special Documentation (SD)

Parameter description
- Heartbeat Diagnostics
- Heartbeat Verification
- Heartbeat Monitoring

The Heartbeat Special Documentation contains a description of the additional parameters and technical data that are available with the Heartbeat Verification and Heartbeat Monitoring application packages.

2.3.6 Safety Instructions (XA)

Depending on the approval, the following Safety Instructions (XA) are supplied with the device. They are an integral part of the Operating Instructions.

The nameplate indicates the Safety Instructions (XA) that are relevant to the device.

2.3.7 Certificate

The associated certificate is available in the Endress+Hauser Device Viewer (Section 2.3) or can be found in the Declaration of Conformity (Section 1) of the applicable Functional Safety Manual. This certificate must be valid at the time of delivery of the device.

3 Design

3.1 Permitted device 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 subsequent versions can also be used for safety functions.

A modification process according to IEC 61508 is applied for device changes.

Valid device versions for safety-related use:

3.1.1 Order codes

FTL63-

Feature: 010 "Approval"
Version: all

Feature: 020 "Output"
Version: A7; FEL67, 2-wire PFM + test button

Feature: 030 "Display, operation"
Version: all

Feature: 040 "Housing; material"
Version: all

Feature: 050 "Electrical connection"
Version: all

Feature: 060 "Application"
Version: all

Feature: 080 "Surface refinement"
Version: all

Feature: 085 "Probe design"
Version: all

Feature: 090 "Sensor length, material"
Version: all

Feature: 105 "Process connection, sealing surface"
Version: all

Feature: 110 "Process connection"
Version: all

Feature: 590 "Additional approval"
Version: LA
Advanced diagnostic measures are only implemented in this version. This version must be selected for use as a safety function as per IEC 61508.

3.2 Identification marking

SIL-certified devices are marked with the SIL logo (SIL) on the nameplate.

3.3 Safety function

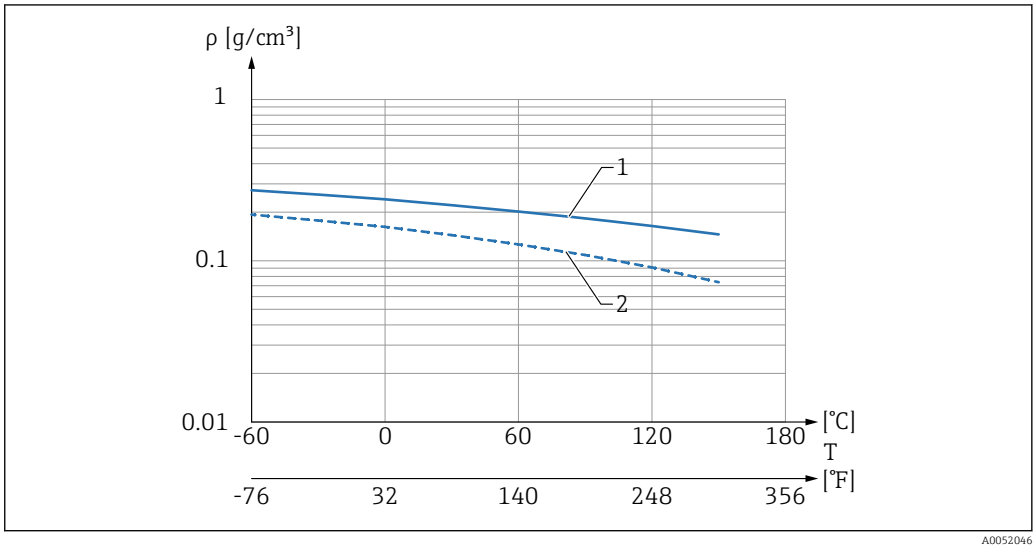
The device's safety functions are:
- Maximum level monitoring (overfill protection system, maximum detection)
- Minimum level monitoring (dry-run protection, minimum detection)

3.4 Basic conditions for use in safety-related applications

The device must be used correctly for the specific application, taking 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 in the Operating Instructions and the Technical Information must not be exceeded.

3.4.1 Density

Operation is only permitted with liquids:
- Depending on the configuration of the density setting, the density of the liquid must be as follows:
  - over 0.7 g/cm³ if switch position is > 0.7 (common water- or oil-based liquids)
  - over 0.5 g/cm³ if switch position is > 0.5 (e.g. liquefied gas, isopentane, benzine)
- The gas phase above the liquid may not exceed a maximum permitted density value. The maximum possible gas density depends on the temperature and the device



1 316L stainless steel, polished

1 Switch position for density 0.7 g/cm³
2 Switch position for density 0.5 g/cm³

⚠ CAUTION

Gas density is exceeded!

