

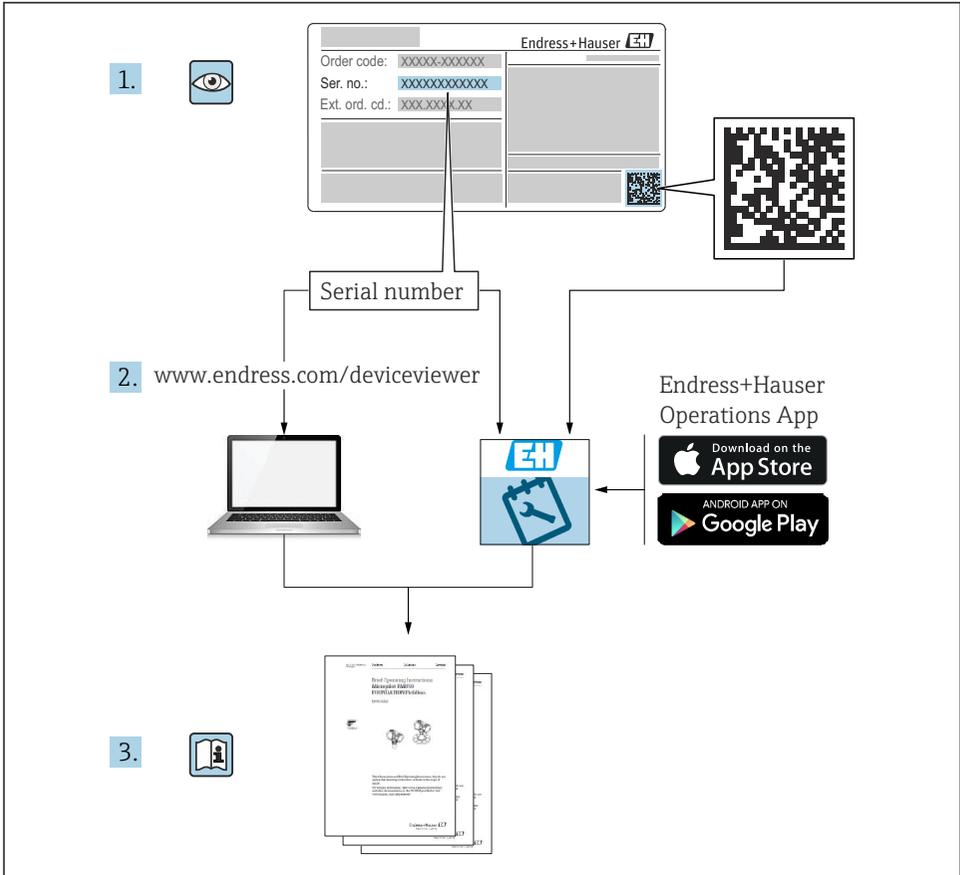
Brief Operating Instructions

Liquicap M

FMI51 PFM

Capacitive
Continuous level measurement for liquids





A0023555

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1 About this document

1.1 Document conventions

1.1.1 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.

1.1.2 Electrical symbols



Alternating current



Direct current and alternating current



Direct current



Ground connection

A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.

Protective earth (PE)

Ground terminals that must be connected to ground prior to establishing any other connections.

The ground terminals are located on the interior and exterior of the device:

- Interior ground terminal: protective earth is connected to the mains supply.
- Exterior ground terminal: device is connected to the plant grounding system.

1.1.3 Tool symbols



Phillips head screwdriver



Flat blade screwdriver



Torx screwdriver



Allen key



Open-ended wrench

1.1.4 Symbols for certain types of information and graphics

Permitted

Procedures, processes or actions that are permitted

Preferred

Procedures, processes or actions that are preferred

Forbidden

Procedures, processes or actions that are forbidden

Tip

Indicates additional information



Reference to documentation



Reference to page



Reference to graphic



Notice or individual step to be observed



Series of steps



Result of a step



Help in the event of a problem



Visual inspection



Operation via operating tool



Write-protected parameter

1, 2, 3, ...

Item numbers

A, B, C, ...

