

Operating Instructions

Liquiphant FTL41

Vibronic

Point level switch for liquids



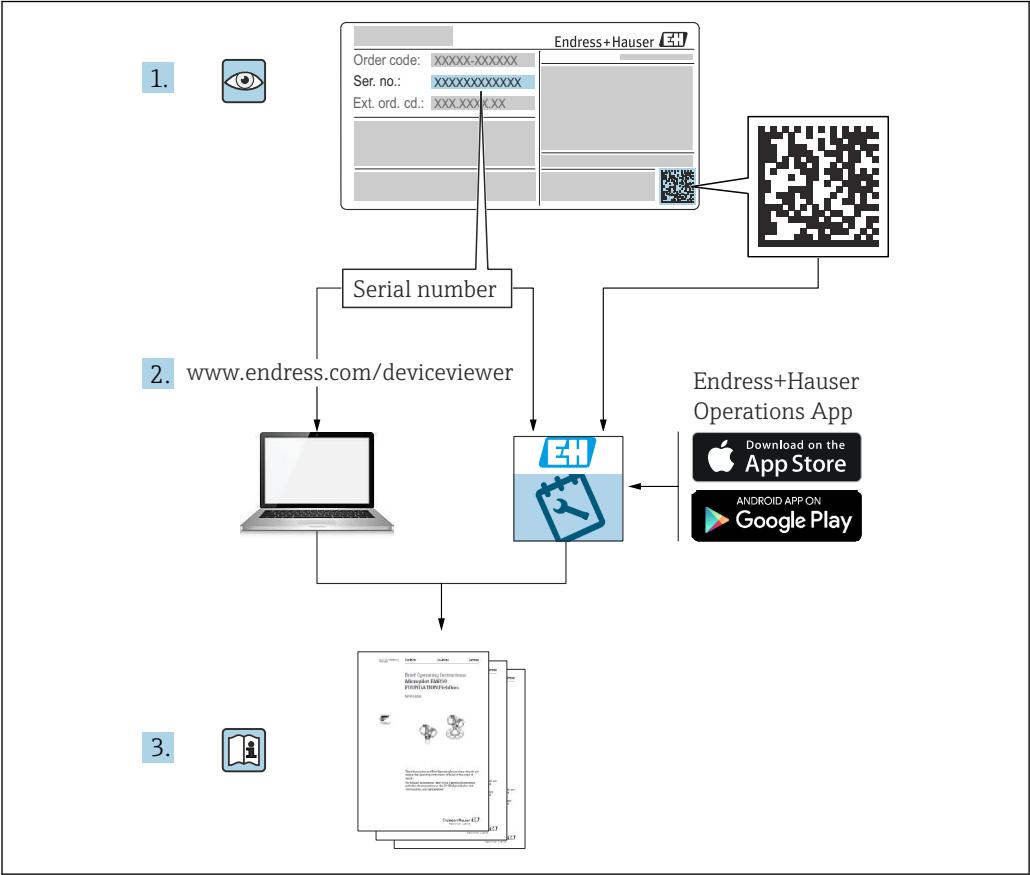


Table of contents

1	About this document	5	6.3	Connecting the device	17
1.1	Purpose of this document	5	6.3.1	3-wire DC-PNP (electronic insert FEL42)	17
1.2	Symbols	5	6.3.2	Universal current connection with relay output (electronic insert FEL44)	19
1.2.1	Safety symbols	5	6.3.3	2-wire NAMUR > 2.2 mA/< 1.0 mA (electronic insert FEL48)	21
1.2.2	Electrical symbols	5	6.3.4	Connecting the cables	22
1.2.3	Tool symbols	5	6.4	Post-connection check	23
1.2.4	Symbols for certain types of information	5			
1.2.5	Symbols in graphics	6			
2	Basic safety instructions	6	7	Operation options	23
2.1	Requirements for the personnel	6	7.1	Overview of operation options	23
2.2	Intended use	6	7.1.1	Operation concept	23
2.2.1	Incorrect use	6	7.1.2	Elements on the electronic insert	23
2.3	Workplace safety	7			
2.4	Operational safety	7	8	Commissioning	24
2.5	Product safety	7	8.1	Function check	24
3	Product description	7	8.2	Switching on the device	24
3.1	Product design	8	8.3	Further information	24
4	Incoming acceptance and product identification	8	9	Diagnostics and troubleshooting	24
4.1	Incoming acceptance	8	9.1	LED on electronic insert	24
4.2	Product identification	8	9.2	Firmware history	24
4.2.1	Nameplate	9	10	Maintenance	25
4.2.2	Electronic insert	9	10.1	Maintenance tasks	25
4.2.3	Manufacturer address	9	10.1.1	Cleaning	25
4.3	Storage and transport	9	11	Repair	25
4.3.1	Storage conditions	9	11.1	General notes	25
4.3.2	Transporting the device	9	11.1.1	Repair concept	25
5	Mounting	10	11.1.2	Repairs to Ex-approved devices	25
5.1	Mounting requirements	10	11.2	Spare parts	25
5.1.1	Take switch point into consideration	10	11.3	Return	26
5.1.2	Take viscosity into consideration	11	11.4	Disposal	26
5.1.3	Avoid buildup	11	12	Accessories	26
5.1.4	Take clearance into consideration	12	12.1	Protective cover for single compartment housing, aluminum or 316L	26
5.1.5	Support the device	12	12.2	M12 socket	26
5.1.6	Weld-in adapter with leakage hole	13	12.3	Sliding sleeves for unpressurized operation	27
5.2	Mounting the device	13	12.4	High pressure sliding sleeves	28
5.2.1	Required tool	13	12.5	Weld-in adapter	29
5.2.2	Installation	13	13	Technical data	30
5.3	Sliding sleeves	15	13.1	Input	30
5.4	Post-mounting check	15	13.1.1	Measured variable	30
6	Electrical connection	16	13.1.2	Measuring range	30
6.1	Required tool	16	13.2	Output	30
6.2	Connecting requirements	16	13.2.1	Output and input variants	30
6.2.1	Cover with securing screw	16			
6.2.2	Connecting protective earth (PE)	16			

13.2.2	Output signal	30
13.2.3	Ex connection data	30
13.3	Environment	31
13.3.1	Ambient temperature range	31
13.3.2	Storage temperature	31
13.3.3	Humidity	31
13.3.4	Operating altitude	31
13.3.5	Climate class	32
13.3.6	Degree of protection	32
13.3.7	Vibration resistance	32
13.3.8	Shock resistance	32
13.3.9	Mechanical load	32
13.3.10	Pollution degree	32
13.3.11	Electromagnetic compatibility (EMC)	32
13.4	Process	33
13.4.1	Process temperature range	33
13.4.2	Thermal shock	33
13.4.3	Process pressure range	33
13.4.4	Overpressure limit	34
13.4.5	Density	34
13.4.6	Viscosity	34
13.4.7	Pressure tightness	34
13.4.8	Solids contents	34
13.5	Additional technical data	34

1 About this document

1.1 Purpose of this document

These Operating Instructions contain all the information that is required in the various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, 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 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

This symbol contains information on procedures and other facts which do not result in personal injury.

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)



2 Basic safety instructions

2.1 Requirements for the personnel

The personnel must fulfill the following requirements to carry out the necessary tasks, e. g., commissioning and maintenance:

- ▶ Trained, qualified specialists must have a relevant qualification for the specific function and task
- ▶ Are authorized by the plant owner/operator
- ▶ Are familiar with federal/national regulations
- ▶ Must have read and understood the instructions in the manual and supplementary documentation
- ▶ Follow instructions and comply with conditions

2.2 Intended use

- Only use the device for liquids
- Improper use can pose hazards
- Ensure that the measuring device is free of defects while it is in operation
- Use the device only for media to which the wetted materials have an adequate level of resistance
- Do not exceed or drop below the relevant limit values for the device
 -  For more details, see the "Technical data" section
 -  See the Technical Documentation

2.2.1 Incorrect use

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

Residual risks

Due to heat transfer from the process, the temperature of the electronics housing and the assemblies contained therein may rise to 80 °C (176 °F) during operation.

Danger of burns from contact with surfaces!

- ▶ If necessary, ensure protection against contact to prevent burns.

For requirements concerning functional safety in accordance with IEC 61508, the associated SIL documentation must be observed.

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

Risk of injury!

- ▶ Operate the device only if it is in proper technical condition, free from errors and faults.
- ▶ The operator is responsible for ensuring the interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers.

- ▶ If, despite this, modifications are required, consult with 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 whether the ordered device can be used for the intended purpose in the hazardous area.
- ▶ Observe the specifications in the separate supplementary documentation that is an integral part of this manual.

2.5 Product safety

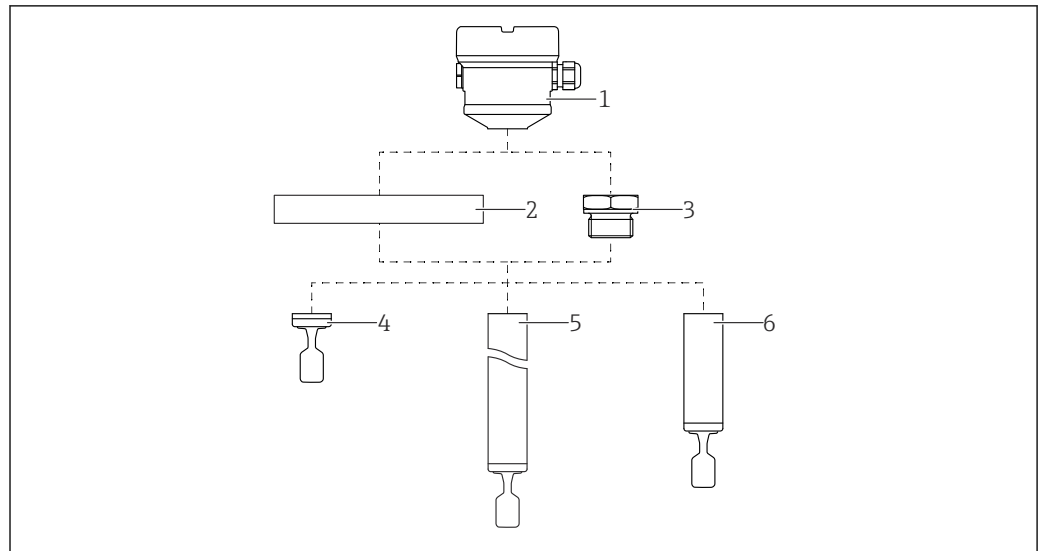
This device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate.

