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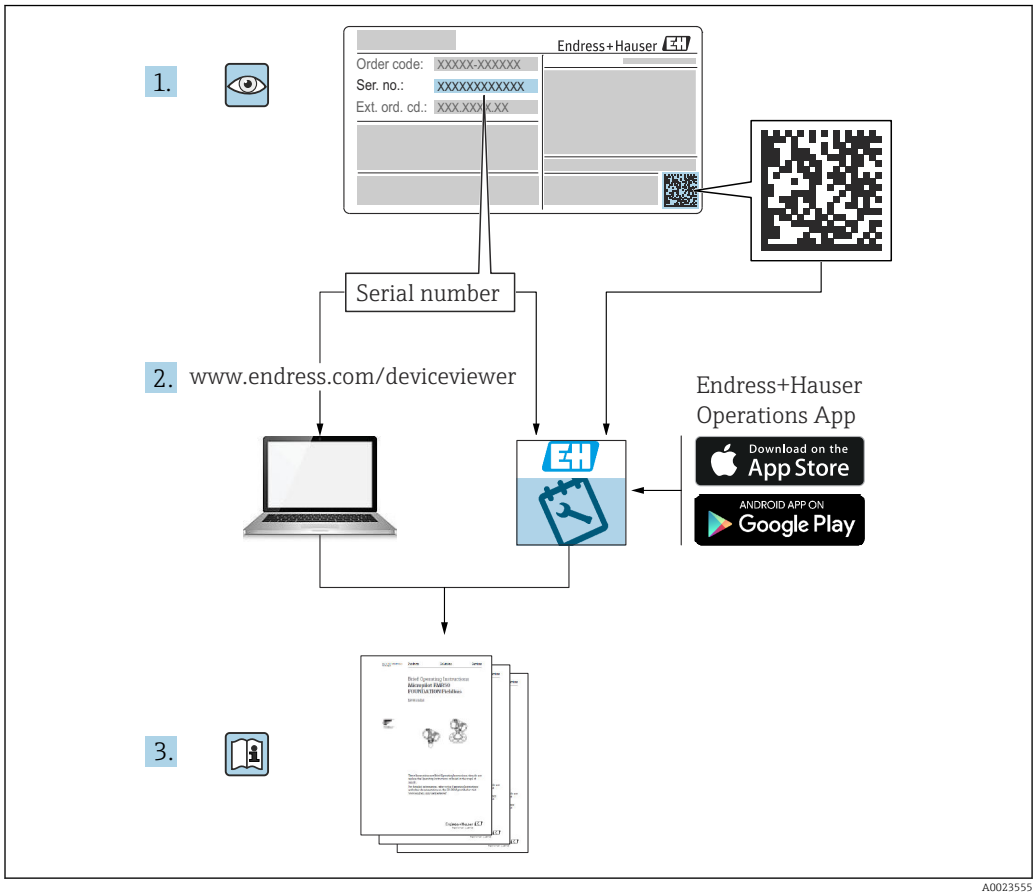
2026-01-12

Operating Instructions
Liquiphant FailSafe FTL80

Vibronic
Compact level switch for liquids for failsafe overfill protection system

Endress+Hauser
People for Process Automation



- Make sure the document is stored in a safe place such that it is always available when working on or with the device
- Avoid danger to individuals or the facility: read the "Basic safety instructions" section carefully, as well as all other safety instructions in the document that are specific to working procedures

The manufacturer reserves the right to modify technical data without prior notice. The Endress+Hauser sales organization will supply you with current information and updates to these instructions.

Table of contents

1 About this document

1.1 Document function

These Operating Instructions contain all the information 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.

1.2 Symbols

1.2.1 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.

1.2.2 Electrical symbols

⏚ Ground connection
Grounded clamp, which is grounded via a grounding system.

⊜ Protective earth (PE)
Ground terminals, which must be grounded prior to establishing any other connections. The ground terminals are located on the inside and outside of the device.

1.2.3 Tool symbols

Flat-blade screwdriver

Allen key

Open-ended wrench

1.2.4 Symbols for certain types of Information

✓ Permitted
Procedures, processes or actions that are permitted.

✗ Forbidden
Procedures, processes or actions that are forbidden.

Tip
Indicates additional information

Reference to documentation

Reference to another section

1., 2., 3. Series of steps

1.2.5 Symbols in graphics

A, B, C ... View

1, 2, 3 ... Item numbers

Hazardous area

Safe area (non-hazardous area)

1.3 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.

2 Basic safety instructions

2.1 Requirements for the 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.
- Are authorized by the plant owner/operator.
- Are familiar with federal/national regulations.
- Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Follow instructions and comply with basic conditions.

The operating personnel must fulfill 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.

2.2 Intended use

The device described in this manual is intended only for the level measurement of liquids.

Do not exceed or drop below the relevant limit values for the device
See the Technical Documentation

Incorrect use
The manufacturer is not liable for damage caused by improper or non-designated use.

Avoid mechanical damage:
- Do not touch or clean device surfaces with pointed or hard objects.

Clarification for borderline cases:
- For special media and fluids for cleaning, Endress+Hauser is glad to provide assistance in verifying the corrosion resistance of fluid-wetted materials, but does not accept any warranty or liability.

Residual risks
Due to the transfer of heat from the process and power dissipation within the electronics, the temperature of the housing may increase to up to 80 °C (176 °F) during operation. When in operation, the sensor can reach a temperature close to the medium temperature.

Danger of burns from contact with surfaces!
- In the event of elevated fluid temperatures, ensure protection against contact to prevent burns.

2.3 Workplace safety

For work on and with the device:
- Wear the required personal protective equipment according to federal/national regulations.

2.4 Operational safety

Damage to the device!
- Operate the device only if it is in proper technical condition, free from errors and faults.
- The operator is responsible for the trouble-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers.
- If modifications are nevertheless required, consult Endress+Hauser.

Repair

To ensure continued operational safety and reliability:
- Only perform repair work on the device if this is expressly permitted.
- Observe federal/national regulations pertaining to the repair of an electrical device.
- Use original spare parts and accessories from Endress+Hauser only.

Hazardous area

To eliminate danger to persons or the facility when the device is used in the hazardous area (e.g. explosion protection):
- Check the nameplate to verify if the device ordered can be put to its intended use in the hazardous area.
- Observe the specifications in the separate supplementary documentation included as an integral part of these instructions.

2.5 Product safety

This state-of-the-art device is designed and tested in accordance with good engineering practice to meet operational safety standards. It left the factory in a condition in which it is safe to operate.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU declaration of conformity. The manufacturer confirms this by affixing the CE mark.

2.6 Functional safety SIL

The Functional Safety Manual must be strictly observed for devices that are used in functional safety applications.

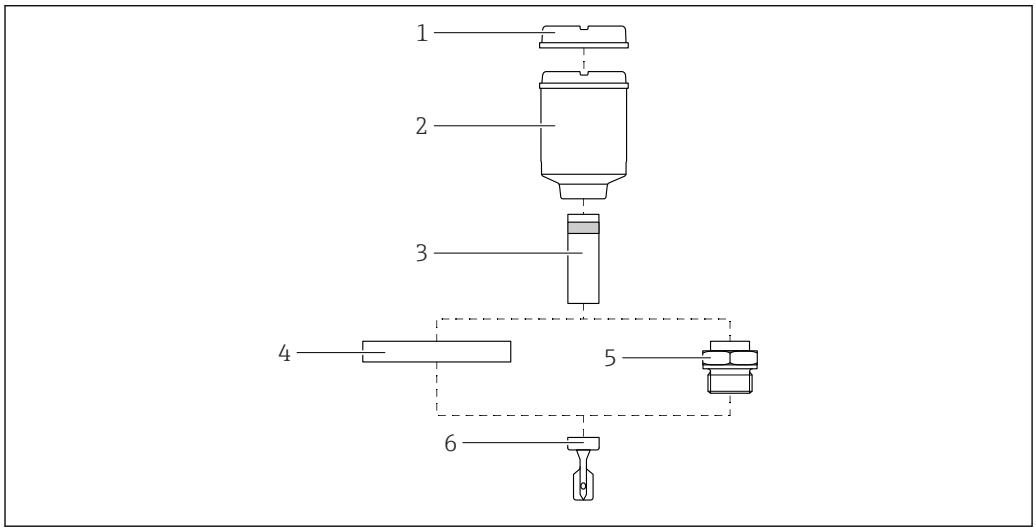
2.7 IT security

The manufacturer warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

3 Product description

Level switch for all liquids, for minimum or maximum detection in tanks, vessels and pipes for applications up to SIL 3. A permanent LIVE signal is used for function monitoring.



1 Product design

1 Cover with sight glass (optional)
2 Housing with cover
3 Temperature spacer with pressure-tight or gas-tight feedthrough, optional
4 Process connection flange
5 Process connection thread
6 Probe design: compact version with vibrating fork

4 Incoming acceptance and product identification

4.1 Incoming acceptance

On receipt of the delivery:

1. Check the packaging for damage.
   ↳ Report all damage immediately to the manufacturer.
   Do not install damaged components.
2. Check the scope of delivery using the delivery note.
3. Compare the data on the nameplate with the order specifications on the delivery note.

4. Check the technical documentation and all other necessary documents, e.g. certificates, to ensure they are complete.

If one of the conditions is not satisfied, contact the manufacturer.

4.2 Product identification

The following options are available for identification of the device:
- Nameplate specifications
- Order code with breakdown of the device features on the delivery note
- Enter the serial numbers from the nameplates in *Device Viewer* (www.endress.com/deviceviewer): all the information about the device is displayed.

4.2.1 Nameplate

Do you have the correct device?

The nameplate provides you with the following information on the device:
- Manufacturer identification, device designation
- Order code
- Extended order code
- Serial number
- Tag name (TAG) (optional)
- Technical values, e.g. supply voltage, current consumption, ambient temperature, communication-specific data (optional)
- Degree of protection
- Approvals with symbols
- Reference to Safety Instructions (XA) (optional)

▶ Compare the information on the nameplate with the order.

4.2.2 Manufacturer address

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

Place of manufacture: See nameplate.

4.3 Storage and transport

4.3.1 Storage conditions

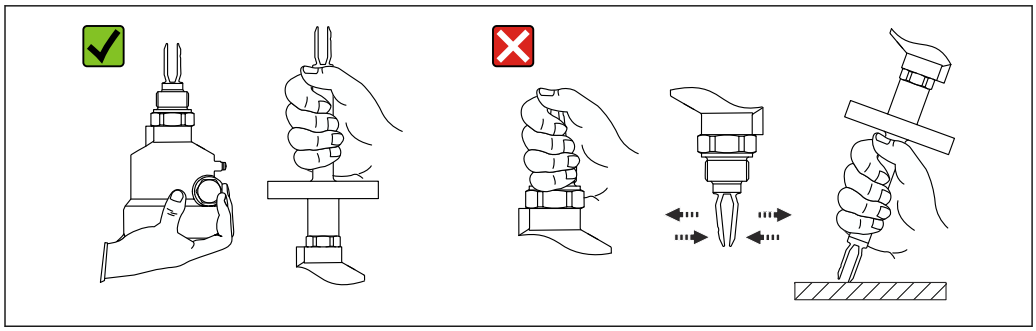
Use original packaging.

Storage temperature

−50 to +80 °C (−58 to +176 °F)

4.3.2 Transporting the device

- Transport the device to the measuring point in the original packaging
- Hold the device by the housing, temperature spacer, flange or extension pipe
- Do not bend, shorten or extend the tuning fork



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2 *Handling the device during transportation*

5 Installation

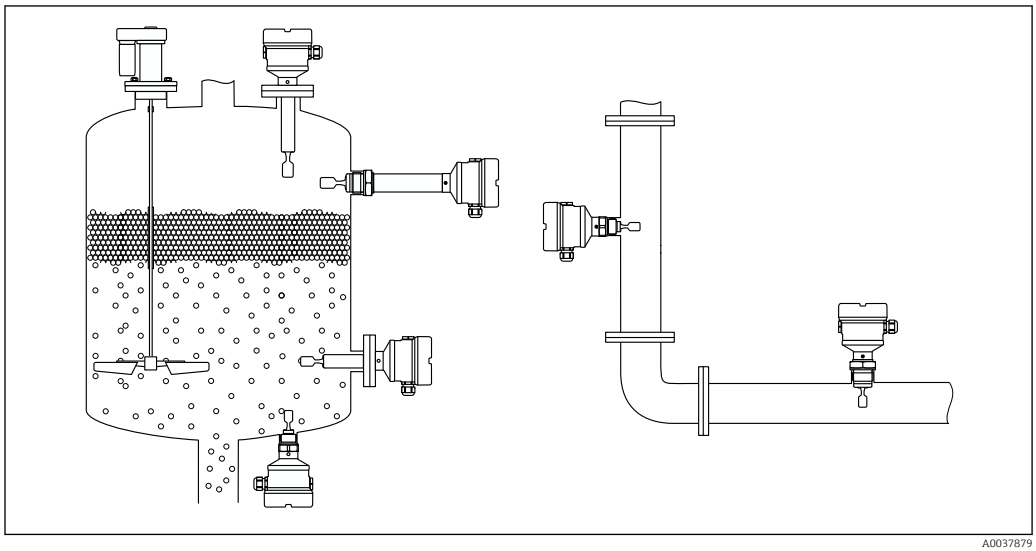
WARNING

Loss of protection rating if the device is opened in a wet environment.