The "Uncovered" state is not recognized and the "Covered" state is always reported.

► The gas density may not be exceeded.

- There is no minimum density for the gas phase.
- Operation in a vacuum is permitted.
- There is no maximum density for the liquid.

For more information on the levels of diagnostic coverage, refer to IEC 61508-2:2010 Appendix A.2, Comment 2 and Table A.1.

3.4.2 Buildup: only MIN detection

The device may only be used in media that do not tend to cause buildup.

Buildup is detected with a low diagnostic coverage.

3.4.3 Solid particles - heterogeneous mixtures (only for MIN detection)

The medium may not contain solid particles with a diameter greater than 5 mm (0.2 in). Solid particles lodged between the tines of the tuning fork can have the effect that the demand mode of the safety function is not detected and the device will not switch as intended.

Lodged solid particles are detected with low diagnostic coverage.

3.4.4 Wall distance

The distance between the tuning fork of the device and the wall of the vessel containing medium (e.g. tank, pipe) must be at least 10 mm (0.39 in).

3.4.5 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.

When using coated sensors, make sure the sensor is not damaged during installation and operation.

3.4.6 Abrasion

It is not permitted to use the device with abrasive media. The removal of material from the sensor as a result of abrasion can result in sensor failure.

Abrasion is detected with low diagnostic coverage.

3.4.7 Flow velocity

In the case of flowing media, the flow velocity in the area around the tuning fork may not exceed 5 m/s. Higher flow velocities can have the effect that the demand mode is not detected and the sensor signals that it is free (uncovered).

3.4.8 External vibration

In systems exposed to strong external vibrations, e.g., in the 400 to 1 200 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.

3.4.9 EMC compatibility

The device is certified in accordance with IEC 61326-3-1 and is thus suitable for general industrial, safety-related applications. If the specified electromagnetic ambient conditions are exceeded, the switch status might not be reliably detected. An unshielded cable up to 1 000 m (3 281 ft) long can be used between the devices in these environmental conditions. Electromagnetic interference immunity can be further improved by using shielded cables.

3.4.10 Mounting with sliding sleeve

NOTICE

Mounting the device with a pipe extension and sliding sleeve

The switch point may be tampered with by the pipe extension with sliding sleeve

- Ensure that the switch point is not tampered with or that any tampering is reliably detected

3.4.11 COM interface

When used as a safety function, there is the option of connecting an additional module to the COM interface.
Bluetooth: BT module VU121

The module may be used for informational purposes only but not as part of the safety function. It does not have a modifying effect on the safety function.

3.5 Useful lifetime of electrical components

The established failure rates of electrical components apply within the useful lifetime as per IEC 61508-2:2010 section 7.4.9.5 note 3.

In accordance with DIN EN 61508-2:2011 section 7.4.9.5 (national footnote N3), appropriate measures taken by the manufacturer and operator can extend the useful lifetime.

4 Commissioning (installation and configuration)

4.1 Requirements for personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- Personnel must be authorized by the plant owner/operator.
- Be familiar with federal/national regulations.

- Before starting work: personnel must read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Personnel must follow instructions and comply with general policies.

The operating personnel must fulfill the following requirements:
- Personnel are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Personnel follow the instructions in this manual.

4.2 Installation

The mounting and wiring of the device and the permitted orientations are described in the Operating Instructions pertaining to the device.

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

4.3 Commissioning

The commissioning of the device is described in the Operating Instructions pertaining to the device.

Prior to operating the device in a safety instrumented system, verification must be carried out by means of a test sequence as described in **the section "Proof testing"**.

4.4 Operation

The operation of the device is described in the Operating Instructions pertaining to the device.

4.5 Parameter configuration for safety-related applications

The device settings may not be changed if SIL operation is in progress.