It meets the general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the device.

3 Product description

Point level switch for all liquids, for minimum or maximum detection in tanks, vessels and pipes.

3.1 Product design



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1 Product design

- 1 Housing with electronic insert and cover
- 2 Process connection flange (optional)
- 3 Process connection (optional)
- 4 Compact probe version with tuning fork
- 5 Pipe extension probe with tuning fork
- 6 Short tube version of probe with tuning fork

4 Incoming acceptance and product identification

4.1 Incoming acceptance

Check the following during incoming acceptance:

- ☐ Are the order codes on the delivery note and the product sticker identical?
- ☐ Are the goods undamaged?
- ☐ Do the data on the nameplate match the ordering information on the delivery note?
- ☐ If required (see nameplate): are the Safety Instructions e.g. XA provided?



If one of these conditions is not met, please contact the manufacturer's sales office.

4.2 Product identification

The device can be identified in the following ways:

- Nameplate specifications
- Extended order code with breakdown of the device features on the delivery note
- Enter serial number from nameplates in *W@M Device Viewer* www.endress.com/deviceviewer. All of the information on the measuring device is displayed along with an overview of the scope of technical documentation provided.
- Enter the serial number on the nameplate into the *Endress+Hauser Operations app* or scan the 2-D matrix code on the nameplate with the Endress+Hauser Operations app

4.2.1 Nameplate

The information that is required by law and is relevant to the device is shown on the nameplate, e.g.:

- Manufacturer identification
- Order number, extended order code, serial number
- Technical data, degree of protection
- Firmware version, hardware version
- Approval-related information, reference to Safety Instructions (XA)
- DataMatrix code (information about the device)

4.2.2 Electronic insert

 Identify the electronic insert via the order code on the nameplate.

4.2.3 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

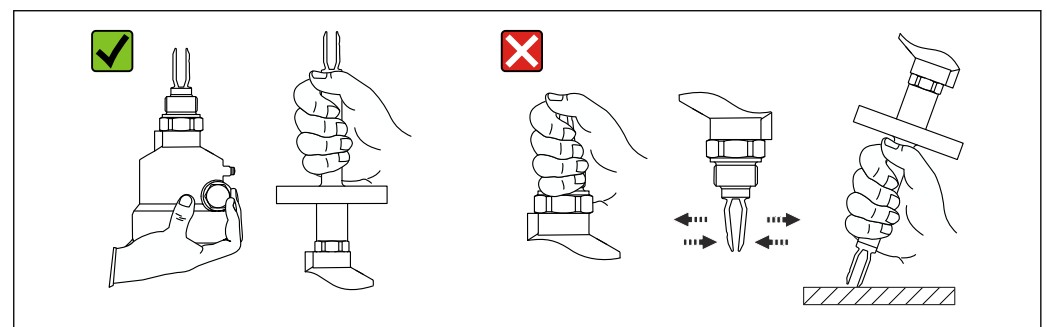
Use original packaging.

Storage temperature

–40 to +80 °C (–40 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, flange or extension pipe
- Do not bend, shorten or extend the tuning fork



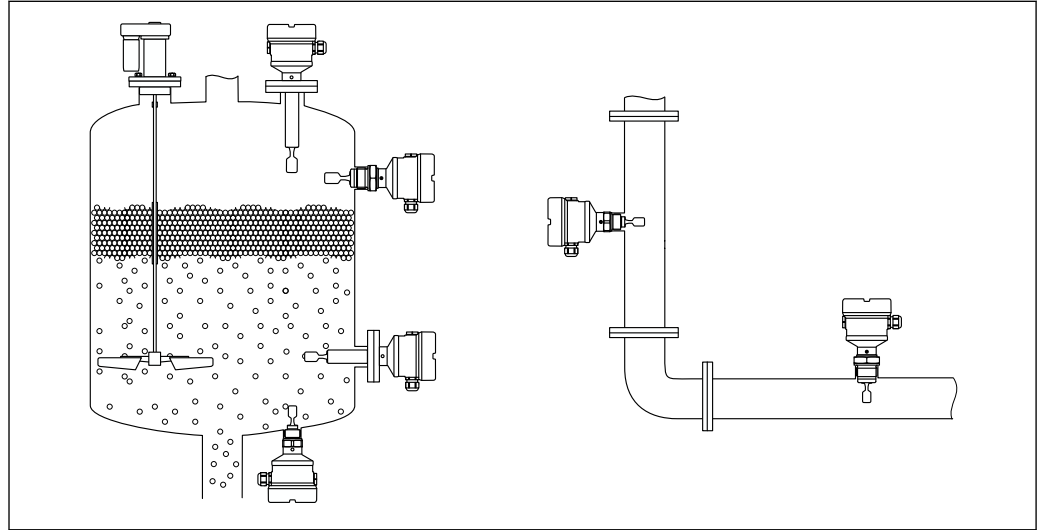
 2 Handling the device during transportation

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5 Mounting

Mounting instructions

- Any orientation for compact version or version with a pipe length up to approx. 500 mm (19.7 in)
- Vertical orientation from above for device with long pipe
- Minimum distance between the tuning 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

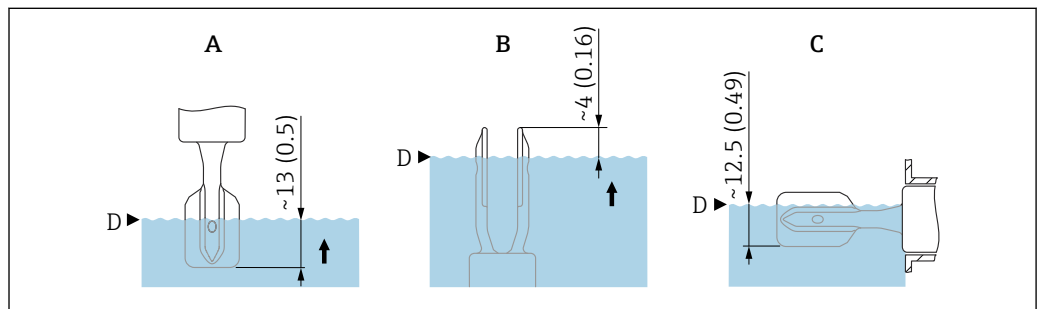
5.1 Mounting requirements

5.1.1 Take switch point into consideration

The following are typical switch points, depending on the orientation of the point level switch.

Water +23 °C (+73 °F)

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



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4 Typical switch points. Unit of measurement mm (in)

- A Installation from above
 B Installation from below
 C Installation from the side
 D Switch point

5.1.2 Take viscosity into consideration



Viscosity values

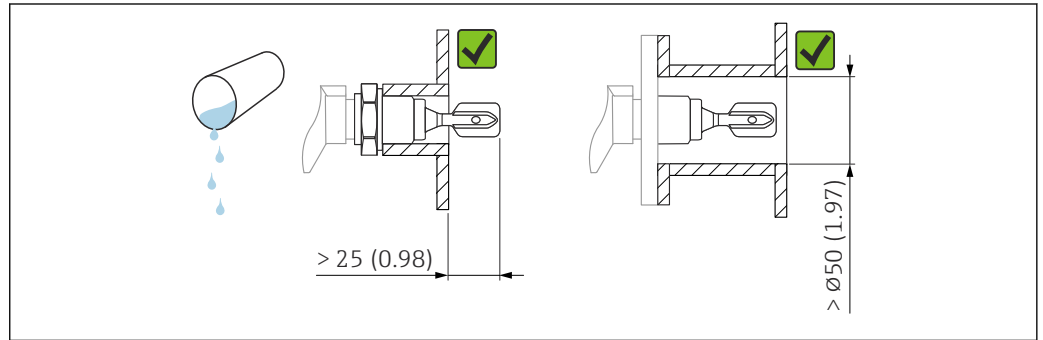
- Low viscosity : $< 2\,000\text{ mPa}\cdot\text{s}$
- High viscosity: $> 2\,000$ to $10\,000\text{ mPa}\cdot\text{s}$

Low viscosity



Low viscosity, e.g. water: $< 2\,000\text{ mPa}\cdot\text{s}$

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



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5 Installation example for low-viscosity liquids. Unit of measurement mm (in)

High viscosity

NOTICE

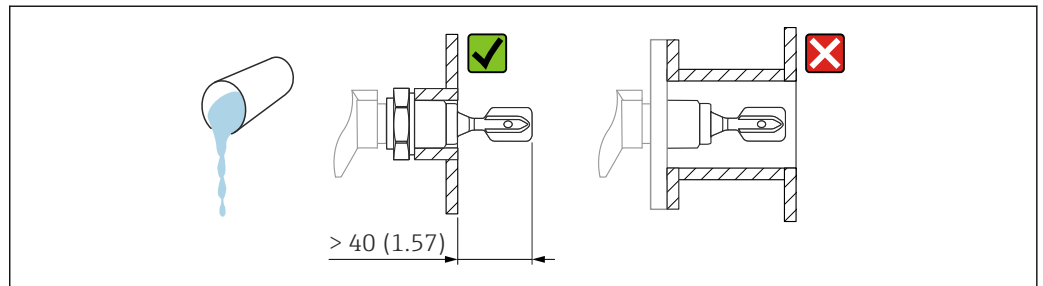
Highly viscous liquids may cause switching delays.