Views

 Hazardous area

Indicates the hazardous area

 Safe area (non-hazardous area)

Indicates the non-hazardous area

 →  Safety instructions

Observe the safety instructions contained in the associated Operating Instructions

 Temperature resistance of the connection cables

Specifies the minimum value of the temperature resistance of the connection cables



LED not lit



LED lit



LED flashes

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel must fulfill the following requirements to carry out the necessary tasks:

- ▶ Are trained, qualified to perform specific functions and tasks.
- ▶ Are authorized by the plant owner or operator to perform specific tasks.
- ▶ Are familiar with federal or national regulations.
- ▶ Have read and understood the instructions in the manual and supplementary documentation.
- ▶ They follow instructions and comply with conditions.

2.2 Workplace safety

For work on and with the device:

- ▶ Wear the required protective equipment according to federal or national regulations.

2.3 Operational safety

When performing configuration, testing, and maintenance work on the device, alternative supervisory measures must be taken to guarantee the operational safety and process safety.

2.3.1 Ex-area

When using the measuring system in Ex-areas, the appropriate national standards and regulations must be observed. Separate Ex-documentation, which constitutes an integral part of this documentation, is supplied with the device. The installation procedures, connection data and safety instructions it contains must be observed.

- Make sure that the technical staff has adequate training.
- The special measuring and safety-related requirements for the measuring points must be observed.

2.4 Product safety

This measuring device is designed following 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 general safety standards and legal requirements. It is compliant with the EC directives listed in the device-specific EC Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the device.

3 Incoming acceptance and product identification

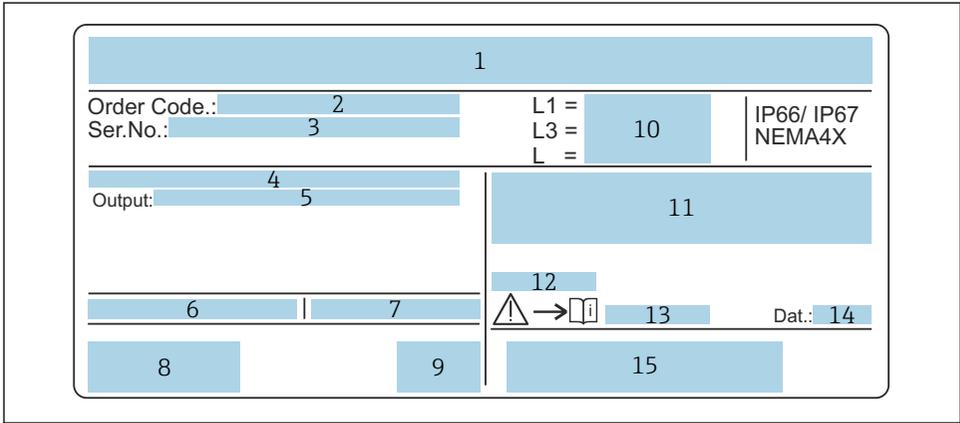
3.1 Incoming acceptance

Check whether the packaging or content is damaged. Check that the goods delivered are complete and compare the scope of delivery with the information in your order.

3.2 Product identification

The measuring device can be identified in the following ways:

- nameplate data
- extended order code with a breakdown of the device features on the delivery note
- the 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 the technical documentation provided
- the serial number on the nameplate into the *Endress+Hauser Operations App* or use the *Endress+Hauser Operations App* to scan the 2-D matrix code (QR Code) on the nameplate



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1 The nameplate

- 2 Order number
- 3 Serial number
- 4 Electronic insert
- 5 Electronic insert output value
- 6 Ambient temperature at housing
- 7 Max. permissible pressure in a tank
- 8 Safety certificates
- 9 Functional safety
- 10 Probe length values
- 11 ATEX approval
- 12 WHG approval (German Water Resources Act)
- 13 Safety information
- 14 Production date
- 15 Bar code

3.3 Storage and transport

For storage and transportation, pack the device to protect it against impact. The original packing offers the best protection for this. The permitted storage temperature is -50 to +85 °C (-58 to +185 °F).