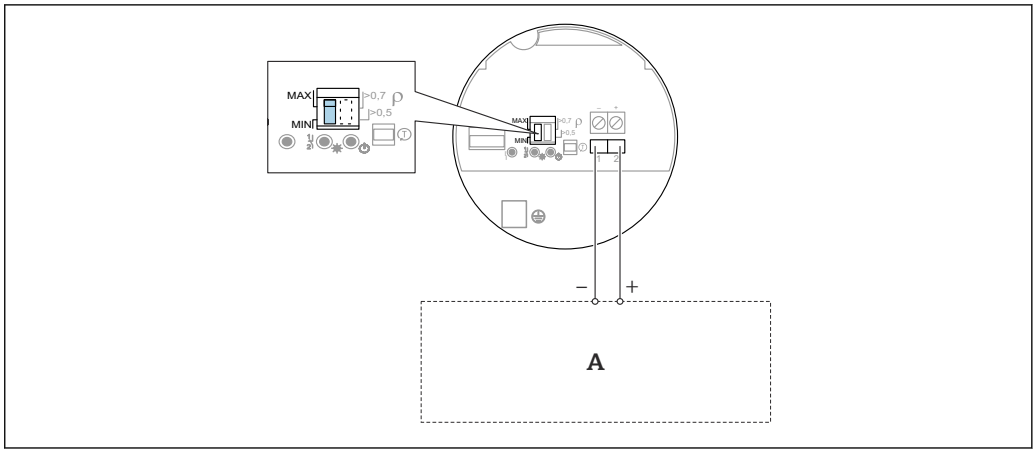
NOTICE

The protective function can be impaired

After commissioning the measuring system, changes to the settings can impact the protective function

- After changing the settings, perform a proof test to ensure that the safety function is working correctly

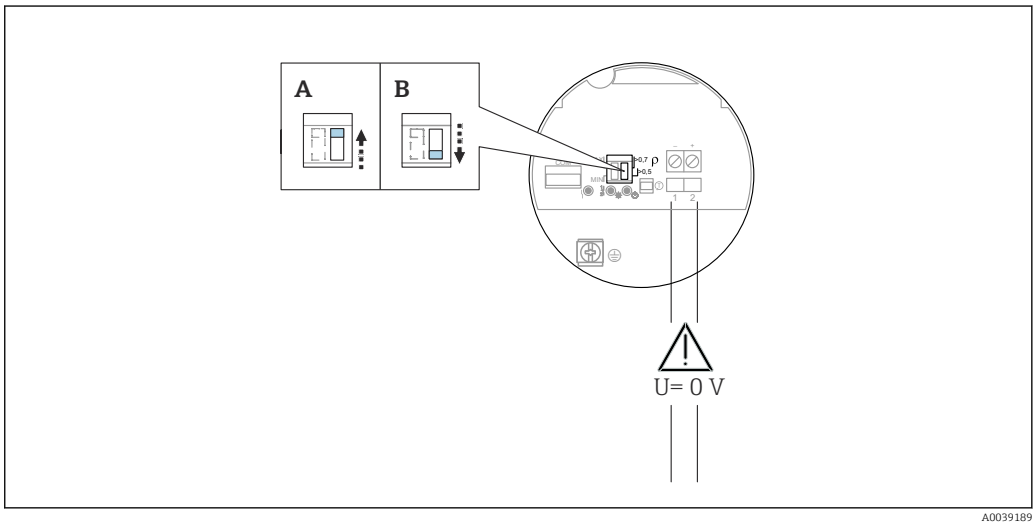
4.5.1 MIN/MAX detection mode



2 *Selection of MIN/MAX detection mode*

A Additional safety equipment

4.5.2 Density mode



3 *Selection of density mode*

A Default setting (density >0.7 g/cm³); always use this setting where possible

B Special setting (density >0.5 g/cm³); extremely light liquids (e.g., liquefied natural gas, isopentane, petroleum ether)

5 Operation

5.1 Device behavior during power-up

The behavior of the device when switched on is described in the relevant Operating Instructions.

5.2 Device behavior in safety function demand mode

The safety-related output signal is described in detail in the Functional Safety Manual (FY01006F) for Nivotester FTL325P.

The Nivotester FTL325P always has switch contacts, they work with quiescent current safety; they are closed when the status is OK.

5.3 Device behavior in the event of an alarm

The behavior of the device in the event of an alarm is described in the relevant Operating Instructions.

6 Proof testing

The safety-related functional integrity of the device in safety-related applications must be checked during commissioning, whenever safety-relevant parameters are changed, and at appropriate intervals. This ensures that the functional integrity can be verified within the complete safety instrumented system. The time intervals must be specified by the operator.

⚠ CAUTION

The safety function is not guaranteed during a proof test

Suitable measures must be taken to guarantee process safety during the test.

- A completed test must be documented; the reports provided in the Appendix can be used for this purpose (see section 8.2).
- The operator specifies the test interval. This must be taken into account when determining the probability of failure PFD_{avg} of the sensor system.