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



High viscosity, e.g. viscous oils: $\leq 10\,000\text{ mPa}\cdot\text{s}$

The tuning fork must be located outside the installation socket!

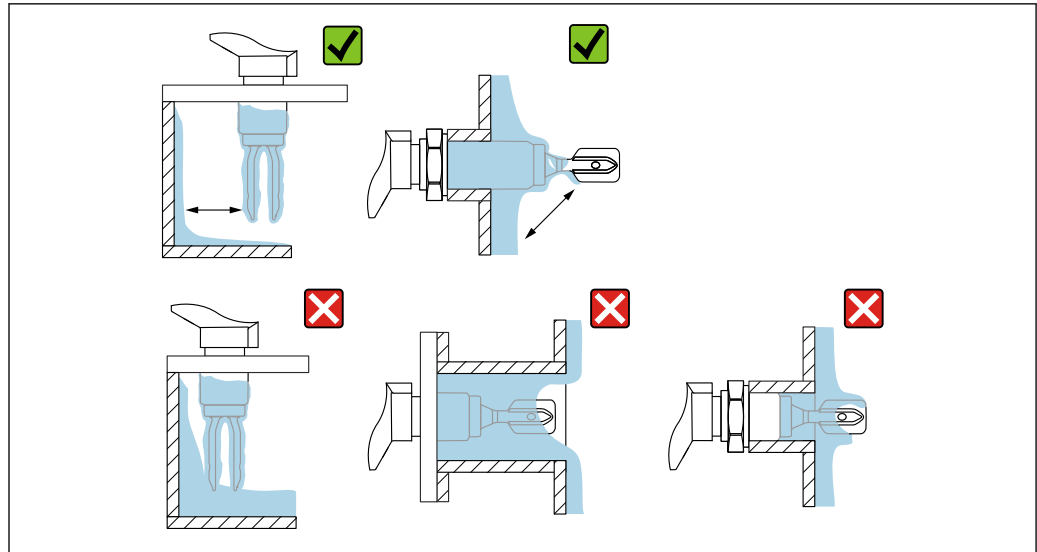


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6 Installation example for a highly viscous liquid. Unit of measurement mm (in)

5.1.3 Avoid buildup

- Use short installation sockets to ensure that the tuning fork projects freely into the vessel
- Leave sufficient distance between the buildup expected on the tank wall and the tuning fork

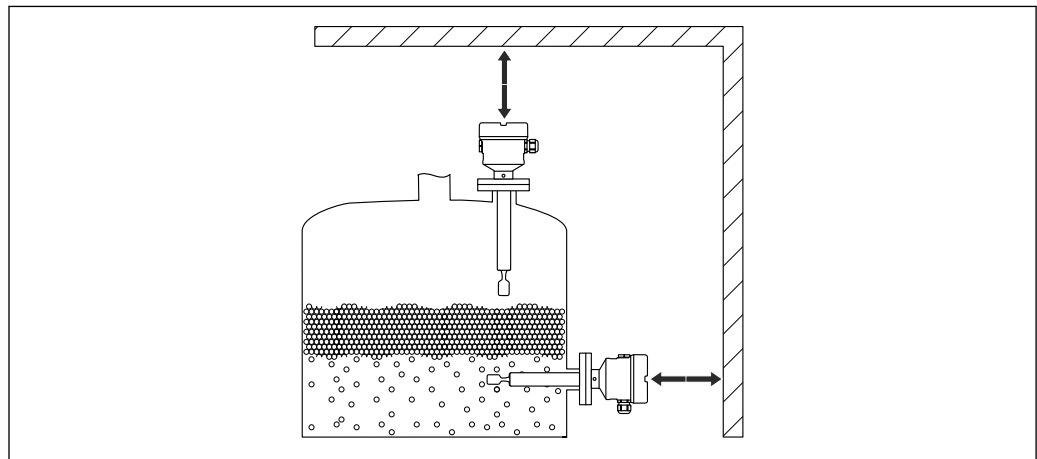


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7 Installation examples for a highly viscous process medium

5.1.4 Take clearance into consideration

Allow sufficient space outside the tank for mounting, connection and settings involving the electronic insert.

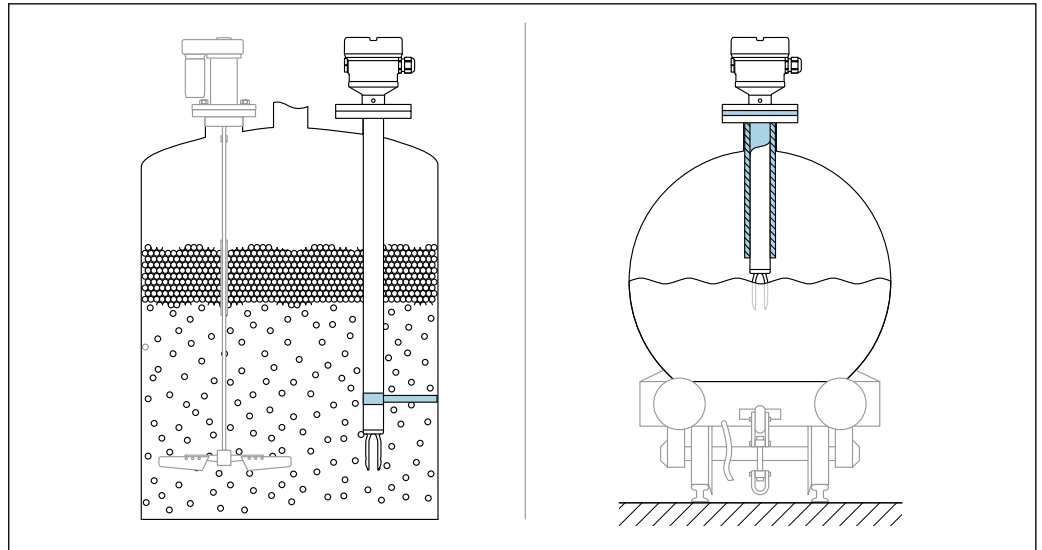


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8 Take clearance into consideration

5.1.5 Support the device

Support the device in the event of severe dynamic load. Maximum lateral loading capacity of the pipe extensions and sensors: 75 Nm (55 lbf ft).



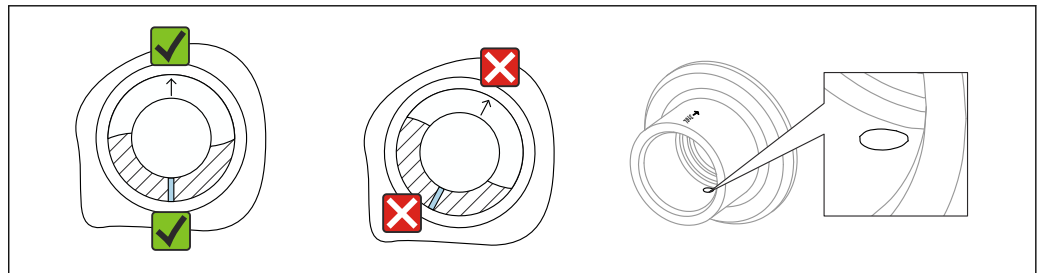
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9 Examples of support in the event of dynamic load

i Marine approval: In the case of pipe extensions or sensors longer than 1 600 mm (63 in), a support is needed at least every 1 600 mm (63 in).

5.1.6 Weld-in adapter with 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.



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10 Weld-in adapter with leakage hole

5.2 Mounting the device

5.2.1 Required tool

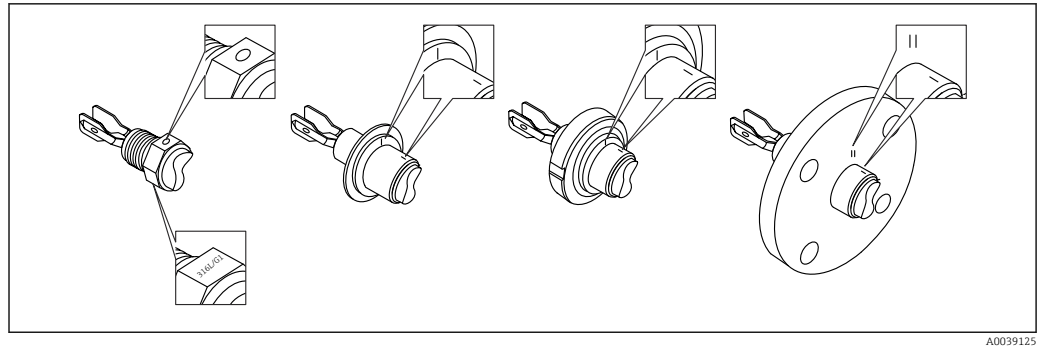
- Open-ended wrench for sensor installation
- Allen key for housing locking screw

5.2.2 Installation

Aligning the tuning fork using the marking

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

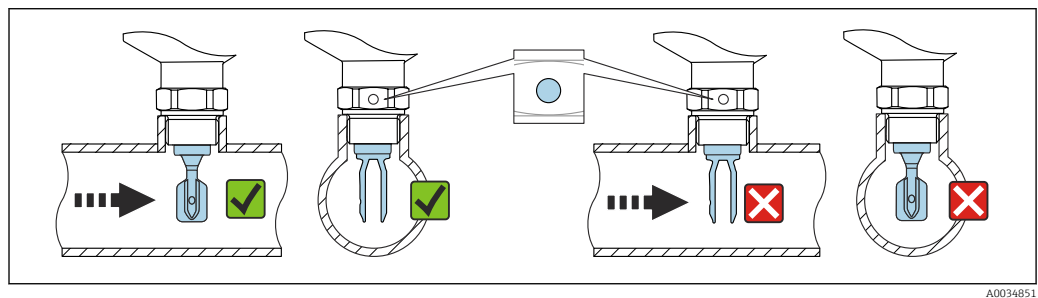
Markings are labeled on the process connection by means of:
Material specification, thread designation, circle, line or double line