4 Mounting

4.1 Mounting requirements

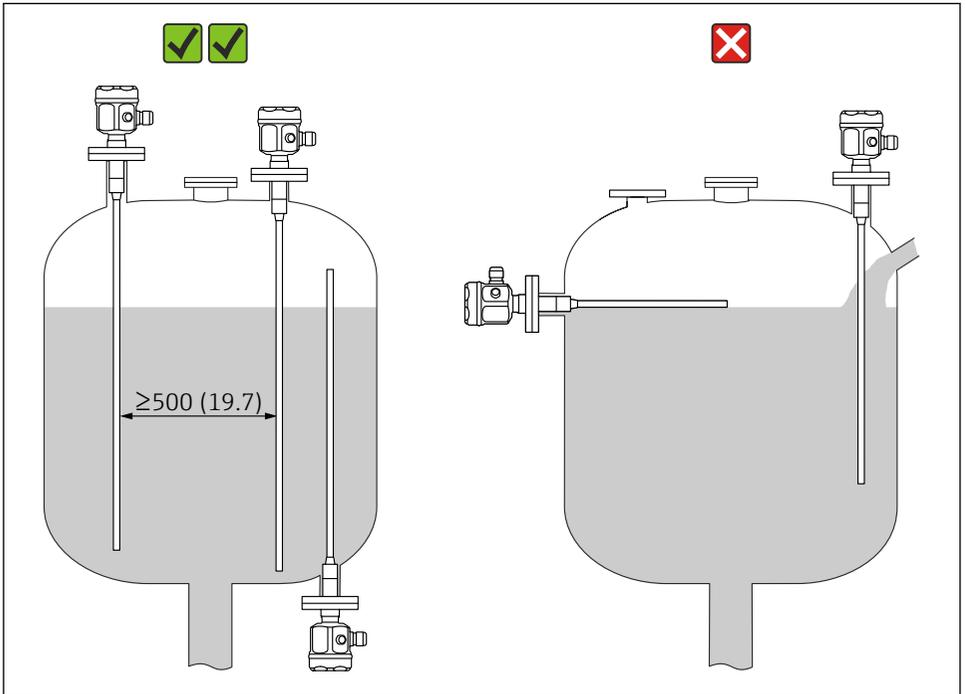
4.1.1 Mounting the sensor

The Liquicap M FMI51 can be installed from the top or from the bottom.



Make sure that:

- the probe is not installed in the area of the filling curtain
- the probe is not in contact with the container wall
- the distance from the container floor is ≥ 10 mm (0.39 in)
- multiple probes are mounted next to each other at the minimum distance between the probes of 500 mm (19.7 in)
- the probe is at a sufficient distance from the agitator if using the probe in agitator tanks
- the rod probes with a ground tube are used in the event of severe lateral load



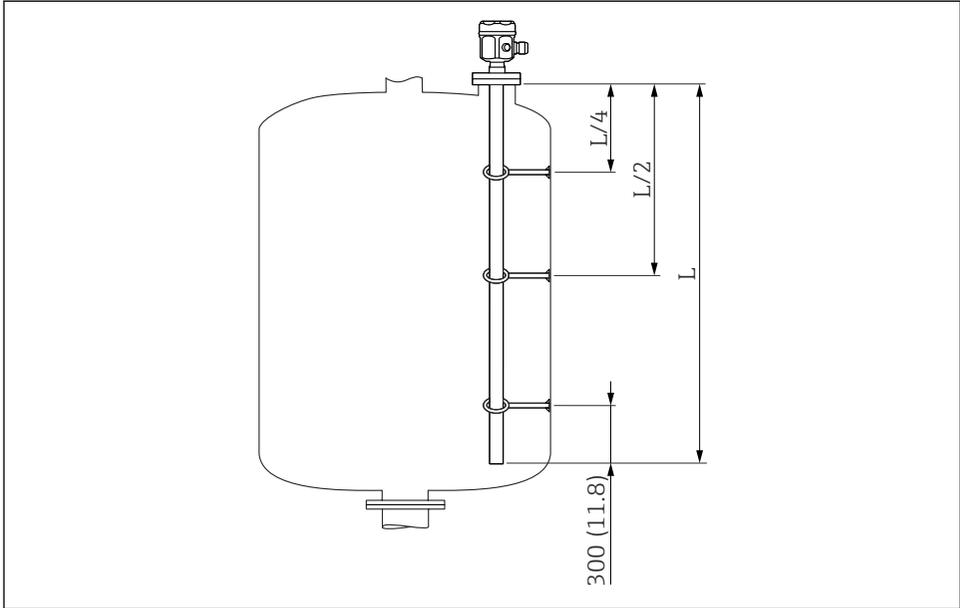
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Unit of measurement mm (in)