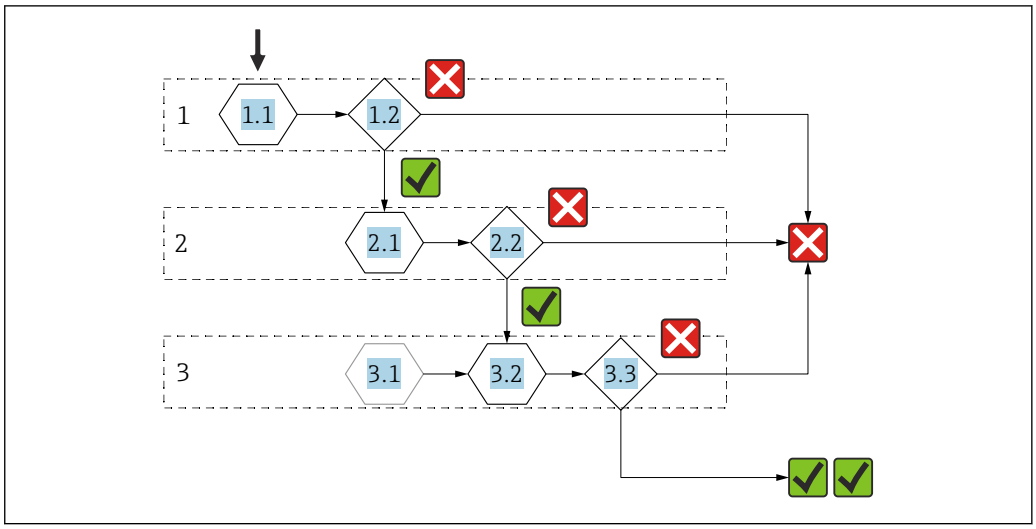
When using the proof-test wizard in the SmartBlue app, the correct version must be selected.

Version II to **version VI** are described in the Functional Safety Manual for the Nivotester FTL325P.

Note the following for the test sequences:

- 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.
- The proof test can and may only be performed if the device status is OK.
- The status of the individual output signal is indicated by a measuring device or a downstream component of the safety path (e.g., PLC, actuator).
- The individual proof test coverages (PTC) that can be used for calculation are specified in the Declaration of Conformity.
- To monitor the safety-related output signal, it is sufficient to evaluate the response of downstream components of the safety function. If the different states are correctly identified there, the test steps are passed.

6.1 Basic test sequence



4 *Basic test sequence*

1.1 Status OK
1.2 Output signal for status OK?
2.1 Establish demand mode
2.2 Output signal for demand mode?
3.1 Re-install the sensor that was removed (optional)
3.2 Establish status OK
3.3 Output signal for status OK?

The output signal can be evaluated based on the response of the following components of the safety function.

7 Repair and error handling

7.1 Maintenance

Maintenance instructions and instructions regarding recalibration may be found in the Operating Instructions pertaining to the device.

Alternative monitoring measures must be taken to ensure process safety during configuration, proof-testing and maintenance work on the device.

7.2 Repair

Repair means restoring functional integrity by replacing defective components.

Only original Endress+Hauser spare parts may be used here.

The repair must be documented. This includes:
- Serial number of the device
- Date of the repair
- Type of repair
- Person who performed the repair

Components may be repaired/replaced by the customer's technical staff if original Endress +Hauser spare parts are used (they can be ordered by the end user), and if the relevant installation instructions are followed.

A proof test must always be performed after every repair.

Installation Instructions are supplied with the original spare part and can also be accessed in the Download Area at www.endress.com

Send in replaced components to Endress+Hauser for fault analysis.

When returning the defective component, always enclose the "Declaration of Hazardous Material and Decontamination" with the note "Used as SIL device in a safety instrumented system".

Information on returns: http://www.endress.com/support/return-material

7.3 Modification

Modifications are changes to SIL devices that are already delivered or installed:

- **Modifications to SIL devices by the user are not permitted as they can impair the functional safety of the device.**
- Modifications to SIL devices may be performed onsite at the user's plant following approval by the Endress+Hauser manufacturing center.
- Modifications to SIL devices must be performed by personnel authorized to do so by Endress+Hauser.
- Only **original spare parts** fromEndress+Hauser may be used for modifications.
- All modifications must be documented in the Endress+Hauser Device Viewer (www.endress.com/deviceviewer)
- All modifications require a change nameplate or replacement of the original nameplate.

7.4 Decommissioning

When decommissioning, the requirements according to IEC 61508-1:2010 section 7.17 must be observed.

7.5 Disposal

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

7.6 Battery disposal

- In some countries, the end user is legally obliged to return used batteries.
- The end user can return old batteries or electronic assemblies containing these batteries free of charge to Endress+Hauser.