▶ Only open the device in a dry environment!

Installation instructions

- Any orientation for compact version
- Minimum distance between the vibrating fork and the tank wall or pipe wall: 10 mm (0.39 in)



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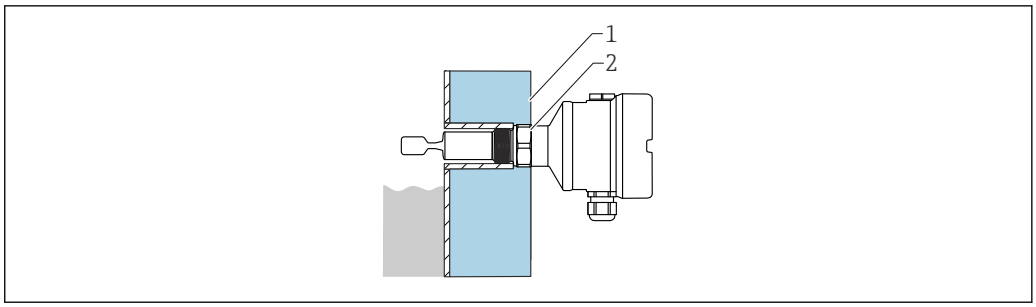
3 *Installation examples for a vessel, tank or pipe*

5.1 Installation requirements

5.1.1 Vessel with heat insulation

If process temperatures are high, the device should be included in the vessel insulation system to prevent the electronics from heating as a result of thermal radiation or convection. The insulation in this case should not be higher than the neck of the device.



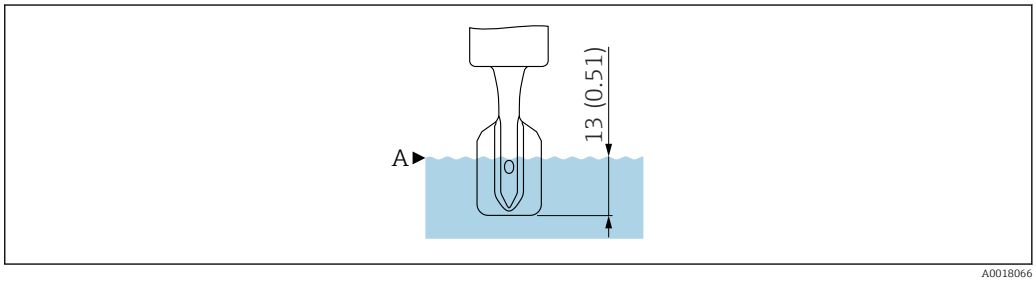
4 *Example of a vessel with heat insulation*

1 Vessel insulation
2 Insulation (up to the housing neck max.)

5.1.2 Taking the switch point into consideration

Minimum distance between the tuning fork and the tank wall or pipe wall: 10 mm (0.39 in)

Switch point at reference operating conditions

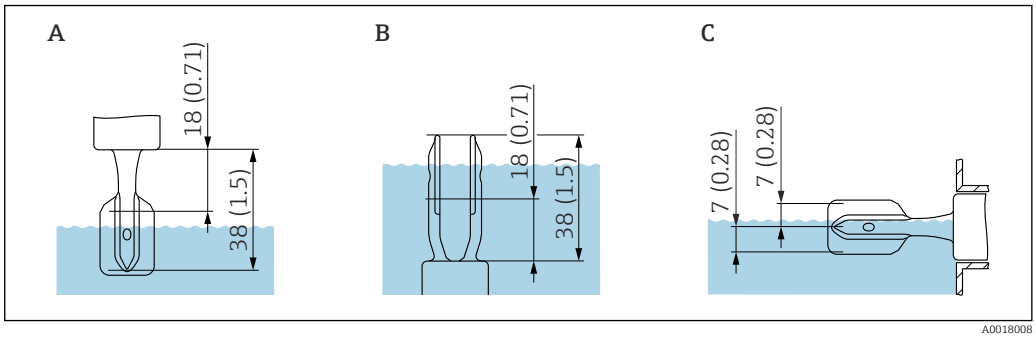


5 *Switch point at reference operating conditions. Unit of measurement mm (in)*

A Switch point

Switch point outside reference operating conditions

Outside the reference operating conditions, the switch point is in the area of the vibrating fork.



6 *Switch points depending on the orientation. Unit of measurement mm (in)*

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

5.1.3 Viscosity depending on the mode of operation

With regard to the viscosity of the medium, the restrictions for applications involved in safety-related operation must be observed, as specified in the Functional Safety Manual.

Align the vibrating fork so that the narrow sides of the vibrating fork point upwards and downwards, allowing the liquid to drain off properly.

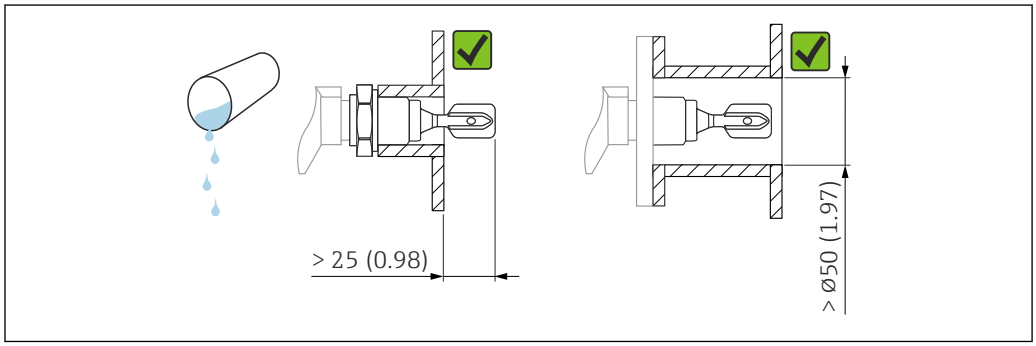
Maximum detection: ≤ 10 000 mPa·s

Minimum detection: ≤ 350 mPa·s

Minimum detection, high temperature 230 to 280 °C (450 to 536 °F): ≤ 100 mPa·s

Low viscosity

It is permitted to position the tuning fork within the installation socket.



7 *Example of installation for low-viscosity liquids. Unit of measurement mm (in)*

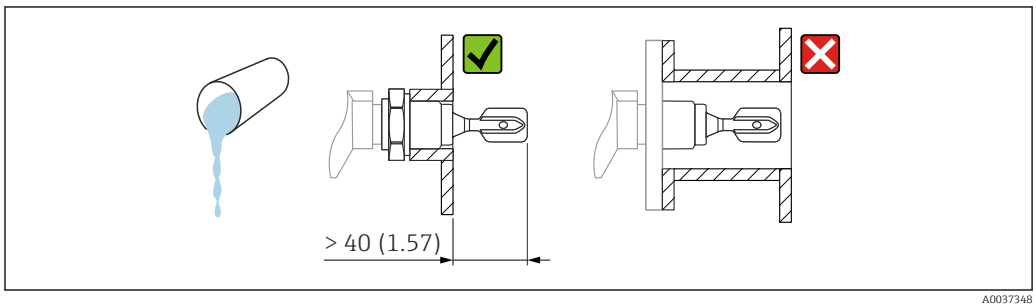
High viscosity

NOTICE

Highly viscous liquids may cause switching delays.

- Make sure that the liquid can run off the tuning fork easily.
- Deburr the socket surface.

The tuning fork must be located outside the installation socket!



8 *Installation example for a highly viscous liquid. Unit of measurement mm (in)*

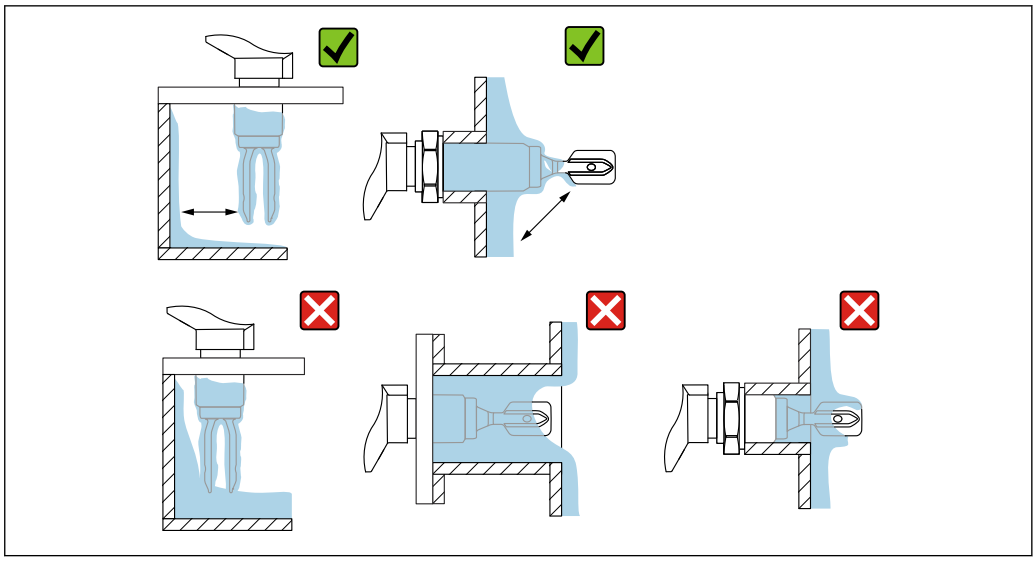
5.1.4 Preventing buildup

NOTICE

Buildup formation can restrict applications during safety-related operation.

- Refer to the Functional Safety Manual.

Ensure that there is sufficient distance between the expected buildup on the tank wall and the fork.



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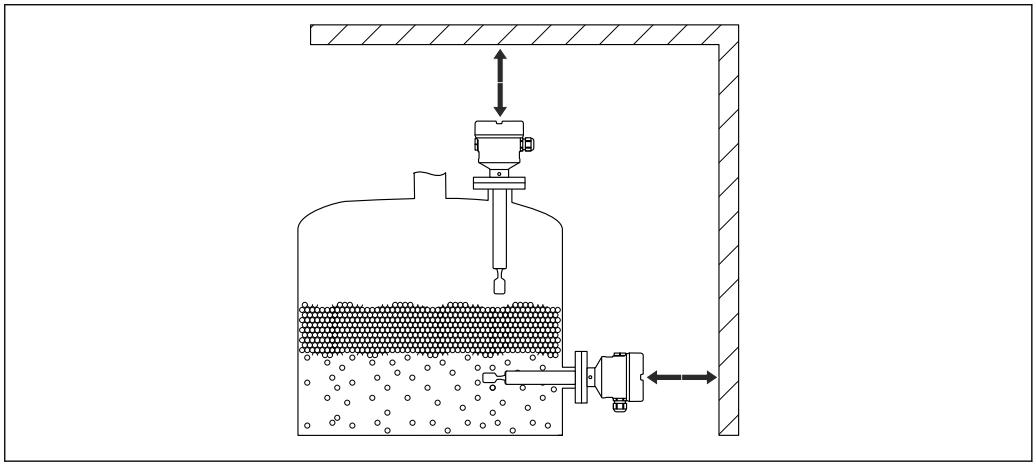
9 *Installation examples for a highly viscous process medium*

5.1.5 Take clearance into consideration



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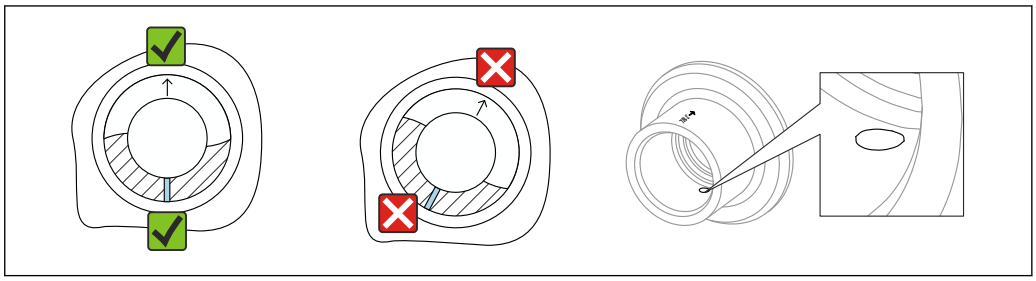
10 *Take clearance outside the tank into consideration*

5.1.6 Weld-in adapter with leakage hole

Position the weld-in adapter so that the leakage hole points downwards. This allows any leakage to be detected at an early stage, as the escaping medium becomes visible.



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11 *Weld-in adapter with leakage hole*

5.2 Installing the device

5.2.1 Required tools

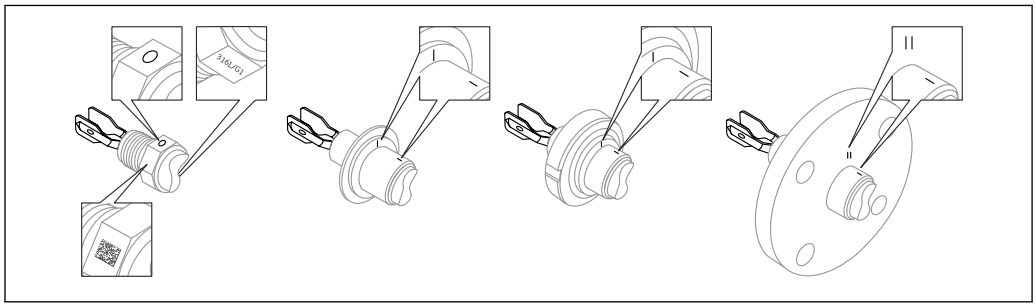
- Screw driver
- Open-ended wrench for sensor installation : SW32 or SW41
- Allen key for housing locking screw

5.2.2 Aligning the vibrating fork using the marking

The vibrating fork can be aligned using the marking in such a way that the medium drains off easily and buildup is avoided.