4.1.2 Support with marine approval (GL)

Conductive or non-conductive support can be provided for fully insulated rod probes. Partially insulated rod probes may only be supported with insulation at the uninsulated end of the probe.

i Rod probes with a diameter of 10 mm (0.39 in) and 16 mm (0.63 in), and a length ≥ 1 m (3.3 ft) must be supported, see →  10



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Unit of measurement mm (in)

$L/4$ $\frac{1}{4}$ probe length

$L/2$ $\frac{1}{2}$ probe length

L Active probe length

Example of calculating distances

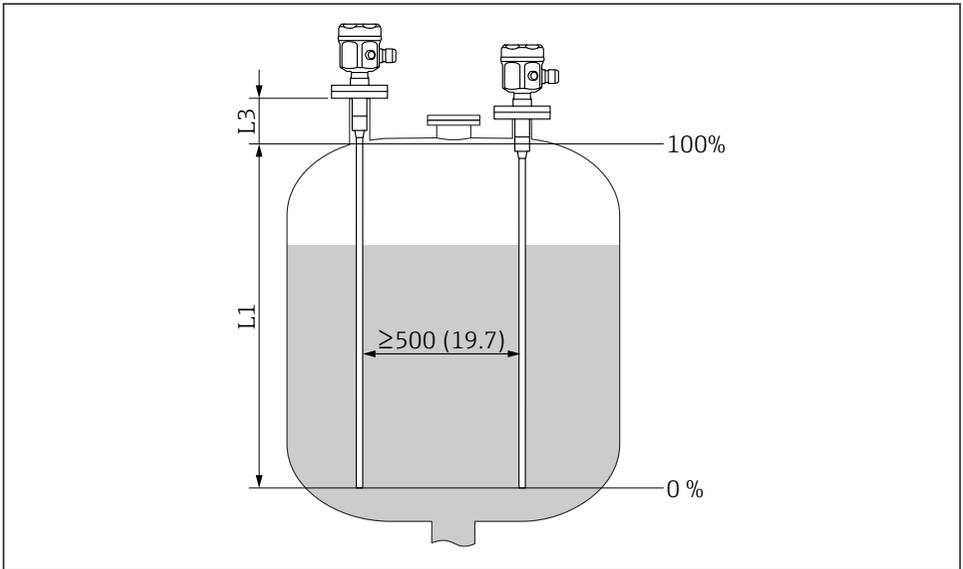
- probe length $L = 2$ m (6.6 ft)
 - $L/4 = 500$ mm (19.7 in)
 - $L/2 = 1$ m (3.3 ft)
- Measured from the end of the probe rod = 300 mm (11.8 in).

4.2 Measuring condition

Measuring range L_1 is possible from the tip of the probe to the process connection.

Particularly suited for small containers.

Use a ground tube for nonconductive media.



Unit of measurement mm (in)

L1 Measuring range

L3 Inactive length



When installing in a nozzle, use inactive length (L3).

The 0 % and 100 % calibration can be inverted.

4.3 Installation examples

4.3.1 Rod probes

The FMI 51 rod probe can be installed:

- in conductive tanks made from metal
- in nonconductive tanks made from plastic

If the process connection of the probe is insulated from the metal tank using a seal material, then the ground connection on the probe housing must be connected to the tank using a short line.