11 Position of the tuning fork when installed horizontally in the vessel using the marking

Installing the device in piping

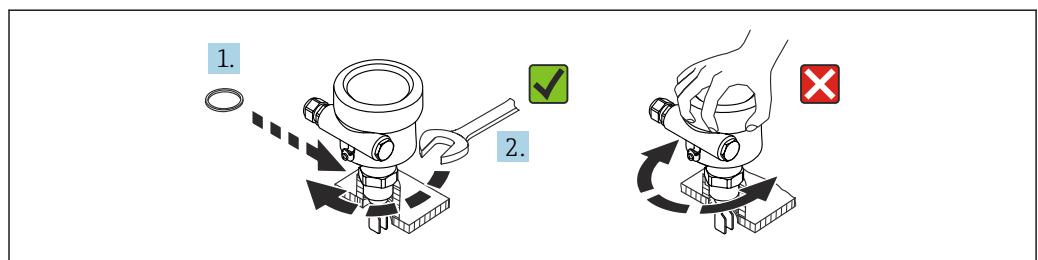
- Flow velocity up to 5 m/s with a viscosity of 1 mPa·s and density of 1 g/cm³ (62.4 lb/ft³) (SGU).
Check for correct functioning in the event of other process medium conditions.
- The flow will not be significantly impeded if the tuning fork is correctly aligned and the marking is pointing in the direction of flow.
- The marking is visible when installed



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

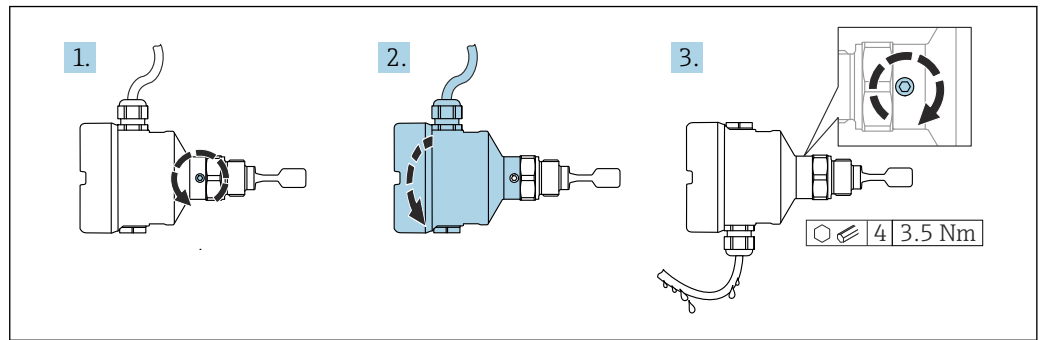
Screwing in the device

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



13 Screwing in the device

Aligning the cable entry



14 Housing with external locking screw and drip loop



Housings with locking screw:

- The housing can be turned and the cable aligned by turning the locking screw.
- The locking screw is not tightened when the device is delivered.

1. Loosen the external locking screw (maximum 1.5 turns).
2. Turn the housing, align the cable entry.
 - ↳ Avoid moisture in the housing, provide a loop to allow moisture to drain off.
3. Tighten the external locking screw.

NOTICE

The housing cannot be unscrewed fully.

- ▶ Loosen the external locking screw by a maximum of 1.5 turns. If the screw is unscrewed too much or completely (beyond the screw anchor point), small parts (counter disk) can become loose and fall out.
- ▶ Tighten the securing screw (hexagon socket 4 mm (0.16 in)) with maximum 3.5 Nm (2.58 lbf ft) ± 0.3 Nm (± 0.22 lbf ft).

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 Sliding sleeves

For more details, see the "Accessories" section.

5.4 Post-mounting check

- ☐ Is the device undamaged (visual inspection)?
- ☐ Does the measuring device meet the measuring point specifications?

For example:

- Process temperature
- Process pressure
- Ambient temperature
- Measuring range
- ☐ Are the measuring point number and labeling correct (visual inspection)?
- ☐ Is the device adequately protected from wet conditions and direct sunlight?
- ☐ Is the device properly secured?

6 Electrical connection

6.1 Required tool

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

6.2 Connecting requirements

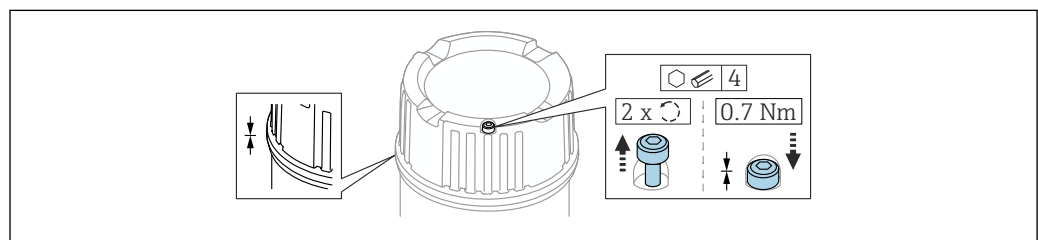
6.2.1 Cover with securing screw

The cover is locked by a securing screw in devices for use in hazardous areas with certain explosion protection.

NOTICE

If the securing screw is not positioned correctly, the cover cannot provide secure sealing.

- ▶ Open the cover: slacken the screw of the cover lock with a maximum of 2 turns so that the screw does not fall out. Fit the cover and check the cover seal.
- ▶ Close the cover: screw the cover securely onto the housing, making sure that the securing screw is positioned correctly. There should not be any gap between the cover and housing.



A0039520

15 Cover with securing screw

6.2.2 Connecting protective earth (PE)

The protective earth conductor at the device must only be connected if the device's operating voltage is $\geq 35 \text{ V}_{\text{DC}}$ or $\geq 16 \text{ V}_{\text{ACeff}}$.

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.

- i** The plastic housing is available with or without an external protective earth connection (PE). If the operating voltage of the electronic insert is $< 35 \text{ V}$, the plastic housing has no external protective earth connection.

6.3 Connecting the device



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.

6.3.1 3-wire DC-PNP (electronic insert FEL42)

- Three-wire DC version
- Switches the load via the transistor (PNP) and separate connection, e.g. in conjunction with programmable logic controllers (PLC), DI modules according to EN 61131-2

Supply voltage



WARNING

Failure to use the prescribed power unit.

Risk of potentially life-threatening electric shock!

- The FEL42 may only be powered by power supply units with secure galvanic isolation in accordance with IEC 61010-1.

$U = 10 \text{ to } 55 \text{ V}_{\text{DC}}$



The device must be powered by a voltage supply categorized as "CLASS 2" or "SELV".



Comply with the following according to IEC/EN61010-1: provide a suitable circuit breaker for the device and limit the current to 500 mA, e.g. by installing a 0.5 A fuse (slow-blow) in the power supply circuit.

Power consumption

$P < 0.5 \text{ W}$

Current consumption

$I \leq 10 \text{ mA}$ (without load)

The red LED flashes in the event of an overload or short-circuit. Check for an overload or short-circuit every 5 s.

Load current

$I \leq 350 \text{ mA}$ with overload and short-circuit protection

Residual current

$I < 100 \text{ }\mu\text{A}$ (for blocked transistor)

Residual voltage

$U < 3 \text{ V}$ (for switched through transistor)

Behavior of output signal

- OK status: switched through
- Demand mode: blocked
- Alarm: blocked

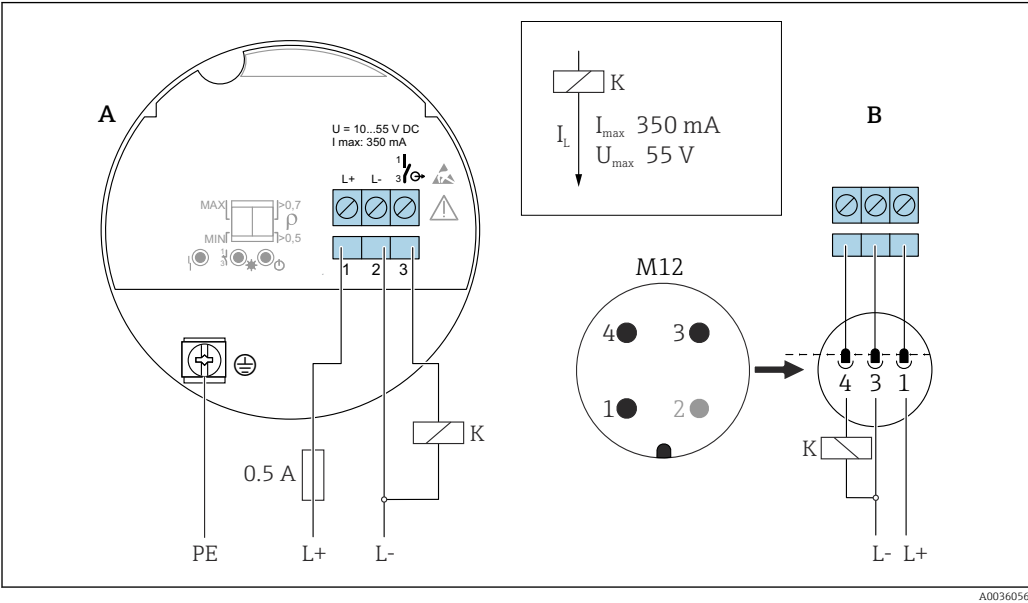
Terminals

Terminals for cable cross-section up to 2.5 mm^2 (14 AWG). Use ferrules for the wires.