- Markings for threaded connections: Circle (material specification/thread designation opposite)
- Markings for flange connections: line or double line

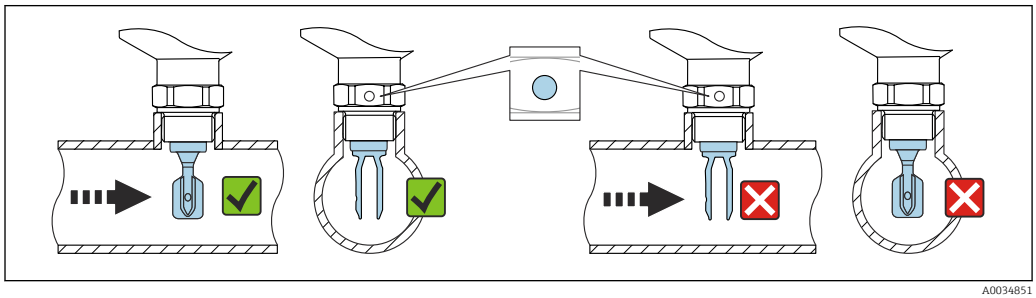
In addition, the threaded connections have a matrix code that is **not** used for alignment.



12 *Position of the vibrating fork when installed horizontally in the vessel using the marking*

5.2.3 Installing the device in piping

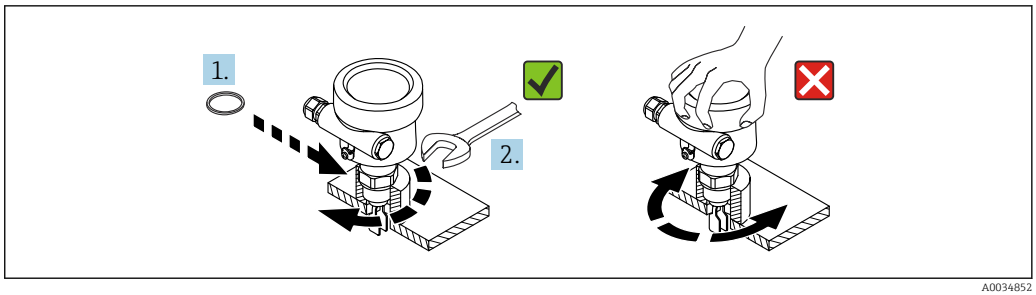
- Flow velocity up to 5 m/s with viscosity 1 mPa·s and density 1 g/cm³ (62.4 lb/ft³). Check for correct functioning in the event of other process medium conditions.
- If the vibrating fork is correctly aligned and the marking is pointing in the flow direction, the flow will not be significantly obstructed.
- The marking is visible when installed.
- Pipe diameter: ≥ 50 mm (2 in)



13 *Installation in pipes (take fork position and marking into consideration)*

5.2.4 Screwing in the device

- Turn by the hex bolt only, 15 to 30 Nm (11 to 22 lbf ft)
- Do not turn using the housing.



14 *Screwing in the device*

5.2.5 Aligning the cable entry

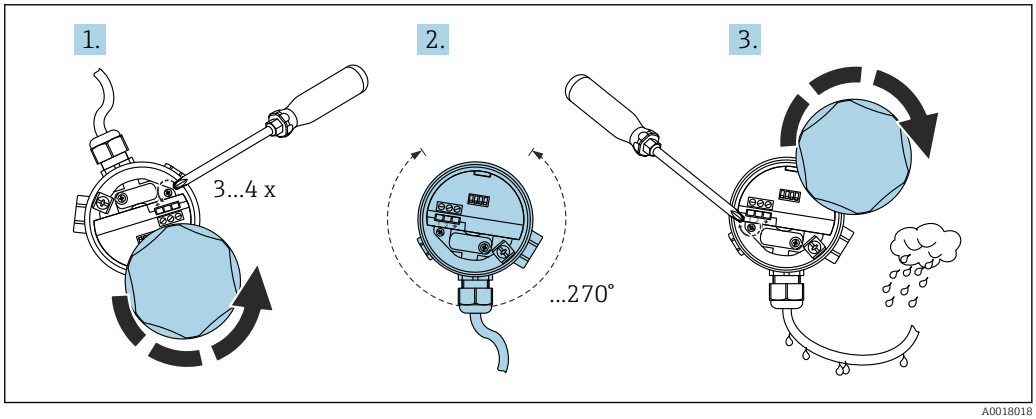
All housings can be aligned. Forming a drip loop on the cable prevents moisture from entering the housing.

Housing with locking screw (316L (F27) and 316L hygienic (F15))

The housing can be aligned using a locking screw.

Aligning the housing:

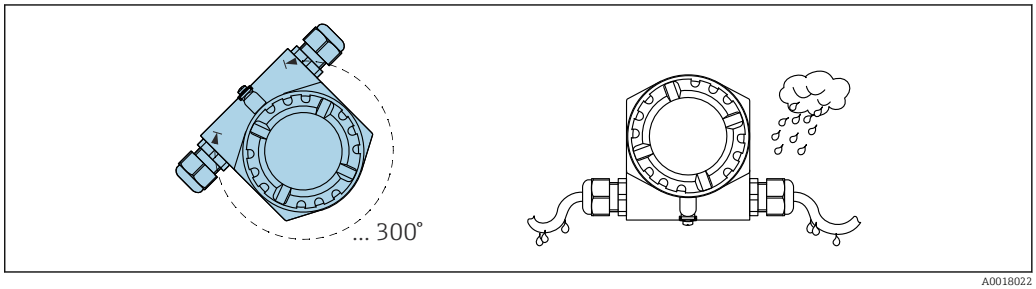
1. Open the housing cover and loosen the locking screw (3-4 rotations).
2. Rotate the housing into the correct position.
3. Tighten the locking screw with maximum 0.9 Nm and close the housing cover.



15 *Housing with locking screw; form a drip loop on the cable*

Housing without locking screw (plastic (F16), aluminum (F13, F17, T13))

The housing can be rotated up to 300 °.



16 *Housing without set screw; form a drip loop on the cable*

5.2.6 Sealing the housing

NOTICE

Risk of device damage due to moisture inside the housing!
The O-ring seal on the housing cover can be destroyed by mineral oil-based grease. This can allow moisture to enter the housing.
- ▶ Use only an approved lubricant such as Syntheso Glep 1 for the O-ring seal on the housing cover.

NOTICE

Risk of device damage due to moisture inside the housing!
An improperly closed housing cover or incorrectly sealed cable entries can allow moisture to enter the housing.
- ▶ Always ensure that the housing cover and cable entries are tightly closed.

5.2.7 Closing the housing covers

NOTICE

Thread and housing cover damaged from dirt and fouling!
- ▶ Remove dirt (e.g. sand) on the thread of the covers and housing.
- ▶ If you continue to encounter resistance when closing the cover, check the thread again for fouling.

Housing thread
The threads of the electronics and connection compartment can be coated with an anti-friction coating.
The following applies for all housing materials:
☒ **Do not lubricate the housing threads.**

5.3 Post-mounting check

❑ Is the device undamaged (visual inspection)?

❑ Are the measuring point number and labeling correct (visual inspection)?

❑ Is the device adequately protected from precipitation and direct sunlight?

❑ Is the device properly secured?

❑ Does the device comply with the measuring point specifications?

For example:
- Process temperature
- Process pressure
- Ambient temperature
- Measuring range

6 Electrical connection

NOTICE

- ▶ Comply with national standards and regulations!

6.1 Connecting requirements

6.1.1 Required tool

- Screwdriver for electrical connection
- Allen key for screw of cover lock

6.1.2 Connecting protective earth (PE)

The protective earth conductor at the device must only be connected if the device's operating voltage is ≥ AC 35 V or ≥ DC 16 V.

When the device is used in hazardous areas, it must always be included in the potential equalization of the system, irrespective of the operating voltage.

6.2 Connecting the device

6.2.1 Power supply

- Nominal supply voltage: DC 24 V
- Supply voltage range: DC 12 to 30 V
- Power consumption: < 660 mW
- Reverse polarity protection: yes

6.2.2 Connectable load

R = (U - 12 V) / 22 mA

U = Supply voltage range: DC 12 to 30 V

6.2.3 Galvanic isolation

▶ Ensure galvanic isolation between the sensor and power supply.

NOTICE

▶ The device must be connected to a power supply that provides sufficient isolation for the operating voltage.

6.2.4 Overvoltage protection

Overvoltage category II (DIN EN 60664-1 VDE 0110-1)

6.2.5 Pollution degree

Pollution degree 2 (IEC 60664-1 and IEC 61010-1)

6.2.6 Mode of operation

The mode of operation (minimum detection or maximum detection) is selected via the connection coding on the electronic insert.

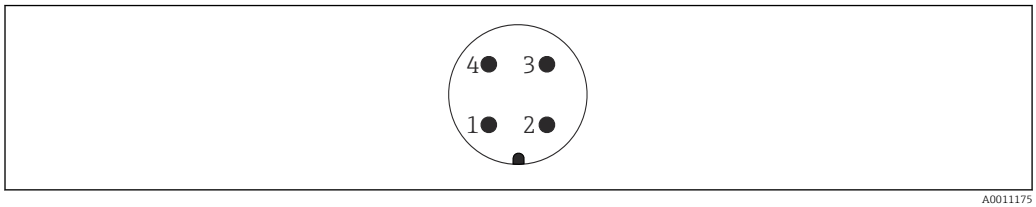
MAX = maximum detection:
- The output switches in a safety-oriented manner when the probe is covered (demand mode)
- Used, for example, for overflow protection systems
- Jamming of the vibrating fork leads to a "covered" signal (demand mode)

MIN = minimum detection:
- The output switches in a safety-oriented manner when the probe is free (demand mode)
- Used, for example, for dry-run protection
- Foam is not detected

6.2.7 Connection via M12 plug connector

For maximum detection mode of operation with an M12 plug connector, it is not necessary to open the housing for connection purposes.

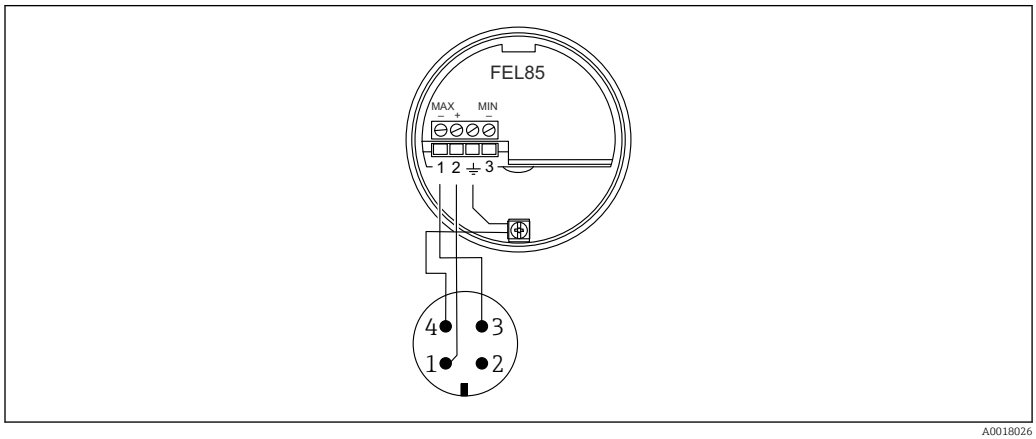
M12 plug



17 M12 plug, pin assignment

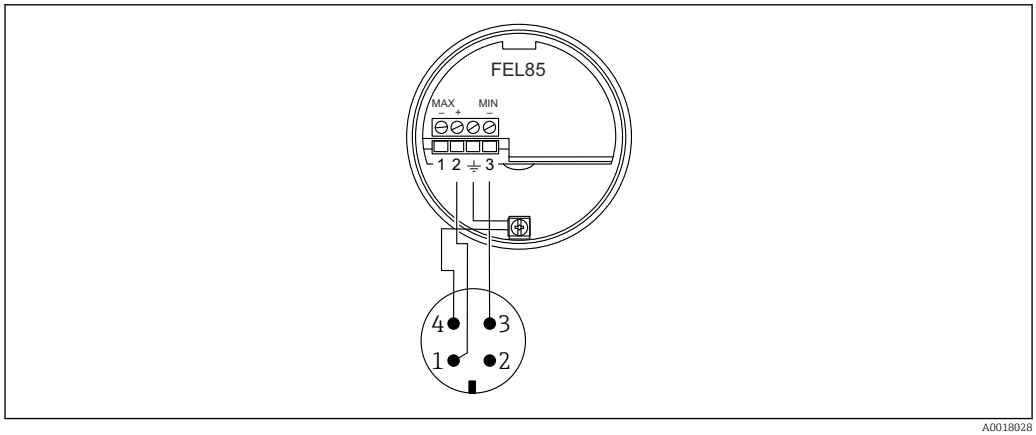
1 Signal +
2 Not used
3 Signal –
4 Ground