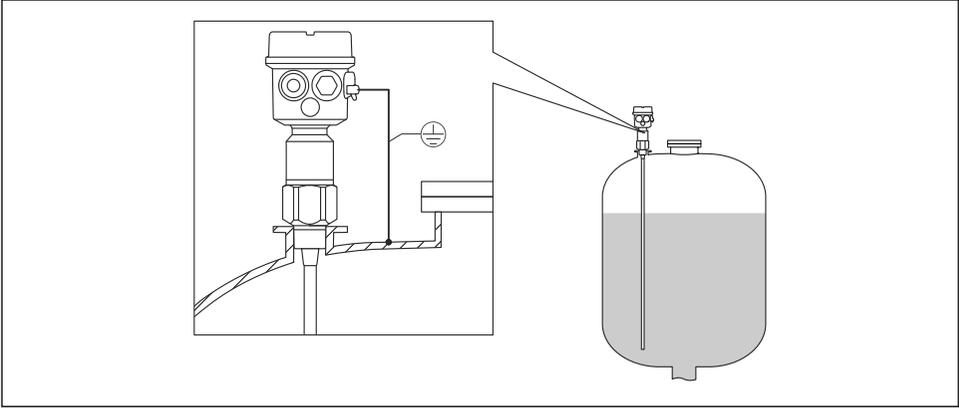
If the probe is installed in a plastic tank, then a probe with ground tube must be used. The probe housing must be grounded.



A fully insulated rod probe may be neither shortened nor extended.

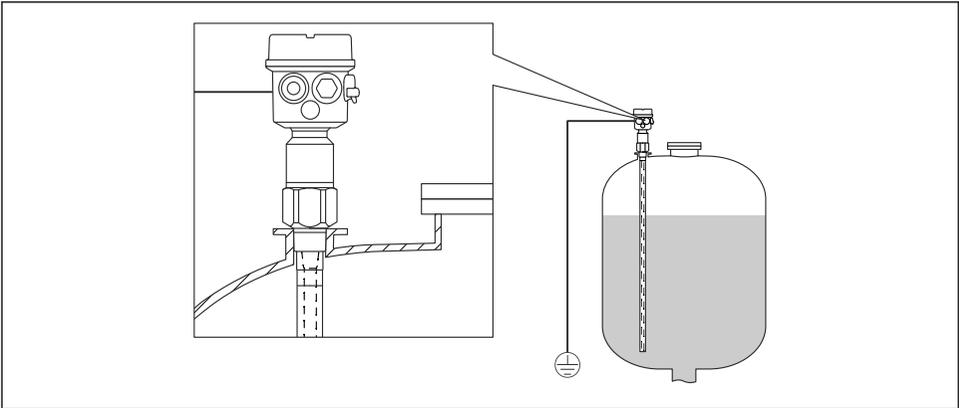
Damaged insulation of the probe rod causes improper measurements.

The following application examples show the vertical installation for continuous level measurement.



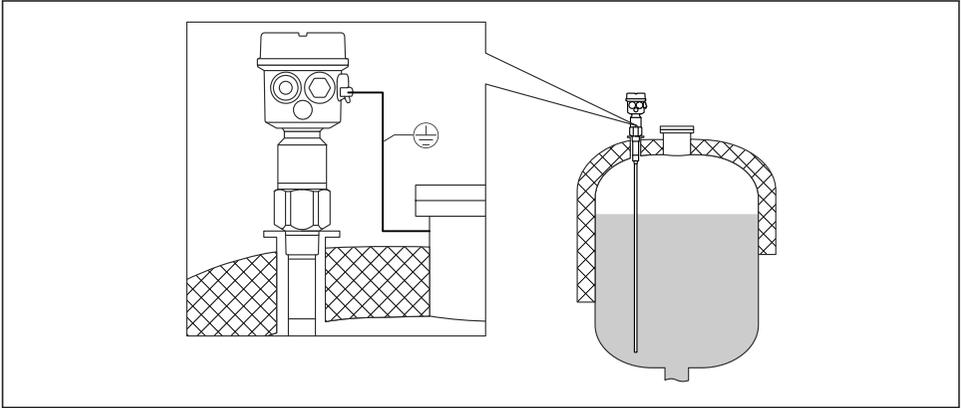
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2 A probe with the conductive tanks