Overvoltage protection

Overvoltage category I

Terminal assignment

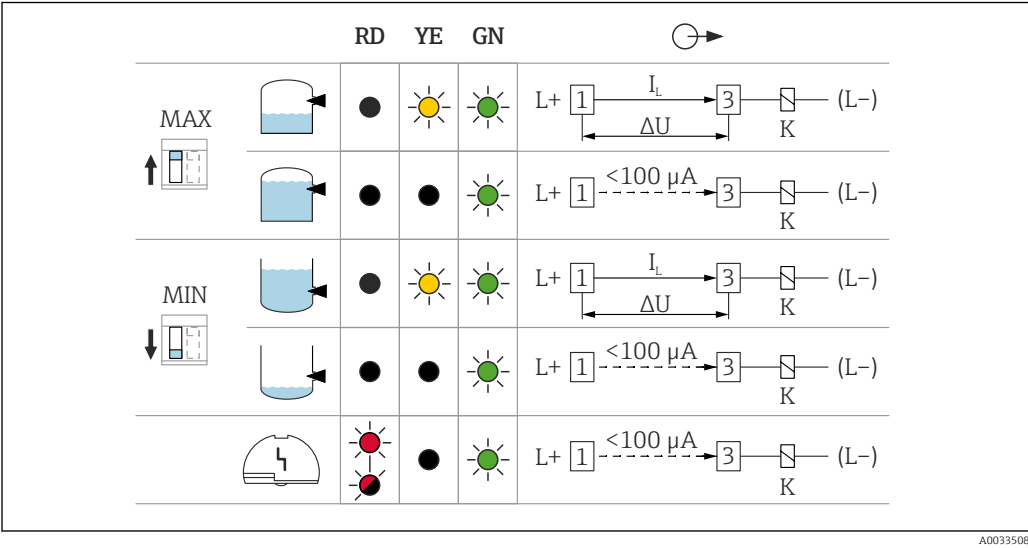


16 Terminal assignment FEL42

A Terminal assignment at electronic insert

B Terminal assignment at M12 plug according to EN61131-2 standard

Behavior of the switch output and signaling



17 FEL42 switching behavior, signaling LED

MAX DIP switch for setting the MAX safety

MIN DIP switch for setting the MIN safety

RD LED red for warning or alarm

YE LED yellow, switch status

GN LED green, operational status, device on

I_L Load current switched through

6.3.2 Universal current connection with relay output (electronic insert FEL44)

- Switches the loads via 2 potential-free change-over contacts
- 2 separate change-over contacts (DPDT)

WARNING

An error at the electronic insert can cause the permitted temperature for touch-safe surfaces to be exceeded. This presents a risk of burns.

- Do not touch the electronics in the event of an error!

Supply voltage

$U = 19 \text{ to } 253 \text{ V}_{AC} / 19 \text{ to } 55 \text{ V}_{DC}$

-  Comply with the following according to IEC/EN61010-1: provide a suitable circuit breaker for the device and limit the current to 500 mA, e.g. by installing a 0.5 A fuse (slow-blow) in the power supply circuit.


Power consumption

$S < 25 \text{ VA}, P < 1.3 \text{ W}$

Connectable load

Loads switched via 2 potential-free changeover contacts (DPDT)

- $I_{AC} \leq 6 \text{ A}, U \sim \leq AC 253 \text{ V}; P \sim \leq 1500 \text{ VA}, \cos \varphi = 1, P \sim \leq 750 \text{ VA}, \cos \varphi > 0.7$
- $I_{DC} \leq 6 \text{ A to DC } 30 \text{ V}, I_{DC} \leq 0.2 \text{ A to } 125 \text{ V}$

-  Additional restrictions for the connectable load depend on the selected approval. Pay attention to the information in the Safety Instructions (XA).

According to IEC 61010, the following applies: Total voltage from relay outputs and power supply $\leq 300 \text{ V}$.

Use electronic insert FEL42 DC PNP for small DC load currents, e.g. for connection to a PLC.

Relay contact material: silver/nickel AgNi 90/10

When connecting a device with high inductance, provide a spark suppressor to protect the relay contact. A fine-wire fuse (depending on the connected load) protects the relay contact in the event of a short-circuit.

Both relay contacts switch simultaneously.

Behavior of output signal

- OK status: relay energized
- Demand mode: relay de-energized
- Alarm: relay de-energized

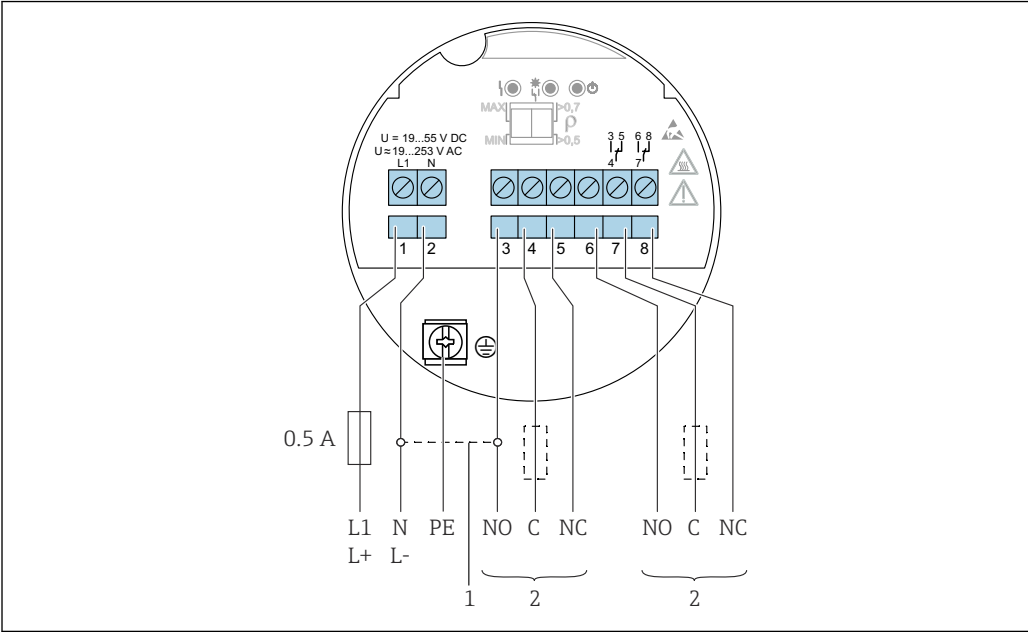
Terminals

Terminals for cable cross-section up to 2.5 mm^2 (14 AWG). Use ferrules for the wires.

Overvoltage protection

Overvoltage category II

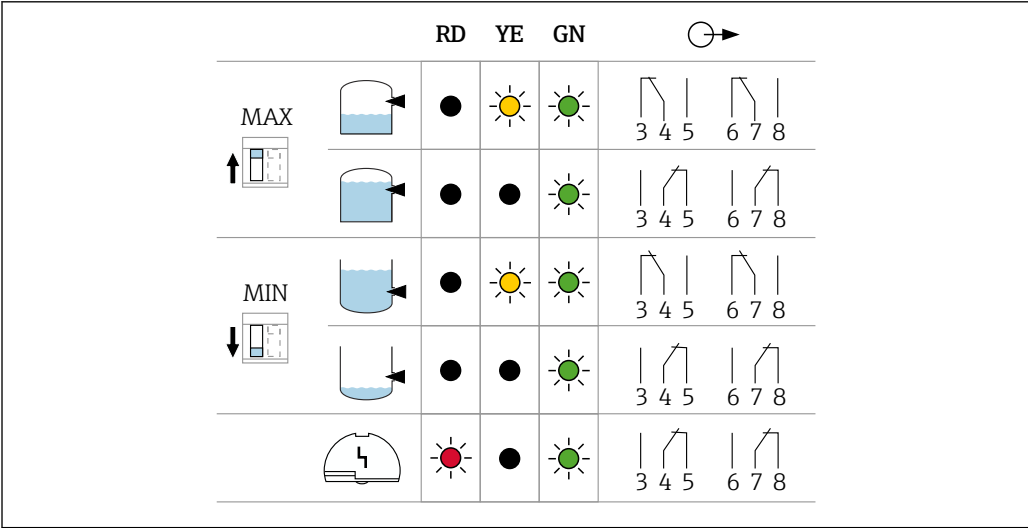
Terminal assignment



18 Universal current connection with relay output, electronic insert FEL44

- 1 When bridged, the relay output works with NPN logic
- 2 Connectable load

Behavior of the switch output and signaling



19 FEL44 switching behavior, signaling LED

- MAX DIP switch for setting the MAX safety
- MIN DIP switch for setting the MIN safety
- RD LED red for alarm
- YE LED yellow, switch status
- GN LED green, operational status, device on


6.3.3 2-wire NAMUR ≥ 2.2 mA/ ≤ 1.0 mA (electronic insert FEL48)

- To connect to isolating amplifiers according to NAMUR (IEC 60947-5-6), e.g. Nivotester FTL325N from Endress+Hauser
- To connect to isolating amplifiers of third-party suppliers according to NAMUR (IEC 60947-5-6), a permanent power supply for the electronic insert FEL48 must be ensured
- Signal transmission H-L edge 2.2 to 3.8 mA/0.4 to 1.0 mA according to NAMUR (IEC 60947-5-6) on two-wire cabling

Supply voltage

$$U = 8.2 \text{ V}_{\text{DC}}$$

 The device must be powered by a voltage supply categorized as "CLASS 2" or "SELV".

 Comply with the following according to IEC/EN61010-1: provide a suitable circuit breaker for the device.