FEL85 Maximum detection mode of operation (factory setting)



18 Terminal assignment with M12 connector, maximum detection mode of operation

FEL85 Minimum detection mode of operation



19 Terminal assignment with M12 connector, minimum detection mode of operation

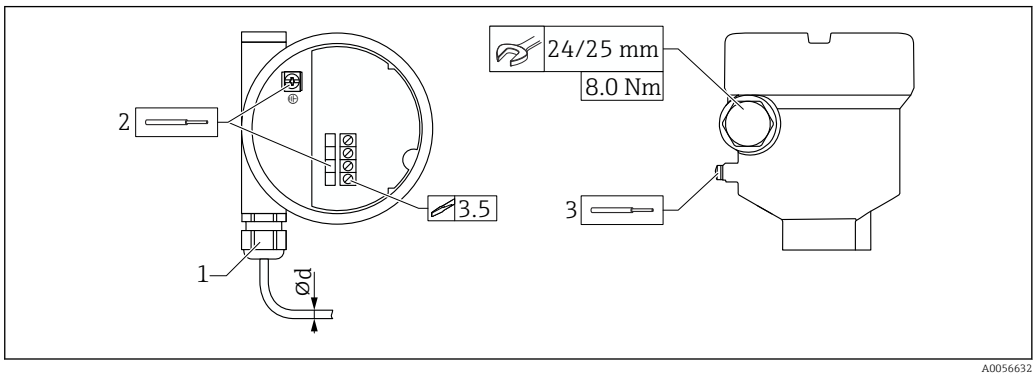
6.2.8 Connecting the cable

Required tools
- Flat-blade screwdriver (0.6 mm x 3.5 mm) for terminals
- Suitable tool with width across flats AF24/25 (8 Nm (5.9 lbf ft)) for M20 cable gland

Cable specification

The electronic inserts can be connected with commercially available instrument cables. If using shielded cables, it is recommended to connect the shielding on both sides for best results (if potential equalization is available).

Cable: maximum 25 Ω per conductor and 100 nF (typically 1 000 m (3 281 ft)).

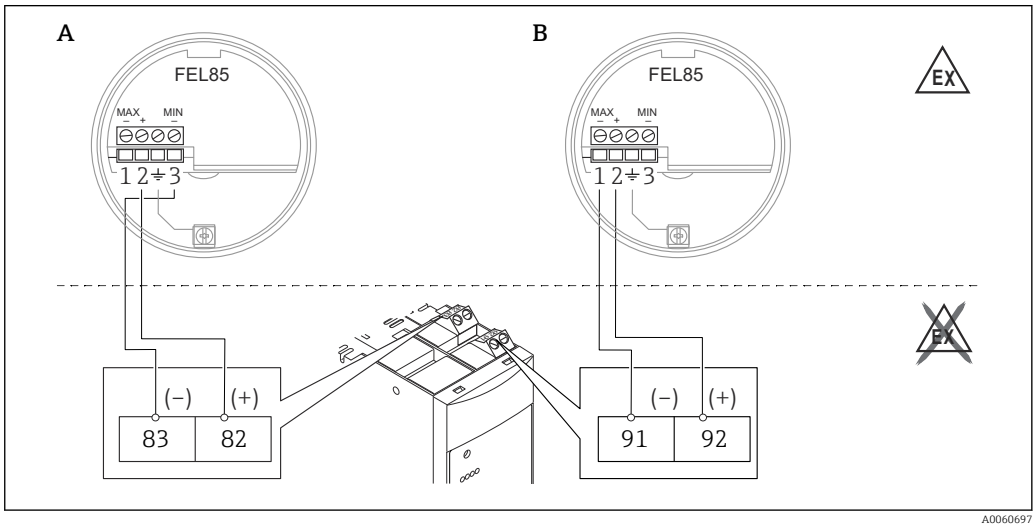


20 *Example of coupling with cable entry, electronic insert with terminals*

1 *M20 coupling (with cable entry)*
2 *Maximum conductor cross-section 2.5 mm² (AWG14), ground terminal inside the housing + terminals on the electronics*
3 *Maximum conductor cross-section 4.0 mm² (AWG12), ground terminal outside the housing*
Ød *Cable gland, plastic 5 to 10 mm (0.2 to 0.38 in)*
Cable gland, nickel-plated brass7 to 10.5 mm (0.28 to 0.41 in)
Cable gland, stainless steel7 to 12 mm (0.28 to 0.47 in)

Pay attention to the following when using the M20 coupling
After inserting the cable:
- Counter-tighten the coupling.
- Tighten the union nut of the coupling with a torque of 8 Nm (5.9 lbf ft)
- Screw the enclosed coupling into the housing with a torque of 3.75 Nm (2.76 lbf ft)

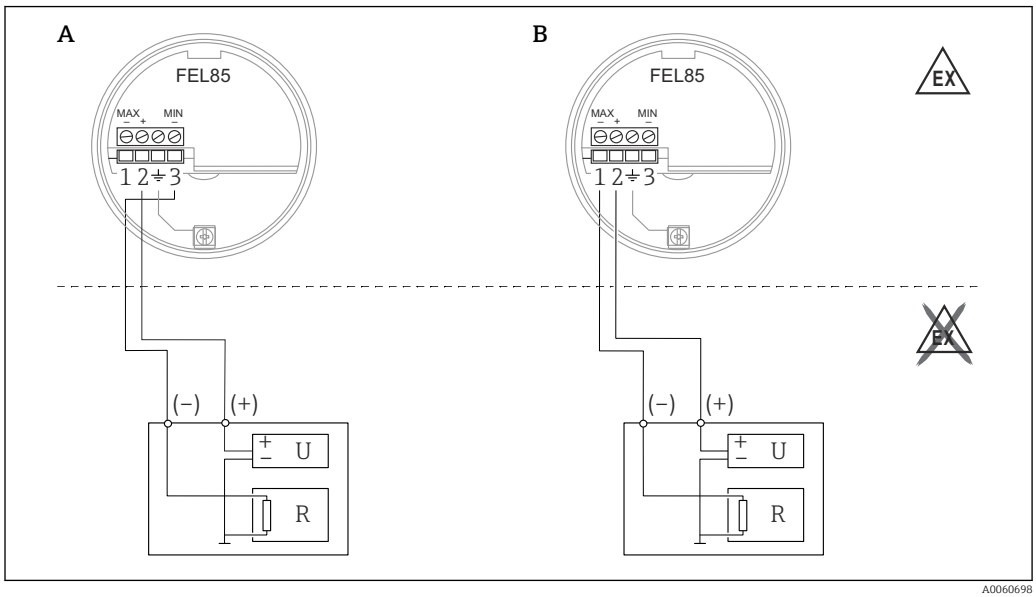
6.2.9 Connection to the Nivotester FailSafe FTL825



A *Minimum detection (dry-run protection)*
B *Maximum detection (overfill protection system)*

6.2.10 Connecting to control systems

The device is suitable for connection to a programmable logic controller (PLC), a safety PLC (SPLC) or AI Modules via a 4 to 20 mA signal according to EN 61131-2 and NE06, NE043.

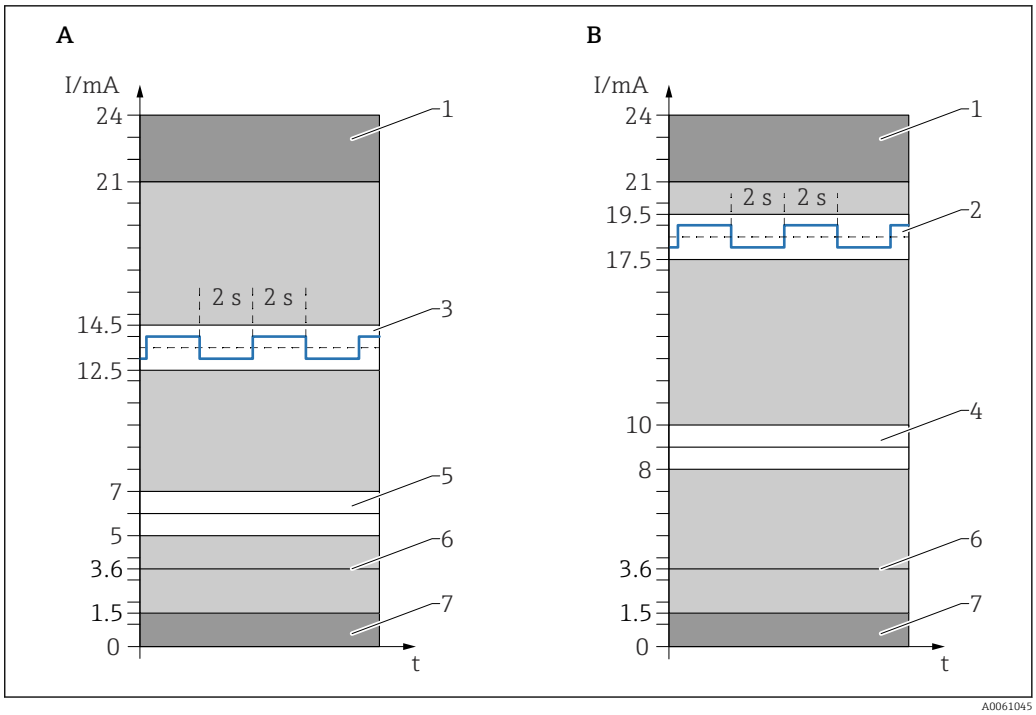


21 *Connecting to a PLC*

A Minimum detection (dry-run protection)
B Maximum detection (overfill protection system)
U Nominal supply voltage DC 24 V
R Resistance

Behavior of current output

When in OK status, the current output is in the range of 12 to 20 mA. In demand mode, the current output is in the range 4 to 12 mA. A separate current range is used for minimum detection and maximum detection.



22 *Current output*

A Maximum detection
B Minimum detection
1 Short-circuit: ≥ 21 mA
2 Minimum detection OK status: 17.5 to 19.5 mA and LIVE signal 18.5 mA±0.5 mA (0.25 Hz)
3 Maximum detection OK status: 12.5 to 14.5 mA and LIVE signal 13.5 mA±0.5 mA (0.25 Hz)
4 Minimum detection demand mode: 8.0 to 10.0 mA (9.0 mA)
5 Maximum detection demand mode: 5.0 to 7.0 mA (6.0 mA)
6 Sensor error: ≤ 3.6 mA
7 Interruption: ≤ 1.5 mA

LIVE signal:
- Changes by 1 mA every 2 000 ms
- Ensures that the sensor is connected correctly
- Can be monitored by the PLC
- Enables identification of faults in downstream components (e.g., PLC)

- To achieve SIL 3, the current values must be monitored during integration into a PLC. A current value outside the OK status current range is invalid (demand mode).
- For SIL 1 or SIL 2 applications, it is sufficient to program a current threshold of 12 mA.
  - Demand mode: < 12 mA
  - OK status: > 12 mA

Device behavior in case of fault (alarm and warning)

In the event of a fault the current output is in the range below 3.6 mA. Short-circuits are an exception: in this case, the current output is in the range above 21 mA. For alarm monitoring, the logic unit must be able to detect both HI alarms (≥ 21.0 mA) and LO alarms (≤ 3.6 mA). No distinction is made between an alarm and a warning.

6.3 Ensuring the degree of protection

Tested in accordance with EN 60529 and NEMA 250

Housing
- Plastic (F16):
  IP66/67/NEMA Type 4X enclosure
- 316L, hygienic (F15):
  IP66/67/NEMA Type 4X enclosure
- 316L (F27):
  IP66/68/NEMA Type 4X/6P enclosure
- Aluminium (F17):
  IP66/67/NEMA Type 4X enclosure
- Aluminium (F13):
  IP66/68/NEMA Type 4X/6P enclosure
- Aluminum (T13) with separate terminal compartment (Ex d):
  IP66/68/NEMA Type 4X/6P enclosure

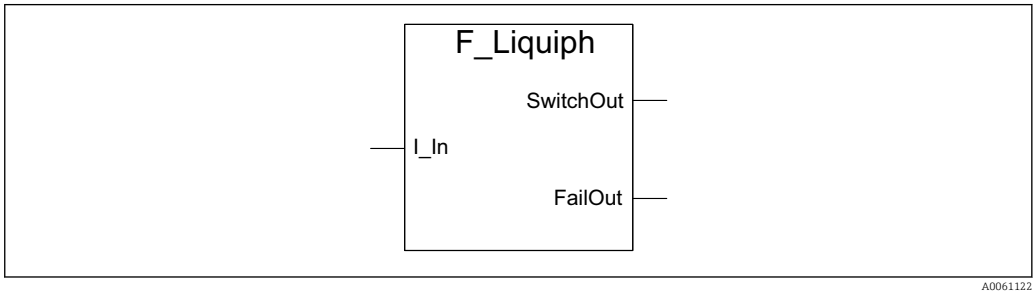
6.4 Post-connection check

- ❑ Is the device or cable undamaged (visual inspection)?
- ❑ Do the cables used comply with the requirements?
- ❑ Do the mounted cables have adequate strain relief?
- ❑ Are the cable glands mounted and firmly tightened?
- ❑ Does the supply voltage match the information on the nameplate?
- ❑ No reverse polarity, is terminal assignment correct?
- ❑ If supply voltage is present, is the green LED lit?
- ❑ Are all the housing covers installed and tightened?
- ❑ Optional: Is the cover tightened with securing screw?