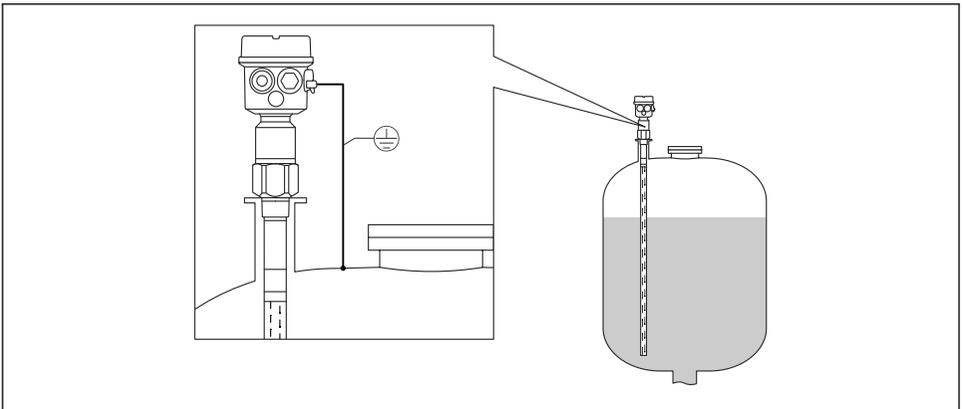
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3 A probe with ground tube for the nonconductive tanks



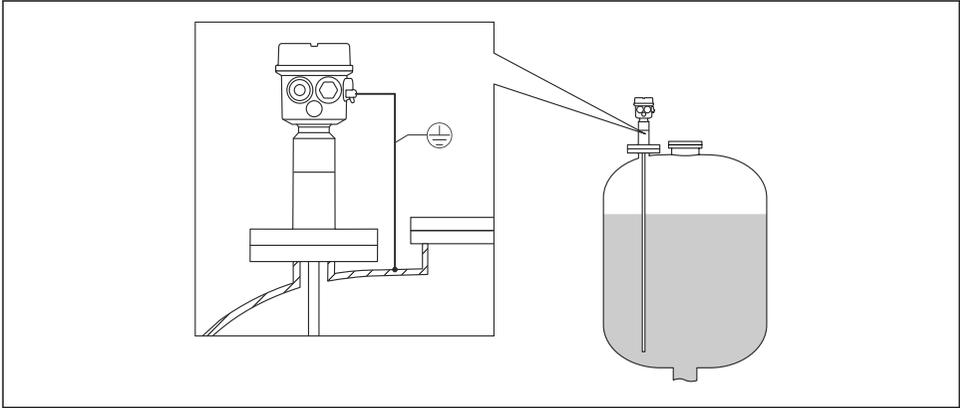
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4 A probe with inactive length for the insulated tanks



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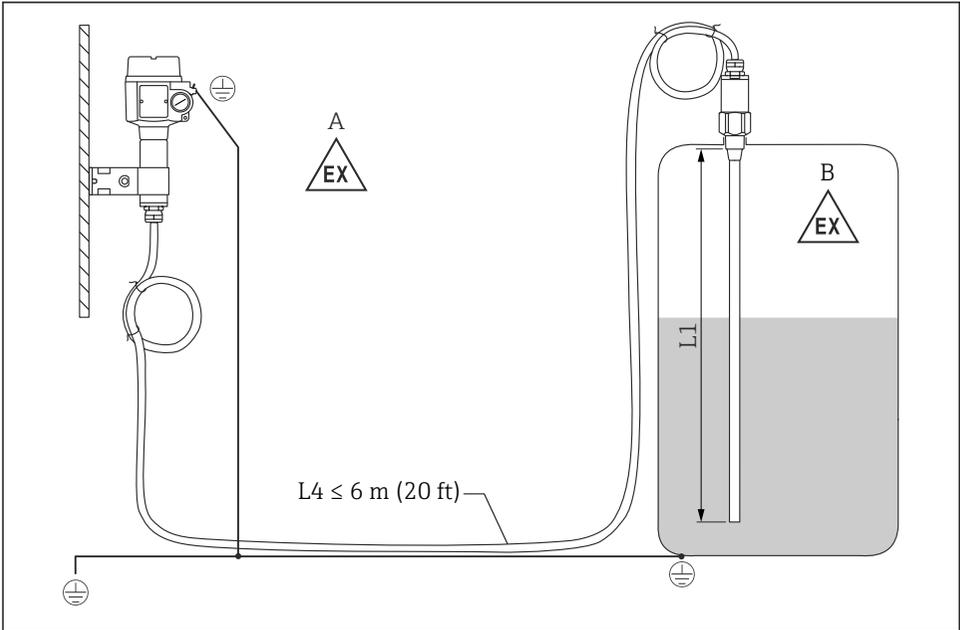
5 A probe with ground tube and inactive length for mounting nozzles



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6 A probe fully insulated with clad flange for aggressive media

4.3.2 Probe with separate housing



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7 Connection of the probe and separate housing

- A Explosive zone 1
- B Explosive zone 0
- L1 Rod length: max. 4 m (13 ft)
- L4 Cable length

The maximum cable length L_4 and rod length L_1 cannot exceed 10 m (33 ft).