Power consumption

$$P < 50 \text{ mW}$$

Behavior output signal

- OK state: Current 2.2 to 3.8 mA
- Demand mode: Current 0.4 to 1.0 mA
- Alarm: Current 0.4 to 1.0 mA

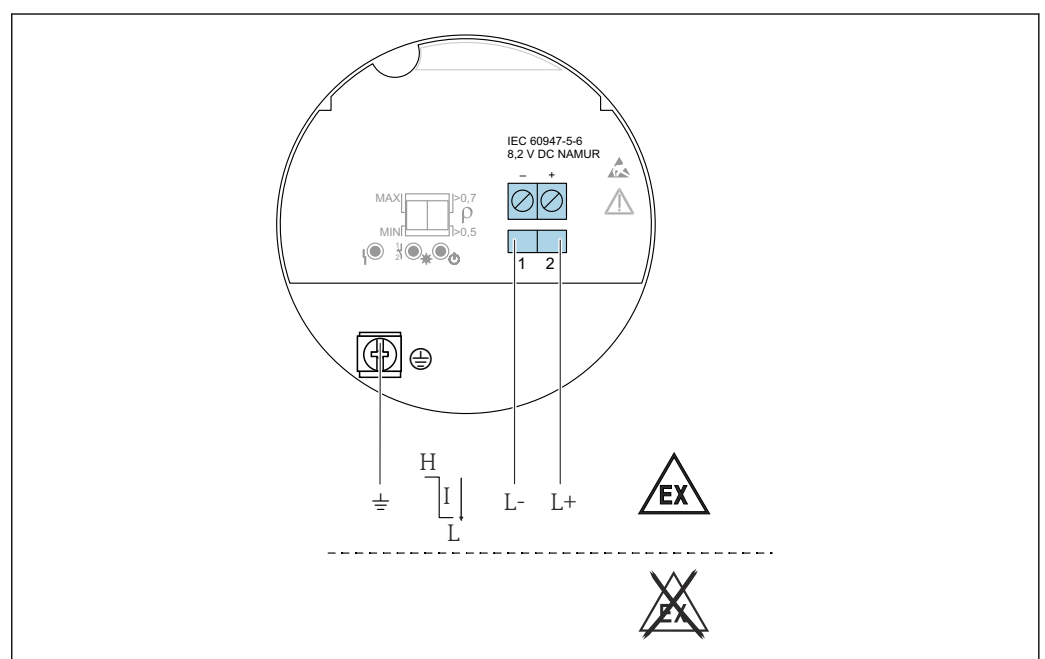
Terminals


Terminals for cable cross-section up to 2.5 mm^2 (14 AWG). Use ferrules for the wires.

Overvoltage protection

Overvoltage category I

Terminal assignment



 20 2-wire NAMUR ≥ 2.2 mA/ ≤ 1.0 mA, electronic insert FEL48

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Behavior of the switch output and signaling

		RD	YE	GN	
MAX					L+ [2] $\xrightarrow{2.2...3.8 \text{ mA}}$ [1] L-
					L+ [2] $\xrightarrow{0.4...1.0 \text{ mA}}$ [1] L-
MIN					L+ [2] $\xrightarrow{2.2...3.8 \text{ mA}}$ [1] L-
					L+ [2] $\xrightarrow{0.4...1.0 \text{ mA}}$ [1] L-
					L+ [2] $\xrightarrow{< 1.0 \text{ mA}}$ [1] L-

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21 FEL48 switching behavior and signaling

MAX DIP switch for setting the MAX safety

MIN DIP switch for setting the MIN safety

RD LED red for alarm

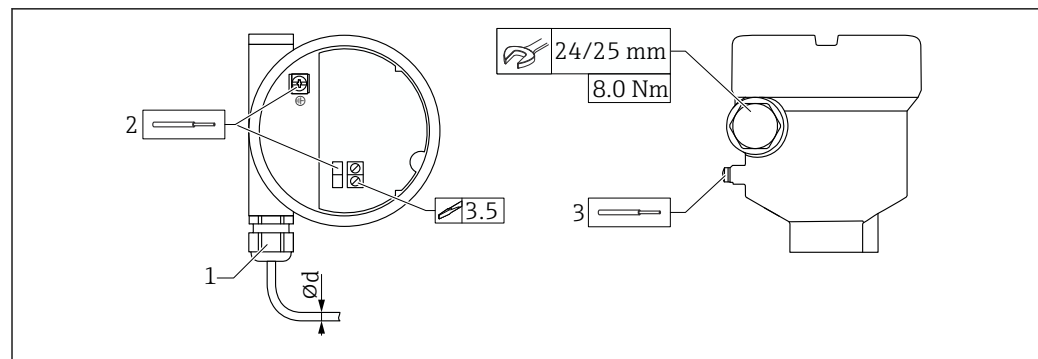
YE LED yellow, switch status

GN LED green, operational status, device on

6.3.4 Connecting the cables

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



A0018023

22 Example of coupling with cable entry, electronic insert with terminals

- 1 M20 coupling (with cable entry), example
 - 2 Conductor cross-section maximum 2.5 mm² (AWG14), ground terminal on inside in housing + terminals on the electronics
 - 3 Conductor cross-section maximum 4.0 mm² (AWG12), ground terminal on outside of the housing (example: plastic housing with outer protective ground connection (PE))
- ød Nickel-plated brass 7 to 10.5 mm (0.28 to 0.41 in),
Plastic 5 to 10 mm (0.2 to 0.38 in),
Stainless steel 7 to 12 mm (0.28 to 0.47 in)

Pay attention to the following when using the M20 coupling

Following cable entry:

- Counter-tighten the coupling
- Tighten the union nut of the coupling with 8 Nm (5.9 lbf ft)
- Screw the enclosed coupling into the housing with 3.75 Nm (2.76 lbf ft)

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?

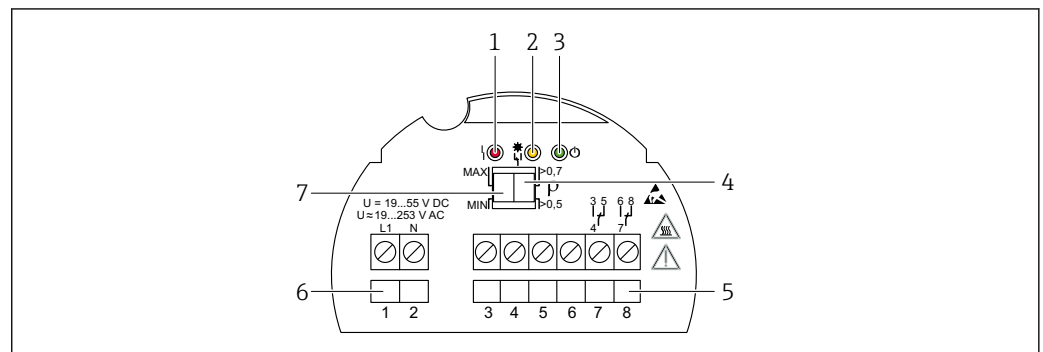
7 Operation options

7.1 Overview of operation options

7.1.1 Operation concept

Operation with DIP switches on the electronic insert

7.1.2 Elements on the electronic insert



23 Example of electronic insert FEL44

- 1 LED red, for warning or alarm
- 2 LED yellow, switch status
- 3 LED green, operational status (LED green lights up = device on)
- 4 DIP switch to set the density to 0.7 or 0.5
- 5 Relay contact terminals
- 6 Power supply terminals
- 7 DIP switch for setting MAX/MIN safety

8 Commissioning

8.1 Function check

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



- → Post-installation check
- → Post-connection check

8.2 Switching on the device

During the power-up time, the device output is in the safety-oriented state, or in the alarm state if available.

The output is in the correct state after a maximum of 3 s following device power-up.

8.3 Further information



Further information and the documentation currently available can be found on the Endress+Hauser website: www.endress.com → Downloads.

9 Diagnostics and troubleshooting

The device indicates warnings and errors via the LEDs on the electronic insert. All the device warnings and faults are for information purposes only and do not have a safety function. Depending on the diagnostic message, the device behaves as per a warning or fault condition.

The device behaves in accordance with NAMUR Recommendation NE131 "NAMUR standard device requirements for field devices for standard applications".

9.1 LED on electronic insert

Green LED not lit

Possible cause: No power supply

Troubleshooting: Check plug, cable and power supply

LED flashing red

Possible cause: Overload or short-circuit in load circuit

Troubleshooting: Clear the short-circuit

Reduce maximum load current to below 350 mA

Red LED continuously lit

Possible cause: Internal sensor error or electronic fault

Troubleshooting: Replace device

9.2 Firmware history

V01.01.zz (01.2019)

- Valid for electronic inserts: FEL41, FEL44, FEL48
- Valid from documentation version: BA01893F/00/EN/01.19
- Changes: none; 1st version (original software)

10 Maintenance

No special maintenance work is required.

10.1 Maintenance tasks

10.1.1 Cleaning

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

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


11 Repair

11.1 General notes

11.1.1 Repair concept

Endress+Hauser repair concept

- The devices have a modular design
- Customers can carry out repairs

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

11.1.2 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.

11.2 Spare parts

- Some replaceable device components are identified by a spare part nameplate. This contains information about the spare part.
- All the spare parts for the measuring device, along with the order code, are listed in the *W@M Device Viewer* (www.endress.com/deviceviewer) and can be ordered. If available, users can also download the associated Installation Instructions.

 Device serial number or QR code:
Located on the device and spare part nameplate.