7 System integration

7.1 Integrating the device into a PLC

The “F_Liquiph” function module has a current input (I_In), a switch output (SwitchOut), and a failure output (FailOut).



23 "F_Liquiph" function module

The function module is shown as an example for maximum detection. It is divided into 3 functional blocks for clarity:
- Error analysis
- LIVE signal analysis
- Switch output

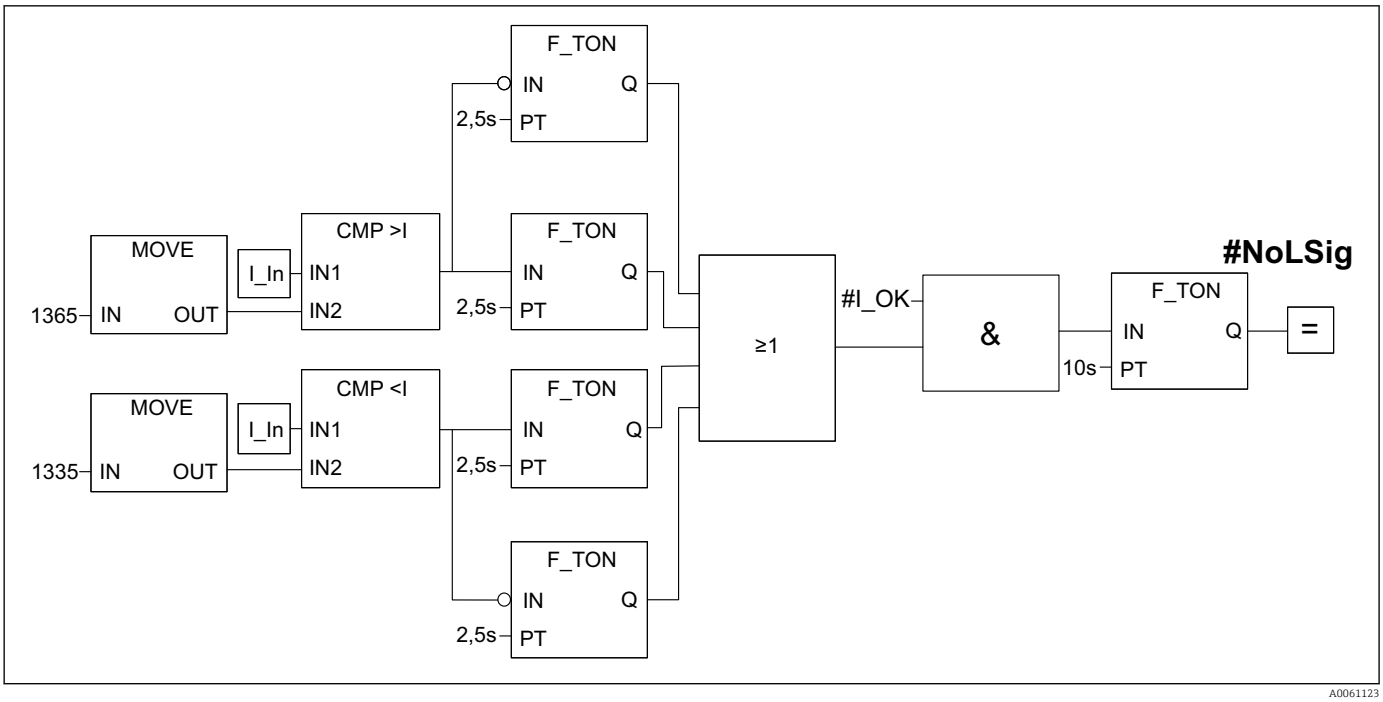
The "I-In" current input must be a standardized integer value of between 0 to 2 000 (0 to 20 mA, e.g. 12.5 mA ≙ 1 250).

The template to create a function module was developed and tested using the example of a Siemens PLC. To keep the response times of the overall system to a minimum, a period of 100 ms is recommended.

7.1.1 LIVE signal analysis

It is possible to analyze the LIVE signal (0.25 Hz frequency, ±0.5 mA amplitude) as an option.

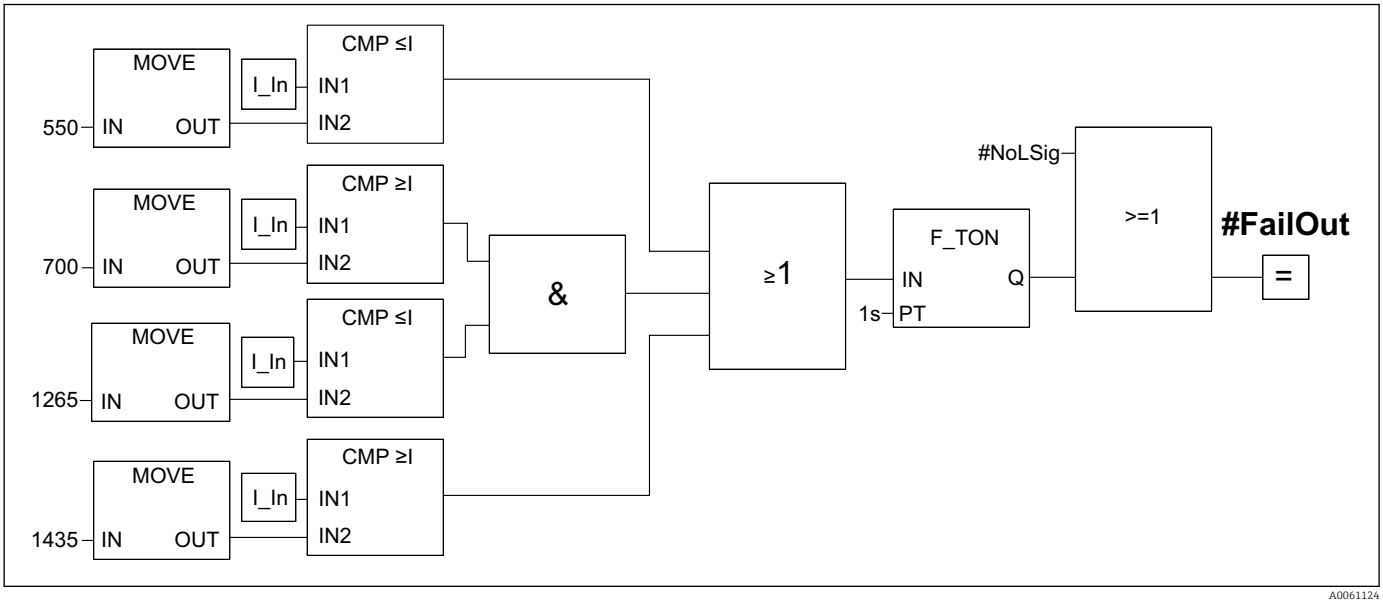
This function block monitors the dynamic signal which is sent by the device in the OK status. To make the system less sensitive to interference (e.g., EMC), a fault is only output if the device does not send a LIVE signal within 12 s.



24 Function block for LIVE signal analysis

7.1.2 Error current analysis

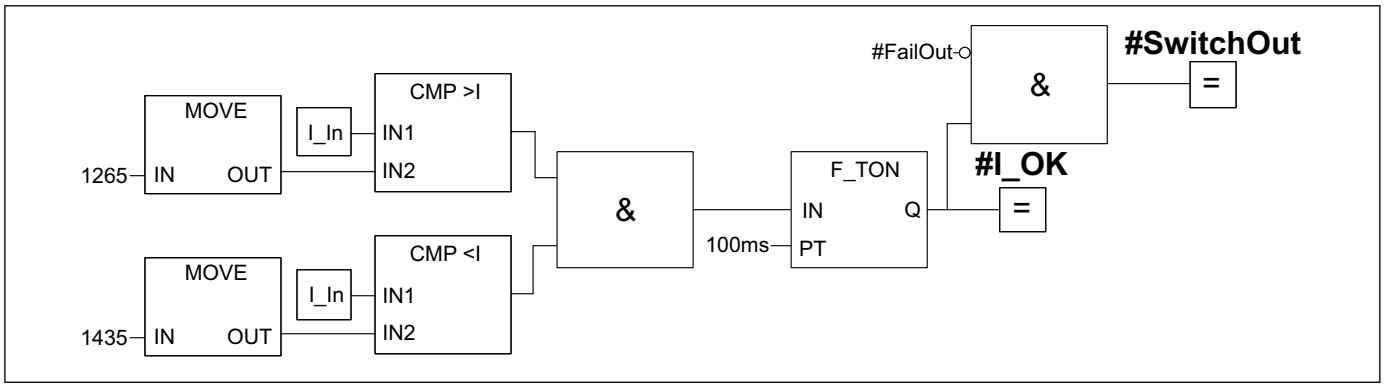
The invalid current ranges are monitored in this part of the function block. A fault is signaled if the device outputs an error current or if it is not configured correctly. A fault also affects the switch output. If the LIVE signal analysis function is not implemented, a logical "0" must be configured instead of "#NoLSig".



25 Function block, error current analysis

7.1.3 Switch output

The switch output is only "high" if a fault is not present and the current status is "OK".



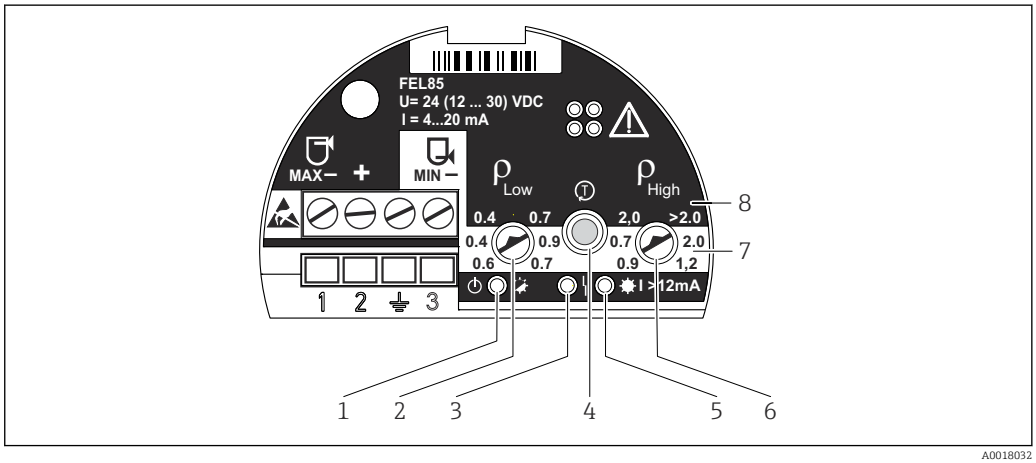
26 Function block, switch output

8 Operation options

8.1 Operation concept

- Operation with button and rotary switches on the electronic insert
- Configuration of minimum or maximum detection via connection wiring
- Density range adjustment via two rotary switches, confirmation via test button

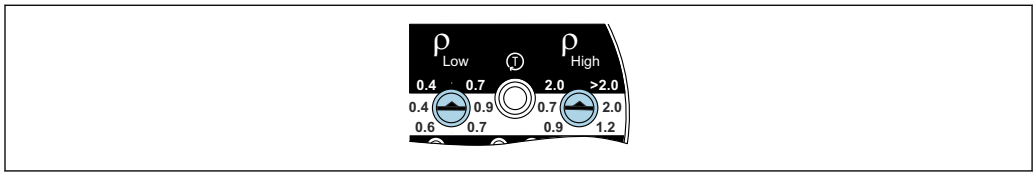
8.2 Elements on the electronic insert



1 Green LED, operation; initialization (lit), normal operation (flashes), fault (off or flashes alternately with red LED)
2 Density ρ_{Low} (rotary switch); Adjusts the lower density range limit
3 Red LED, fault; sensor error (lit permanently), operating error and electronic insert fault (flashing)
4 Test button; used to confirm configuration changes and activate proof testing
5 Yellow LED, current output; MAX (free) lit (13.5 mA), MIN (covered) lit (18.5 mA)
6 Density ρ_{High} (rotary switch); Adjusts the upper density range limit
7 MIN; white background indicates the adjustable density range in minimum detection mode
8 MAX; black background indicates the adjustable density range in maximum detection mode

9 Commissioning

- The minimum detection or maximum detection mode of operation is configured via the connection wiring.
- The device is not operational in its delivery state. The density range must be set for commissioning. Otherwise, the device starts with an error message.



27 *Invalid switch position of density range in the as-delivered state*

9.1 Post-installation and function check

Before commissioning the measuring point, check whether the post-installation and post-connection checks have been performed.

Post-mounting check

Post-connection check

9.2 Setting the density range

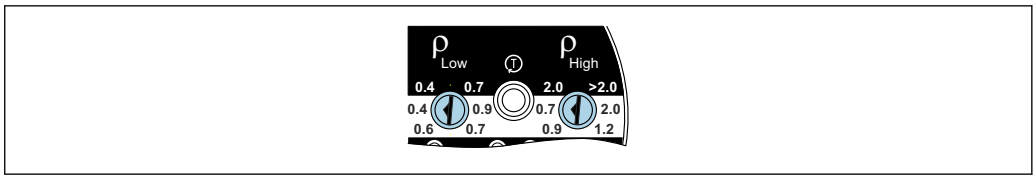
- The device switches to alarm condition during initial commissioning and after the density setting is changed. The output current is ≤ 3.6 mA and the red LED starts flashing. This status is changed by confirming the configuration.
- An incorrect choice of density range can result in an unsafe device status.
- If the density of the medium is outside the configured density range due to the process conditions, the device outputs an error current for safety reasons.