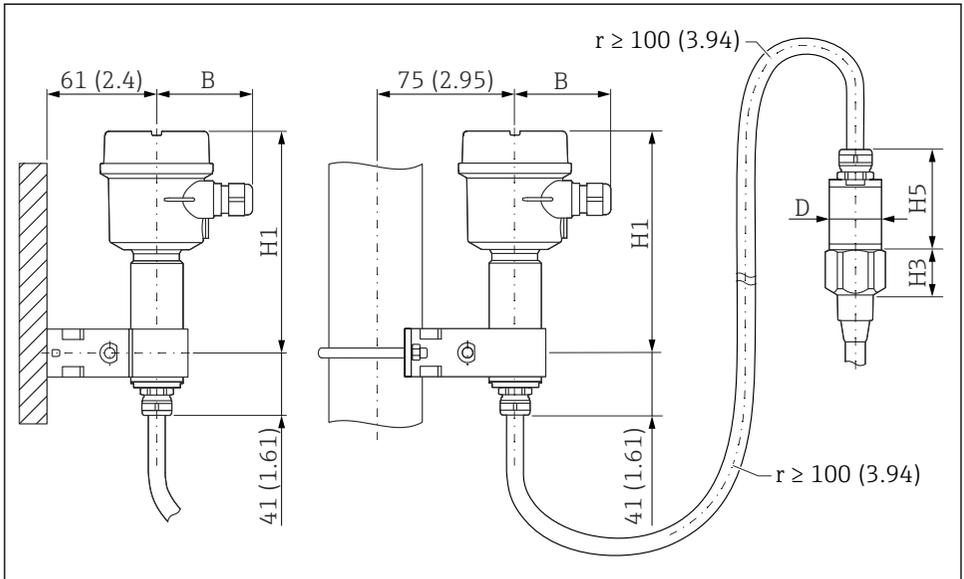
i The maximum cable length between the probe and separate housing is 6 m (20 ft). The required cable length must be indicated in the ordering process of a Liquicap M with separate housing.

If the cable connection has to be shortened or led through a wall, then it must be separated from the process connection.

Extension heights: separate housing

i The cable has:

- a minimum bending radius of $r \geq 100$ mm (3.94 in)
- diameter \varnothing 10.5 mm (0.41 in)
- outer jacket made of silicone, notch resistance



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8 Housing side: wall mounting, pipe mounting, and sensor side. Unit of measurement mm (in)

Values of parameters ¹⁾:

Polyester housing (F16)

- B: 76 mm (2.99 in)
- H1: 172 mm (6.77 in)

1) See parameters on the drawings.

Polyester housing (F15)

- B: 64 mm (2.52 in)
- H1: 166 mm (6.54 in)

Aluminum housing (F17)

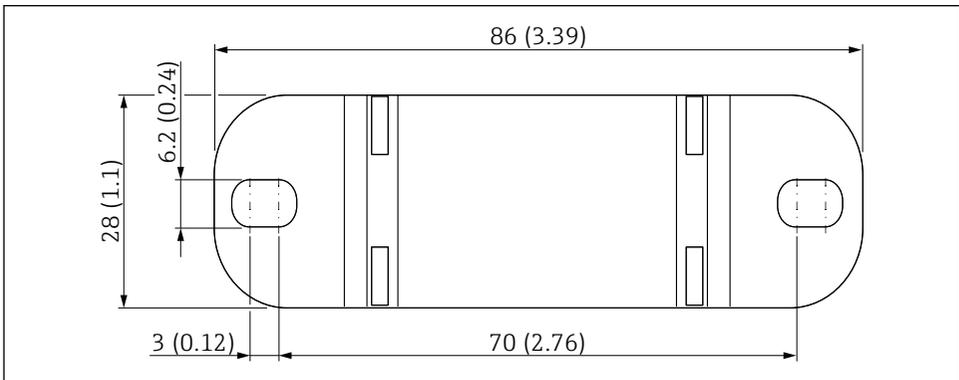
- B: 65 mm (2.56 in)
- H1: 177 mm (6.97 in)