11.3 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:
<http://www.endress.com/support/return-material>
 ↳ Select the region.
2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

11.4 Disposal

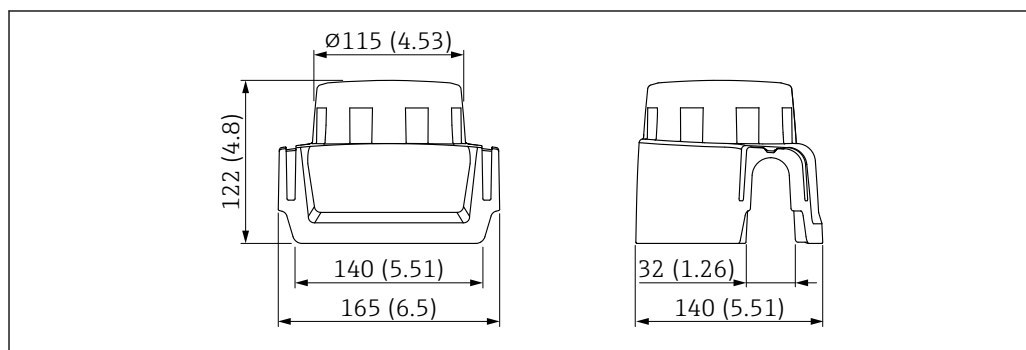


If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return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

12 Accessories

12.1 Protective cover for single compartment housing, aluminum or 316L

- Material: plastic
- Order number: 71438291



A0038280

24 Protective cover for single compartment housing, aluminum or 316L. Unit of measurement mm (in)

12.2 M12 socket

- i** 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

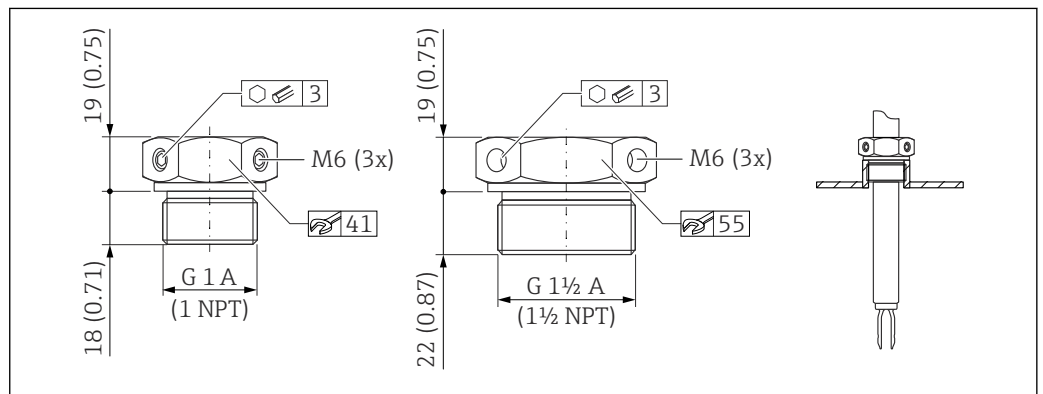
M12 socket IP67


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

12.3 Sliding sleeves for unpressurized operation

 Not suitable for use in explosive atmospheres.

Switch point, infinitely adjustable.



 25 Sliding sleeves for unpressurized operation $p_e = 0$ bar (0 psi). Unit of measurement mm (in)

G 1, DIN ISO 228/I

- Material: 1.4435 (AISI 316L)
- Weight: 0.21 kg (0.46 lb)
- Order number: 52003978
- Order number: 52011888, approval: with inspection certificate EN 10204 - 3.1 material

NPT 1, ASME B 1.20.1


- Material: 1.4435 (AISI 316L)
- Weight: 0.21 kg (0.46 lb)
- Order number: 52003979
- Order number: 52011889, approval: with inspection certificate EN 10204 - 3.1 material

G 1½, DIN ISO 228/I

- Material: 1.4435 (AISI 316L)
- Weight: 0.54 kg (1.19 lb)
- Order number: 52003980
- Order number: 52011890, approval: with inspection certificate EN 10204 - 3.1 material


NPT 1½, ASME B 1.20.1

- Material: 1.4435 (AISI 316L)
- Weight: 0.54 kg (1.19 lb)
- Order number: 52003981
- Order number: 52011891, approval: with inspection certificate EN 10204 - 3.1 material

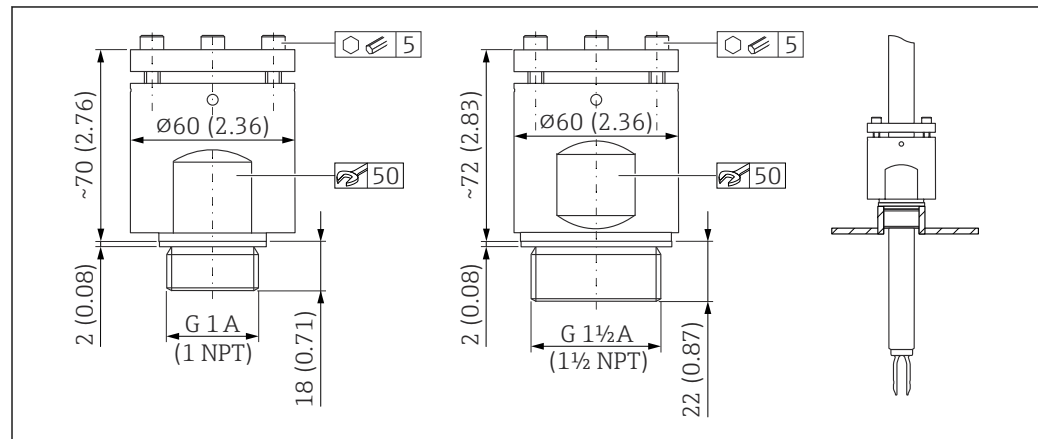
 More detailed information and documentation are available:

- Product Configurator on the Endress+Hauser website www.endress.com
- Endress+Hauser sales organization www.addresses.endress.com

12.4 High pressure sliding sleeves

 Suitable for use in explosive atmospheres.

- Switch point, infinitely adjustable
- Seal package made of graphite
- Graphite seal available as spare part 71078875
- For G 1, G 1½: seal is included in the delivery



 26 High pressure sliding sleeves. Unit of measurement mm (in)

G 1, DIN ISO 228/I

- Material: 1.4435 (AISI 316L)
- Weight: 1.13 kg (2.49 lb)
- Order number: 52003663
- Order number: 52011880, approval: with inspection certificate EN 10204 - 3.1 material

G 1, DIN ISO 228/I

- Material: Alloy C22
- Weight: 1.13 kg (2.49 lb)
- Approval: with inspection certificate EN 10204 - 3.1 material
- Order number: 71118691

NPT 1, ASME B 1.20.1

- Material: 1.4435 (AISI 316L)
- Weight: 1.13 kg (2.49 lb)
- Order number: 52003667
- Order number: 52011881, approval: with inspection certificate EN 10204 - 3.1 material

NPT 1, ASME B 1.20.1

- Material: Alloy C22
- Weight: 1.13 kg (2.49 lb)
- Approval: with inspection certificate EN 10204 - 3.1 material
- Order number: 71118694

G 1½, DIN ISO 228/1

- Material: 1.4435 (AISI 316L)
- Weight: 1.32 kg (2.91 lb)
- Order number: 52003665
- Order number: 52011882, approval: with inspection certificate EN 10204 - 3.1 material

G 1½, DIN ISO 228/1


- Material: Alloy C22
- Weight: 1.32 kg (2.91 lb)
- Approval: with inspection certificate EN 10204 - 3.1 material
- Order number: 71118693

NPT 1½, ASME B 1.20.1

- Material: 1.4435 (AISI 316L)
- Weight: 1.32 kg (2.91 lb)
- Order number: 52003669
- Order number: 52011883, approval: with inspection certificate EN 10204 - 3.1 material

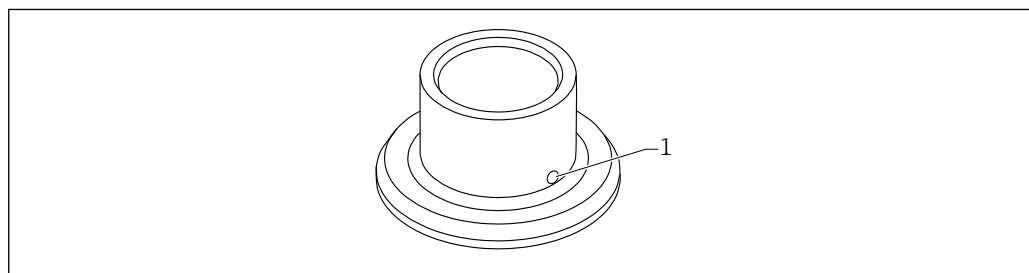
NPT 1½, ASME B 1.20.1

- Material: Alloy C22
- Weight: 1.32 kg (2.91 lb)
- Approval: with inspection certificate EN 10204 - 3.1 material
- Order number: 71118695


-  More detailed information and documentation are available:
- Product Configurator on the Endress+Hauser website www.endress.com
 - Endress+Hauser sales organization www.addresses.endress.com

12.5 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 EN10204.



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 27 Weld-in adapter (sample view)

1 Leakage hole

Weld-in adapter G 1:

FDA-listed materials as per 21 CFR Part 175-178


- Ø 53 mounting on the pipe
- Ø60 flush mount on the vessel

Weld-in adapter G ¾:

FDA-listed materials as per 21 CFR Part 175-178

Ø55 flush mount

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.