Setting the density:

1. Determine the density range of the medium under current process conditions. The density ranges that can be selected on the electronics are predefined according to typical media groups within the maximum permitted process parameters.
2. Set the ρ_{Low} and ρ_{High} rotary switches according to the density range. The tip of the left rotary switch must point towards the lower density value; the tip of the right rotary switch must point towards the upper density value.
   ↳ The density range is only valid if the rotary switches are aligned parallel to each other. The red LED and green LED flash alternately if a valid density range is not selected.
3. Press the test button on the device to confirm the configuration.

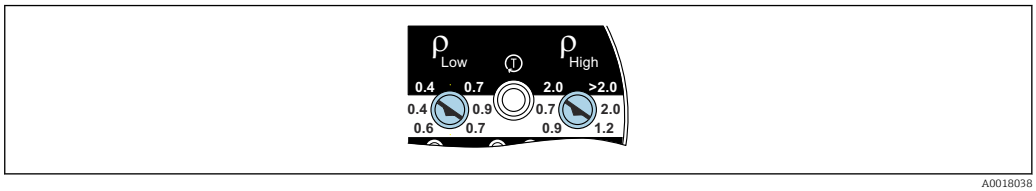
9.2.1 Density setting for minimum detection mode of operation

The white area on the electronic insert indicates the density setting for the minimum detection mode of operation.



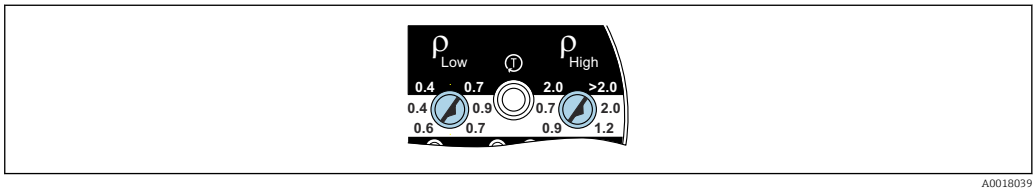
28 *Density setting for minimum detection for media such as liquefied gas*

ρ_{Low} *0.4 g/cm³ (25.0 lb/ft³)*
ρ_{High} *0.7 g/cm³ (43.7 lb/ft³)*



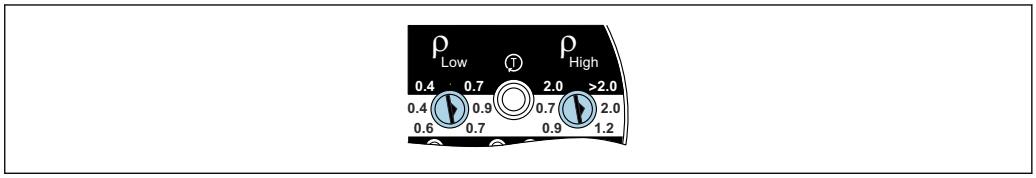
29 *Density setting for minimum detection for media such as alcohol*

ρ_{Low} *0.6 g/cm³ (37.5 lb/ft³)*
ρ_{High} *0.9 g/cm³ (56.2 lb/ft³)*



30 *Density setting for minimum detection for aqueous solutions*

ρ_{Low} *0.7 g/cm³ (43.7 lb/ft³)*
ρ_{High} *1.2 g/cm³ (74.9 lb/ft³)*

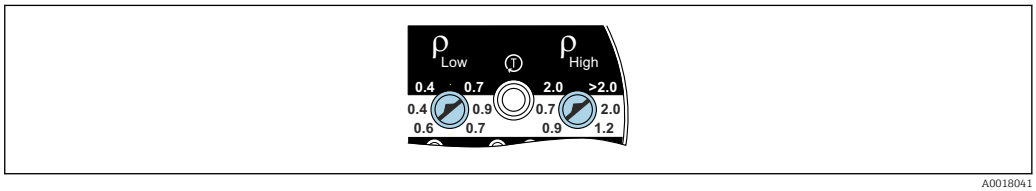


31 *Density setting for minimum detection for media such as acid*

ρ_{Low} *0.9 g/cm³ (56.2 lb/ft³)*
ρ_{High} *2.0 g/cm³ (124.9 lb/ft³)*

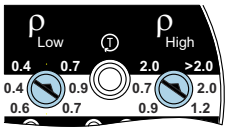
9.2.2 Density setting for maximum detection mode of operation

The black area on the electronic insert indicates the density setting for the maximum detection mode of operation.



32 *Density setting for maximum detection for media such as liquefied gas*

ρ_{Low} *0.4 g/cm³ (25.0 lb/ft³)*
ρ_{High} *2.0 g/cm³ (124.9 lb/ft³)*



A0018042

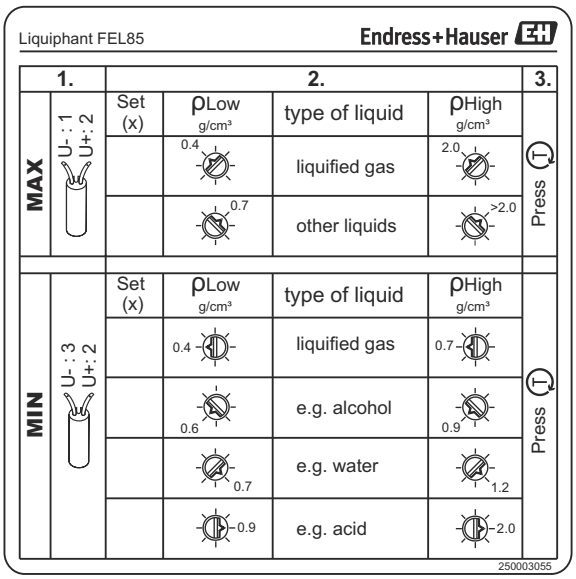
33 *Density setting for maximum detection of other liquids*

ρ_{Low} *0.7 g/cm³ (43.7 lb/ft³)*
ρ_{High} *> 2.0 g/cm³ (124.9 lb/ft³)*

9.2.3 Sensor pass

The sensor pass is a plug-in card located inside the device housing.

1. Mark the selected density range on the sensor pass.
2. Store the sensor pass inside the housing.



A0018034

34 *Figure: sensor pass*

9.3 Confirming configuration

Configuration confirmation is required. It can be performed in two ways:
- Press the test button on the device
- Disconnect the device from the supply voltage (restart)

If the red LED continues to flash 3 seconds after confirming the configuration, see the "Diagnostics and troubleshooting" section.

9.4 Proof testing

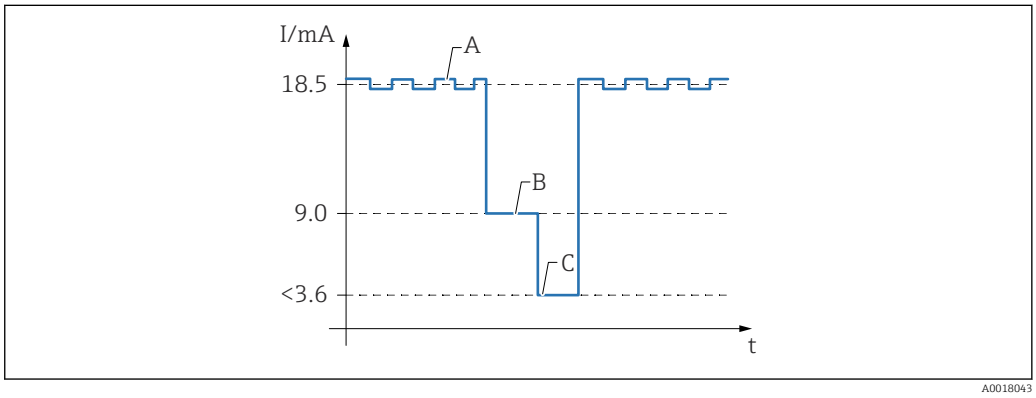
- Only start the function test in the OK status
- For applications involved in safety-related operation, refer to the Functional Safety Manual

The test button can be used to simulate the demand current. The output is set so that the currents 6 mA (demand for maximum detection) or 9 mA (demand for minimum detection) are displayed.

Carry out the proof test:

1. Press the test button
   ↳ A limit alarm is triggered (Maximum detection = 6 mA or Minimum detection = 9 mA)
2. Release the test button
   ↳ System restarts with ≤ 3.6 mA, followed by normal operation

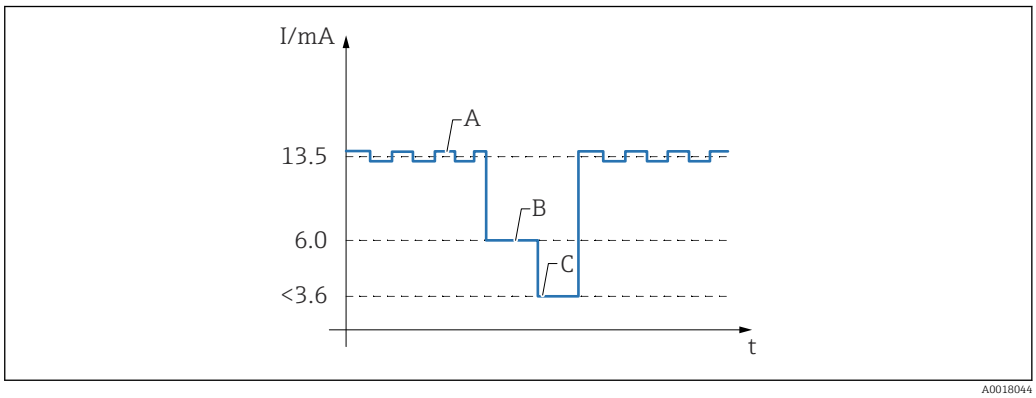
9.4.1 Proof testing procedure for minimum detection



35 *Proof testing procedure for minimum detection*

A OK status (sensor covered)
B Pressing the test button triggers simulation of demand mode (sensor uncovered)
C Releasing the test button causes the system to restart with ≤ 3.6 mA

9.4.2 Proof testing procedure for minimum detection



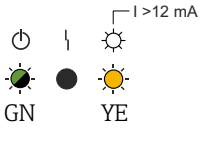
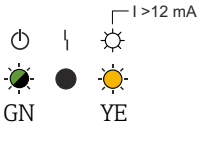
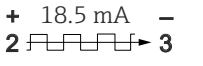
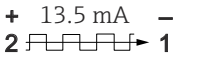
36 *Proof testing procedure for maximum detection*

A OK status (sensor uncovered)
B Pressing the test button triggers simulation of demand mode (sensor covered)
C Releasing the test button causes the system to restart with ≤ 3.6 mA

9.5 Switching on the device

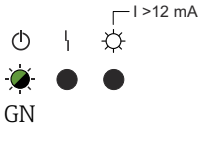
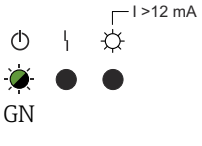
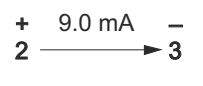
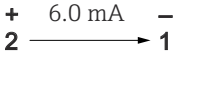
When the power connection is switched on, the output is in a fault signal state. The device is ready for operation after a maximum of 4 s.

9.5.1 Behavior of switch output and signaling in OK status

MIN	MAX
	
37 *LED signaling* ☼= on ●= off ☼ = flashes	38 *LED signaling* ☼= on ●= off ☼ = flashes
	
39 *Output signal*	40 *Output signal*

A permanent LIVE signal (frequency 0.25 Hz, amplitude ±0.5 mA) is superimposed on the output signal in the OK status.

9.5.2 Behavior of the switch output and signaling in demand mode

MIN	MAX
	
41 *LED signaling* ●= off ☼ = flashes	42 *LED signaling* ●= off ☼ = flashes
	
43 *Output signal*	44 *Output signal*

10 Diagnostics and troubleshooting

In the event of an error, the output current I is < 3.6 mA (error current in accordance with NAMUR NE43).

10.1 Diagnostics information via LED

No LED is lit

- Possible causes:
  - No power supply
  - Incorrectly wired
  - Device is defective
- Measures:
  - Check power supply
  - Check the wiring
  - Replace the electronic insert

Red LED continuously lit
- Possible causes:
  - Sensor error
  - Corrosion
- Measures:
  - Restart the electronics
  - Replace the device

Red LED flashes and green LED does not light up
- Possible causes:
  Electronics error
- Measures:
  - Restart the electronics
  - Replace the electronics

Red LED and green LED flash alternately
- Possible causes:
  - (1) Configuration not confirmed after the density range has been changed
  - (2) Density range setting does not match connection coding (minimum or maximum detection)
  - (3) The medium density is higher than the set density range for minimum detection
  - (4) The density range setting (ρ_{Low} and ρ_{High}) is incorrect, i.e. the rotary switches are not parallel to one another
  - (5) Density range is not selected, i.e. the rotary switches are in a vertical upwards position (as-delivered state)
  - (6) The vibrating fork is blocked in the minimum detection mode of operation
- Measures:
  - (1) Confirm the configuration
  - (2) Match the connection coding with the density range (black area on the electronic insert for maximum detection and white area on the electronic insert for minimum detection)
  - (3) Adjust the density range
  - (4) Correct the density range setting
  - (5) Set the density range
  - (6) Ensure that the vibrating fork is freely vibrating

11 Maintenance

11.1 Maintenance tasks

No specific maintenance work is required.