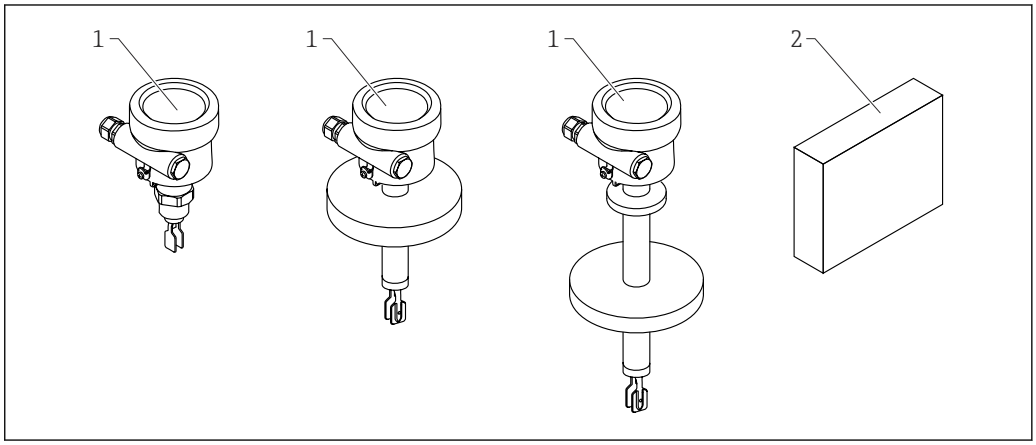
In accordance with German law regulating the use of batteries (BattG §17 Para Number 3), this symbol is used to denote electronic assemblies that must not be disposed of as municipal waste.

8 Appendix

8.1 Structure of the measuring system

8.1.1 System components

The measuring system's devices are shown in the following diagram (example).



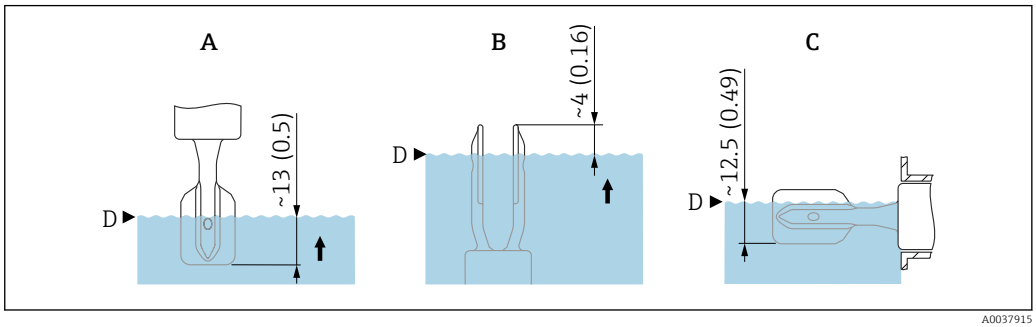
5 *System components*

1 Measuring device/sensor
2 1-channel Nivotester FTL325P
3 3-channel Nivotester FTL325P

8.1.2 Description of use as a safety instrumented system

The sensor's tuning fork vibrates at its intrinsic frequency. The vibration frequency decreases as the density increases. This change in the frequency causes the current signal to change.

The switch point is in the range of the tuning fork and depends on the installation position.



6 *Switch point depending on the installation position. Unit of measurement mm (in)*

A Installation from above
B Installation from below
C Installation from the side

For information on the switch point under reference operating conditions, see the Technical Information.

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

8.1.3 Measurement function

Choice of operating modes:

- MIN detection
  The measuring system is used to protect against a level that is too low (e.g. pump dry running protection, protection against emptying or protection against insufficient filling).
  In normal operation, the tuning fork is covered by liquid and the measuring system reports the "GOOD" state. If the tuning fork is free, the device assumes the safe state and signals the demand mode.
- MAX detection
  The measuring system is used to protect against a level that is too high (e.g. overfill prevention).
  In normal operation, the tuning fork is not covered by liquid and the measuring system reports the "GOOD" state. If the tuning fork is covered, the device assumes the safe state and signals the demand mode.

8.1.4 Versions

The Liquiphant FTL51B with FEL67 electronic insert and Nivotester FTL325P components may be operated in the versions described in the Functional Safety manual for Nivotester FTL325P (FY01006F).

Version I, without the Nivotester, may not be used as a safety function in accordance with IEC 61508.

8.2 Version history

FY01095F; Version: 02.26
- Firmware version: from 01.01.zz (zz: any double number)
- Hardware version: from 01.00.ww (ww: any double number)
- Changes:
  Adjustments to text

FY01095F; Version: 01.23
- Firmware version: from 01.01.zz (zz: any double number)
- Hardware version: from 01.00.ww (ww: any double number)
- Changes:
  First version

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