-  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 Technical data

13.1 Input

13.1.1 Measured variable

Level (point level), MAX or MIN safety

13.1.2 Measuring range

Depends on the installation location and the pipe extension ordered
Maximum sensor length 6 m (20 ft)

13.2 Output

13.2.1 Output and input variants

Electronic inserts

3-wire DC-PNP (FEL42)

- Three-wire direct current version
- Switches the load via the transistor (PNP) and separate connection, e.g. in conjunction with programmable logic controllers (PLC)

Universal current connection, relay output (FEL44)

Switches the loads via 2 potential-free changeover contacts

2-wire NAMUR > 2.2 mA / < 1.0 mA (FEL48)

- For separate switching unit
- Signal transmission H-L edge 2.2 to 3.8 mA / 0.4 to 1.0 mA as per IEC 60947-5-6 (NAMUR) on two-wire cabling

13.2.2 Output signal

Switch output

Preset switching delay times for the point level switches can be ordered for the following ranges:

- 0.5 s when the tuning fork is covered and 1.0 s when the tuning fork is uncovered (factory setting)
- 0.25 s when the tuning fork is covered and 0.25 s when the tuning fork is uncovered
- 1.5 s when the tuning fork is covered and 1.5 s when the tuning fork is uncovered
- 5.0 s when the tuning fork is covered and 5.0 s when the tuning fork is uncovered

13.2.3 Ex connection data

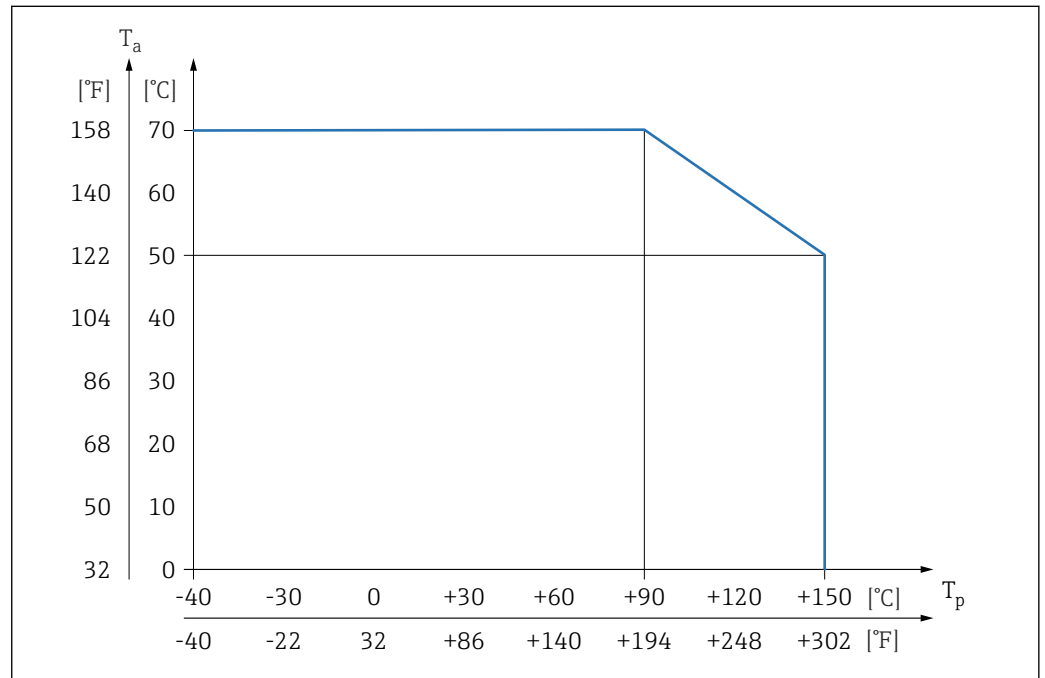
See safety instructions (XA): All data relating to explosion protection are provided in separate Ex documentation and are available from the Downloads area of the Endress+Hauser website. The Ex documentation is supplied as standard with all devices approved for use in explosion hazardous areas.

13.3 Environment

13.3.1 Ambient temperature range

−40 to +70 °C (−40 to +158 °F)

The minimum permitted ambient temperature of the plastic housing is limited to −20 °C (−4 °F); 'indoor use' applies to North America.



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28 For FEL44 and process temperature $T_p > 90$ °C max. load current 4 A

If operating outdoors in strong sunlight:

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

Hazardous area

In the hazardous area, the permitted ambient temperature can be limited depending on the zones and gas groups. Pay attention to the information in the Ex documentation (XA).

13.3.2 Storage temperature

−40 to +80 °C (−40 to +176 °F)

13.3.3 Humidity

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

13.3.4 Operating altitude

As per IEC 61010-1 Ed.3:

- Up to 2 000 m (6 600 ft) above sea level
- Can be extended to 3 000 m (9 800 ft) above sea level if overvoltage protection is used

13.3.5 Climate class

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

13.3.6 Degree of protection

Testing according to IEC 60529 and NEMA 250

IP68 test condition: 1.83 m H₂O for 24 h

Housing

See cable entries

Cable entries

- M20 threaded joint, plastic, IP66/68 NEMA Type 4X/6P
- M20 threaded joint, nickel-plated brass, IP66/68 NEMA Type 4X/6P
- G ½ thread, NPT ½, NPT ¾ IP66/68 NEMA Type 4X/6P

Degree of protection for M12 plug

- When housing is closed and connecting cable is plugged in: IP66/67 NEMA Type 4X
- When housing is open or connecting cable is not plugged in: IP20, NEMA Type 1

NOTICE

M12 plug: Loss of IP protection class due to incorrect installation!

- ▶ The degree of protection only applies if the connecting cable used is plugged in and screwed tight.
- ▶ The degree of protection only applies if the connecting cable used is specified according to IP67 NEMA Type 4X.



If the "M12 plug" option is selected as the electrical connection, **IP66/67 NEMA Type 4X** applies for all housing types.

13.3.7 Vibration resistance

As per IEC60068-2-64-2008

$a(\text{RMS}) = 50 \text{ m/s}^2$, $f = 5 \text{ to } 2\,000 \text{ Hz}$, $t = 3 \text{ axes} \times 2 \text{ h}$

13.3.8 Shock resistance

In accordance with IEC60068-2-27-2008: $300 \text{ m/s}^2 [= 30 g_n] + 18 \text{ ms}$

g_n : standard acceleration of gravity

13.3.9 Mechanical load

Support the device in the event of severe dynamic load. Maximum lateral loading capacity of the pipe extensions and sensors: 75 Nm (55 lbf ft).



For more details, see the "Supporting the device" section.

13.3.10 Pollution degree

Pollution degree 2

13.3.11 Electromagnetic compatibility (EMC)

- Electromagnetic compatibility as per EN 61326 series and NAMUR recommendation EMC (NE21)
- The requirements of EN 61326-3-1 are fulfilled

13.4 Process

13.4.1 Process temperature range

−40 to +150 °C (−40 to +302 °F)

Observe pressure and temperature dependency,  see the "Process pressure range of the sensors" section.

13.4.2 Thermal shock


≤ 120 K/s

13.4.3 Process pressure range

PN: 40 bar (580 psi)

WARNING


The maximum pressure for the device depends on the lowest-rated element, with regard to pressure, of the selected component. This means that it is necessary to pay attention to the process connection as well as the sensor.

- ▶ Pressure specifications,  Technical Information, "Mechanical construction" section.
- ▶ Only operate the device within the specified limits!
- ▶ The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the device.

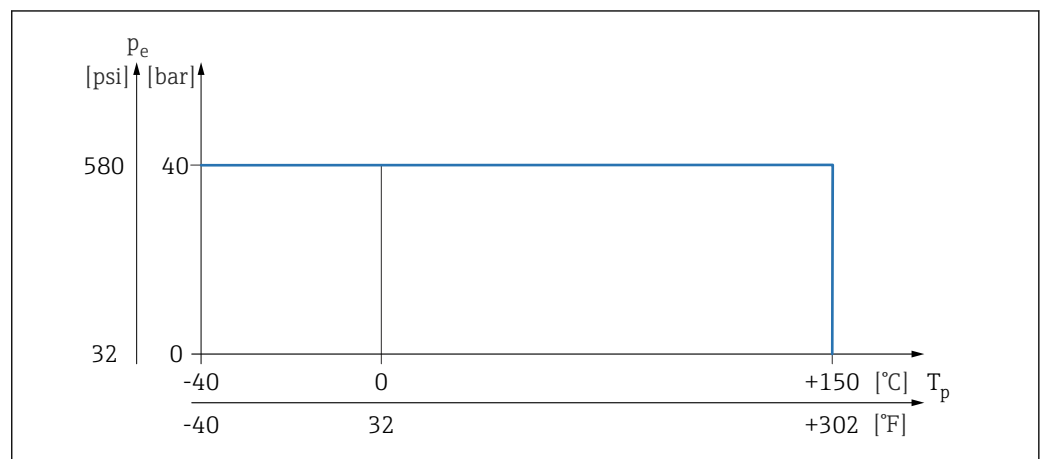
Refer to the following standards for the permitted pressure values of the flanges at higher temperatures:

- pR EN 1092-1: With regard to its stability-temperature property, the material 1.4435 is identical to 1.4404, which is classed as 13E0 in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.
- ASME B 16.5
- JIS B 2220

In each case, the lowest value from the derating curves of the device and the selected flange applies.

 Canadian CRN approval: more details about the maximum pressure values are available in the download area of the product page under: www.endress.com → Downloads.

Process pressure range of the sensors



 29 Process temperature FTL41

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13.4.4 Overpressure limit

PN = 40 bar (580 psi): overpressure limit = $1.5 \cdot \text{PN}$ maximum 60 bar (870 psi) depending on the selected process connection

The device function is limited during the pressure test.

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

13.4.5 Density

Liquids with density > 0.7 g/cm³ (43.7 lb/ft³)

Switch position > 0.7 g/cm³ (43.7 lb/ft³), order configuration

Liquids with density 0.5 g/cm³ (31.2 lb/ft³)

Switch position > 0.5 g/cm³ (31.2 lb/ft³), can be configured via DIP switch

Liquids with density > 0.4 g/cm³ (25.0 lb/ft³)

- Optionally available to order
 - Fixed value that cannot be edited.
- The function of the DIP switch is interrupted.

13.4.6 Viscosity

$\leq 10\,000 \text{ mPa}\cdot\text{s}$

13.4.7 Pressure tightness

Up to vacuum



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

13.4.8 Solids contents

$\varnothing \leq 5 \text{ mm}$ (0.2 in)

13.5 Additional technical data



Technical Information TI01402F.

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



www.addresses.endress.com