11.1.1 Cleaning

Cleaning of surfaces not in contact with the medium

- Recommendation: Use a lint-free cloth that is either dry or slightly dampened using water.
- Do not use any sharp objects or aggressive cleaning agents that corrode the surfaces (displays, housing, for example) and seals.
- Do not use high-pressure steam.
- Observe the degree of protection of the device.

The cleaning agent used must be compatible with the materials of the device configuration. Do not use cleaning agents with concentrated mineral acids, bases or organic solvents.

Cleaning of surfaces in contact with the medium

Note the following for cleaning and sterilization in place (CIP/SIP):
- Use only cleaning agents to which the materials in contact with the medium are sufficiently resistant.
- Observe the permitted maximum medium temperature.

Cleaning the vibrating fork

It is not permitted to use the device with abrasive media. Material abrasion on the vibrating fork can result in the device malfunctioning.

- Clean the vibrating fork as necessary
- Cleaning is also possible in the installed state, e.g. CIP Cleaning in Place and SIP Sterilization in Place

12 Repair

12.1 General information

12.1.1 Repair concept

- The devices have a modular design.
- All repairs to the devices must be carried out by the manufacturer only. Otherwise the safety instrumented functions can no longer be guaranteed.
- The cover, cover seal, cable gland and electronic insert may be replaced by trained, specialist personnel on the customer side.
  - Use original spare parts.
  - Follow the relevant installation instructions.
  - Send in replaced components to the manufacturer for fault analysis. Enclose a "Declaration of Hazardous Material and Decontamination" with the note "Used as SIL device in safety instrumented system".
  - Always perform a new proof test if one of the components mentioned has been replaced on a device operating in SIL-certified areas.

For more information on service and spare parts, please contact your Endress+Hauser sales representative.

12.1.2 Repairs to Ex-approved devices

⚠ WARNING

Incorrect repair can compromise electrical safety!

Explosion hazard!

- ▶ Only specialist personnel or the manufacturer's service team may carry out repairs on Ex-certified devices in accordance with national regulations.
- ▶ Relevant standards and national regulations on hazardous areas, safety instructions and certificates must be observed.
- ▶ Only use original spare parts from the manufacturer.
- ▶ Please note the device designation on the nameplate. Only identical parts may be used as replacements.
- ▶ Carry out repairs according to the instructions.
- ▶ Only the manufacturer's service team is permitted to modify a certified device and convert it to another certified version.

12.1.3 Replacing the electronic insert

Full commissioning, including proof testing, are required after replacing the electronic insert.

12.2 Spare parts

Product spare parts that are currently available can be found online at:
www.endress.com/onlinetools

12.3 Return

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the web page for information: https://www.endress.com
2. If returning the device, pack the device in such a way that it is reliably protected against impact and external influences. The original packaging provides the best protection.

12.4 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.

13 Accessories

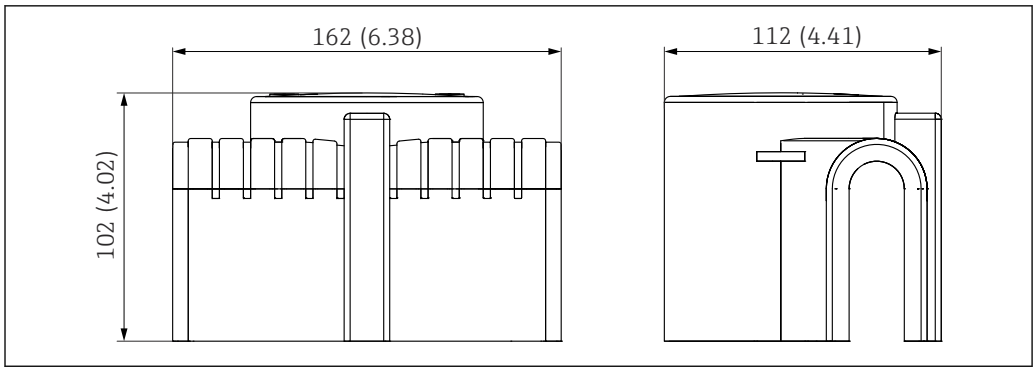
The accessories currently available for the product can be selected at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Spare parts & Accessories**.

13.1 Weather protection cover PA6 (aluminum housing (F13, F17) and 316L (F27))

The weather protection cover can be ordered together with the device via the "Accessory enclosed" product structure.

It is used to protect against direct sunlight, precipitation and ice.

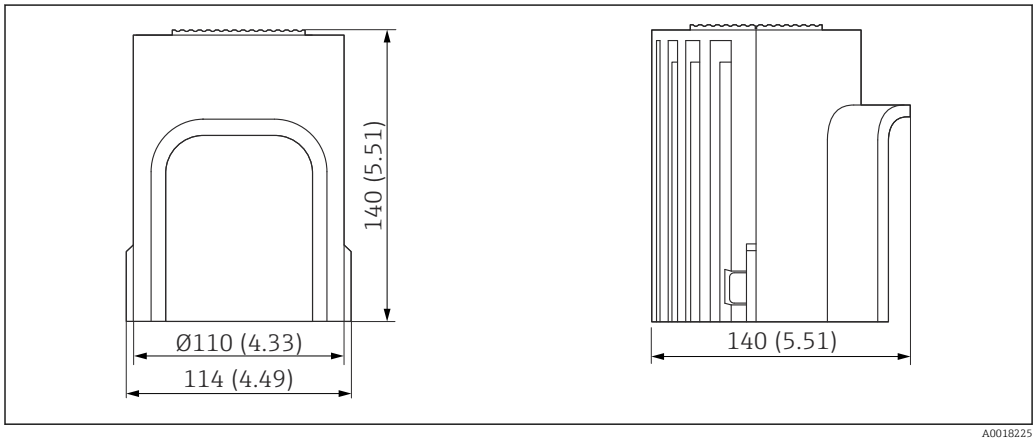


45 Dimensions of weather protection cover PA6. Unit of measurement mm (in)

- Order No. 71040497
- Material: PA6, gray
- Weight: 0.3 kg (0.66 lb)

13.2 Weather protection cover PBT (plastic housing (F16))

The weather protection cover is used to protect against direct sunlight, precipitation and ice.

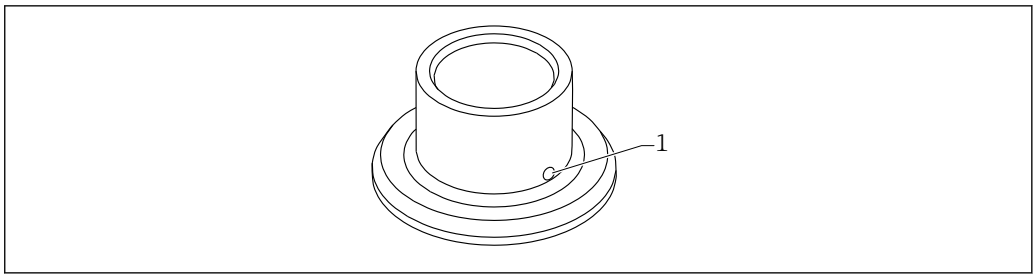


46 Dimensions of weather protection cover PBT. Unit of measurement mm (in)

- Order No. 71127760
- Material: PBT, gray
- Weight: 0.24 kg (0.53 lb)

13.3 Weld-in adapter

Various weld-in adapters are available for installation in vessels or pipes. The adapters are optionally available with inspection certificate 3.1 EN 10204.



47 *Weld-in adapter (sample view)*

1 Leakage hole

Weld in the weld-in adapter in such a way that the leakage hole is pointing downwards. This enables any leaks to be detected quickly.

- G 1, Ø53 mounting on the pipe
- G 1, Ø60 flush mount on the vessel
- G ¾, Ø55 flush mount
- G 1 sensor adjustable

For detailed information, see "Technical Information" TI00426F (Weld-in adapters, process adapters and flanges)

Available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads).

13.4 M12 socket

The M12 sockets listed are suitable for use in the temperature range −25 to +70 °C (−13 to +158 °F).

M12 socket IP69
- Terminated at one end
- Angled
- 5 m (16 ft) PVC cable (orange)
- Slotted nut 316L (1.4435)
- Body: PVC
- Order number: 52024216

M12 socket IP67
- Angled
- 5 m (16 ft) PVC cable (gray)
- Slotted nut Cu Sn/Ni
- Body: PUR
- Order number: 52010285

14 Technical data

14.1 Input

14.1.1 Measured variable

The point level signal is triggered according to the operating mode (minimum or maximum detection) when the level exceeds or falls below the relevant point level.

14.1.2 Measuring range

Depends on installation point

Sensor length: compact version up to max. 80 mm (3.15 in)

14.2 Output

14.2.1 Output signal

Electronic insert FEL85

2-wire 4-20 mA
- For connecting to the separate Nivotester FailSafe FTL825 switching unit, a programmable logic controller (PLC), a safety-related PLC or 4-20 mA AI modules in accordance with EN 61131-2
- Output signal jump from high to low current when the point level is reached:
  - Minimum detection: from 18.5 mA to 9.0 mA
  - Maximum detection: from 13.5 mA to 6.0 mA
- A permanent LIVE signal (0.25 Hz, ±0.5 mA amplitude) is superimposed on the output signal in the OK status.

14.2.2 Signal on alarm

Error current in accordance with NAMUR NE43
Output current < 3.6 mA in the following cases:
- Function check: End proof test
- Out of specification: Correct density setting
- Maintenance required: Clean sensor
- Failure: Replace electronic insert
- Failure: Replace device

14.2.3 Load

R = (U - 12 V / 22 mA)

U = Supply voltage range: DC 12 to 30 V

14.2.4 Ex connection data

See safety instructions (XA): All data relating to explosion protection are provided in separate Ex documentation and are available from the Downloads area of the Endress+Hauser website. The Ex documentation is supplied as standard with all devices approved for use in explosion hazardous areas.

14.2.5 Galvanic isolation

Provide between the sensor and the power supply

14.2.6 Switch output

Switching delay time

The switching delay time is:
- Approx. 0.5 s ± 0.2 s when vibrating fork is covered
- Approx. 1.0 s ± 0.2 s when vibrating fork is free
- Dwell time: at least 0.3 s

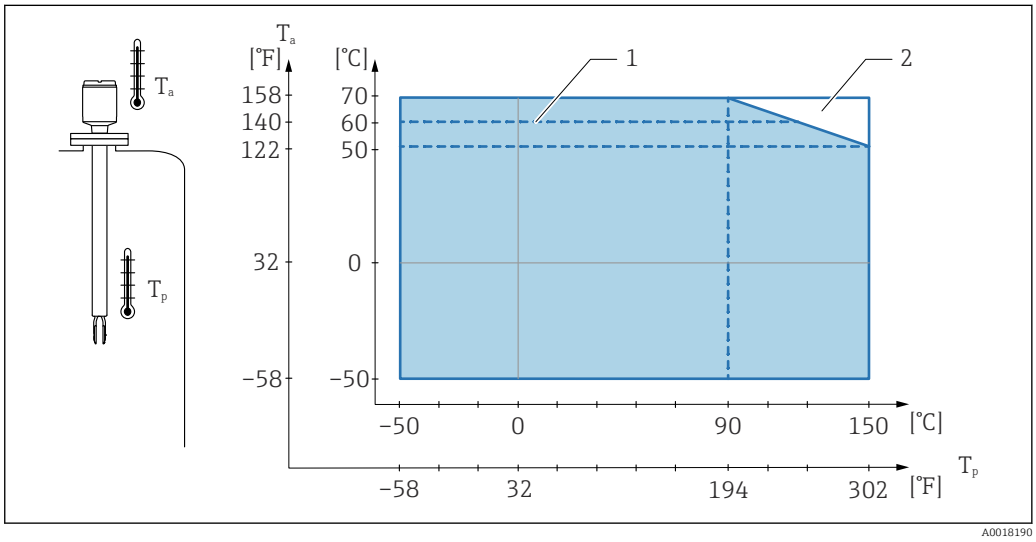
14.3 Environment

14.3.1 Ambient temperature range

−40 to 70 °C (−40 to 158 °F)

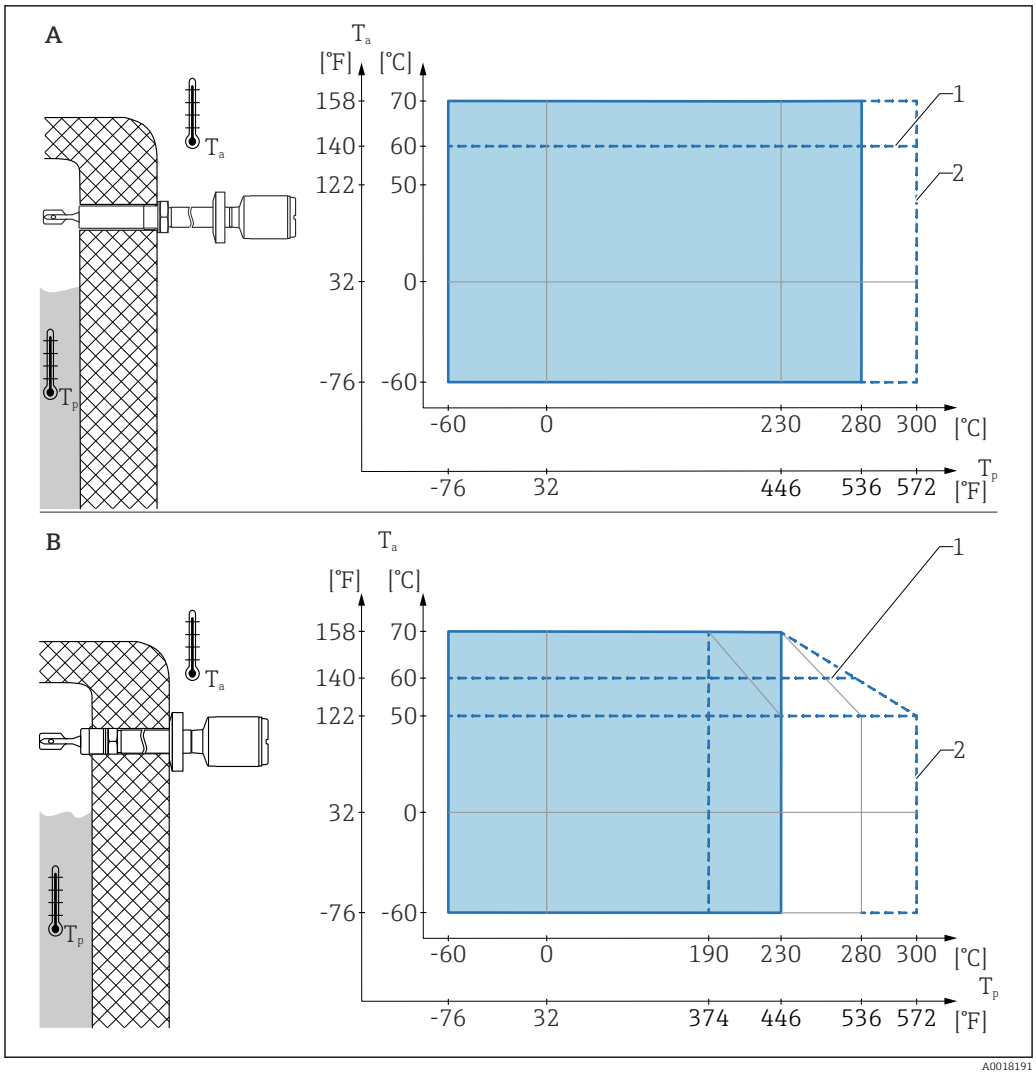
Optionally available to order:
- −50 °C (−58 °F) with restricted operating life and performance
- −60 °C (−76 °F) for devices with a process temperature up to 230 °C (446 °F)/ 280 °C (536 °F) with restricted operating life and performance

Below −50 °C (−58 °F): Devices can be permanently damaged



48 *Permitted ambient temperature T_a at the housing as a function of the process temperature T_p in the vessel; maximum process temperature 150 °C (302 °F)*

1 *Maximum ambient temperature in hazardous area (T6) and intrinsically safe power supply*
2 *Additional usable temperature range for devices with temperature spacer or pressure-tight feedthrough*



49 *Permitted ambient temperature T_a at the housing as a function of the process temperature T_p in the vessel; maximum process temperature 230 °C (446 °F) or 280 °C (536 °F)*

A Temperature spacer inside insulation
B Temperature spacer outside insulation
1 Maximum ambient temperature in hazardous area (T6) and intrinsically safe power supply
2 Maximum 50 h on cumulative basis

Outdoor operation in strong sunlight:
- Mount the device in a shaded location
- Avoid direct sunlight, particularly in warmer climatic regions
- Use a protective cover, which can be ordered as an accessory

14.3.2 Storage temperature

−50 to 80 °C (−58 to 176 °F)

14.3.3 Humidity

Operation up to 100 %. Do not open in a condensing atmosphere.

14.3.4 Operating height

As per IEC 61010-1 Ed.3:
Up to 2 000 m (6 500 ft) above sea level

14.3.5 Climate class

As per IEC 60068-2-38 test Z/AD

14.3.6 Degree of protection

Tested in accordance with EN 60529 and NEMA 250

Housing
- Plastic (F16):
  IP66/67/NEMA Type 4X enclosure
- 316L, hygienic (F15):
  IP66/67/NEMA Type 4X enclosure
- 316L (F27):
  IP66/68/NEMA Type 4X/6P enclosure
- Aluminum (F17):
  IP66/67/NEMA Type 4X enclosure
- Aluminum (F13):
  IP66/68/NEMA Type 4X/6P enclosure
- Aluminum (T13) with separate terminal compartment (Ex d):
  IP66/68/NEMA Type 4X/6P enclosure

14.3.7 Vibration resistance

As per IEC 60068-2-64, load class 1 $(m/s^2)^2/Hz$, 3 x 100 minutes

14.3.8 Pollution degree

Pollution degree 2

14.3.9 Electromagnetic compatibility (EMC)

- Electromagnetic compatibility as per EN 61326 series and NAMUR recommendation EMC (NE21)
- 1 % span ≤ 160 µA

For more details, refer to the EU Declaration of Conformity.

14.4 Process

14.4.1 Process temperature range

- −50 to 150 °C (−58 to 302 °F)
- −60 to 280 °C (−76 to 536 °F)/to 300 °C (572 °F) for max. 50 h on cumulative basis

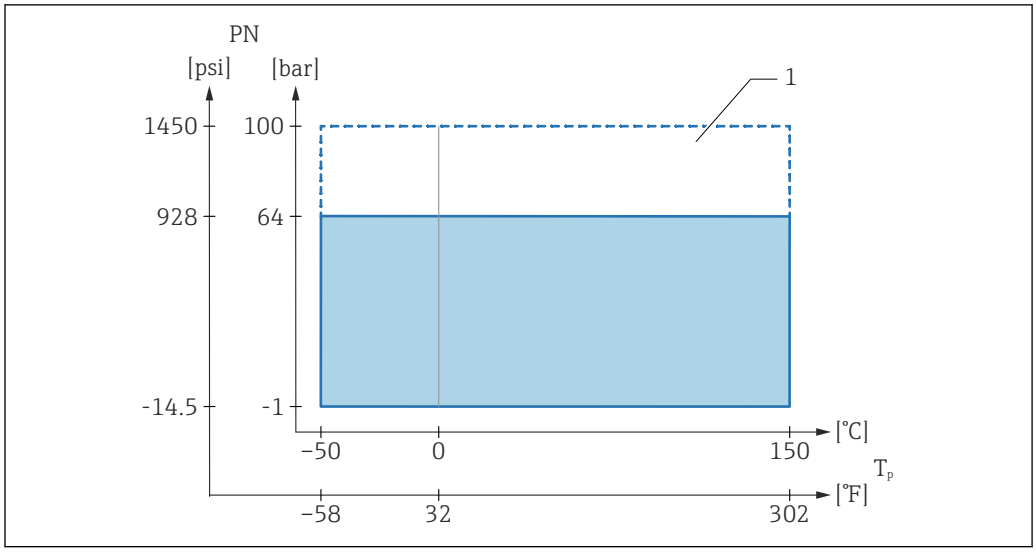
Pay attention to pressure and temperature dependencies.

Liquid gas application:
−50 to 60 °C (−58 to 140 °F)

14.4.2 Thermal shock

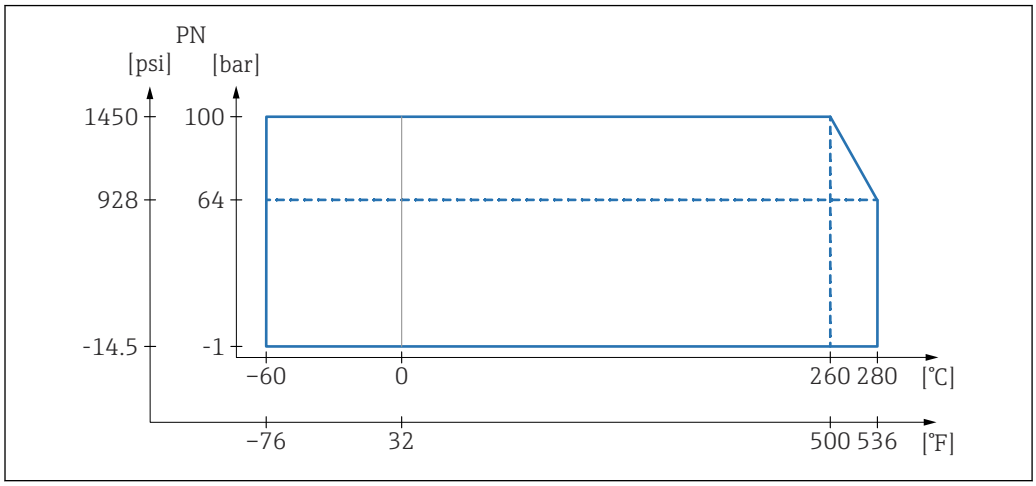
≤ 120 K/s

14.4.3 Process pressure range



50 *Process pressure range at process temperature T_p to 150 °C (300 °F)*

1 *Permitted pressure rating for version with option 100 bar (1450 psi)*



51 *Process pressure range for high-temperature version with 230 °C (450 °F)/280 °C (540 °F)*

The maximum pressure for the device depends on the lowest-rated element with regard to pressure.

Components are: process connection, optional mounting parts, or accessories.

⚠ WARNING

Incorrect design or use of the device may lead to bursting parts!
This may result in severe, possibly irreversible injury to persons and environmental hazards.

- ▶ Only operate the device within the specified limits for the components!
- ▶ MWP (maximum working pressure): The maximum working pressure is specified on the nameplate. This value refers to a reference temperature of +20 °C (+68 °F) and may be applied to the device for an unlimited time. Observe the temperature dependency of the maximum working pressure. For higher temperatures, refer to the following standards for the permitted pressure values for flanges:EN 1092-1 (materials 1.4435 and 1.4404 are identical with regard to their stability/temperature property and are grouped together in under 13E0 in EN 1092-1 Tab. 18; the chemical composition of the two materials can be identical), ASME B 16.5a, JIS B 2220 (the latest version of the standard applies in each case).
- ▶ The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PS". The abbreviation "PS" corresponds to the maximum working pressure of the device.
- ▶ MWP data that deviate from this are provided in the relevant sections of the Technical Information.

14.4.4 Test pressure

Process pressure P_N = 64 bar (928 psi)

- Test pressure = 100 bar (1 450 psi) = $1.5 \cdot P_N$
- Burst pressure > 200 bar (2 900 psi)

Process pressure P_N = 100 bar (1 450 psi)

- Test pressure = 150 bar (2 175 psi) = $1.5 \cdot P_N$
- Burst pressure > 400 bar (5 800 psi)

The device function is limited during the pressure test.

Mechanical integrity is guaranteed up to 1.5 times the process nominal pressure PN.

14.4.5 Medium density

Set the density at the two rotary switches ("Low" density and "High" density).

Only the density setting combinations indicated below are permitted.

Maximum detection

- Combination 1: Liquid gas
  - Density ρ_{Low}: 0.4 g/cm³ (25.0 lb/ft³)
  - Density ρ_{High}: 2.0 g/cm³ (124.9 lb/ft³)
- Combination 2: Other liquids
  - Density ρ_{Low}: 0.7 g/cm³ (43.7 lb/ft³)
  - Density ρ_{High}: >2.0 g/cm³ (124.9 lb/ft³)

Minimum detection

- Combination 1: Liquid gas
  - Density ρ_{Low}: 0.4 g/cm³ (25.0 lb/ft³)
  - Density ρ_{High}: 0.7 g/cm³ (43.7 lb/ft³)
- Combination 2, e.g. alcohol
  - Density ρ_{Low}: 0.6 g/cm³ (37.5 lb/ft³)
  - Density ρ_{High}: 0.9 g/cm³ (56.2 lb/ft³)
- Combination 3, e.g. water
  - Density ρ_{Low}: 0.7 g/cm³ (43.7 lb/ft³)
  - Density ρ_{High}: 1.2 g/cm³ (74.9 lb/ft³)
- Combination 4, e.g. acid
  - Density ρ_{Low}: 0.9 g/cm³ (56.2 lb/ft³)
  - Density ρ_{High}: 2.0 g/cm³ (124.9 lb/ft³)

14.4.6 Viscosity

- Maximum detection: ≤ 10 000 mPa·s
- Minimum detection: ≤ 350 mPa·s
- Minimum detection, high temperature (230 °C (450 °F)/280 °C (536 °F)): ≤ 100 mPa·s

14.4.7 Pressure tightness

Up to vacuum

In vacuum evaporation plants, select the 0.4 g/cm³ (25.0 lb/ft³)/ density setting.

14.4.8 Solids contents

Ø ≤ 5 mm (0.2 in)

14.5 Additional technical data

Current Technical Information: Endress+Hauser website: www.endress.com → Downloads.

www.addresses.endress.com

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