D and H5 parameter value

- Probes $\varnothing 10$ mm (0.39 in) rod:
 - D: 38 mm (1.5 in)
 - H5: 66 mm (2.6 in)
- Probes $\varnothing 16$ mm (0.63 in) rod, without fully insulated inactive length and threads $G\frac{3}{4}$ ", G1", NPT $\frac{3}{4}$ ", NPT1", Clamp 1", Clamp 1 $\frac{1}{2}$ ", Universal $\varnothing 44$ mm (1.73 in), flange < DN50, ANSI 2", 10K50:
 - D: 38 mm (1.5 in)
 - H5: 66 mm (2.6 in)
- Probes $\varnothing 16$ mm (0.63 in) rod, without fully insulated inactive length and threads: G1 $\frac{1}{2}$ ", NPT1 $\frac{1}{2}$ ", Clamp 2", DIN 11851, flange \geq DN50, ANSI 2", 10K50:
 - D: 50 mm (1.97 in)
 - H5: 89 mm (3.5 in)
- Probes $\varnothing 22$ mm (0.87 in) rod, with fully insulated inactive length:
 - D: 38 mm (1.5 in)
 - H5: 89 mm (3.5 in)

Wall bracket

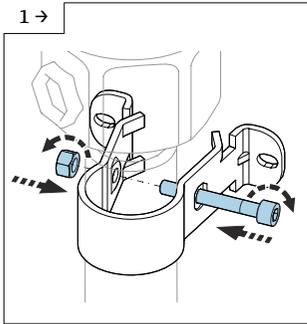
- The wall bracket is a part of the scope of delivery.
- To use the wall bracket as a drill template, the wall bracket must be first screwed to the separate housing.
- The distance between the holes is reduced by screwing it to the separate housing.



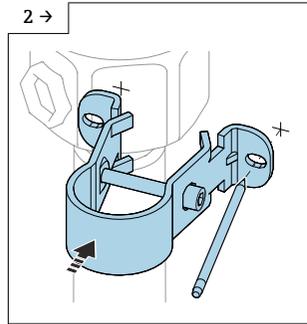
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Unit of measurement mm (in)

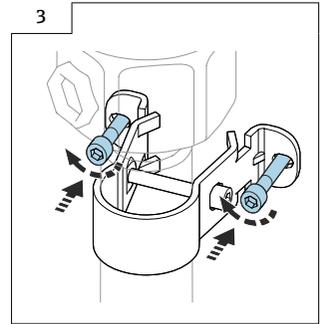
Wall mounting



- ▶ Screw together the wall bracket on the tube.



- ▶ Mark the distance between the holes on the wall before drilling.

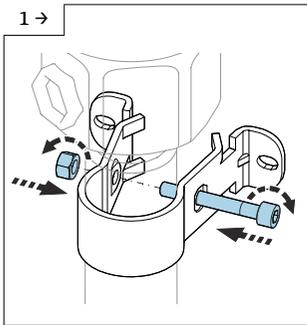


- ▶ Screw the separate housing on the wall.

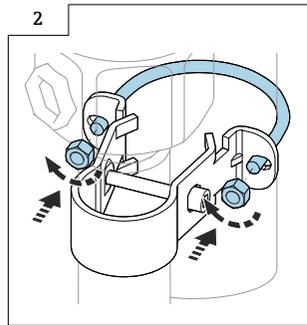
Pipe mounting



The maximum pipe diameter is 50.8 mm (2 in).



- ▶ Screw together the wall bracket on the tube.



- ▶ Screw the separate housing on a pipe.

Shortening the connecting cable

NOTICE

Risk of damage to connections and cable.

- ▶ Make sure that neither the connecting cable nor the probe is turning with the pressing screw!



Recalibration must be performed before commissioning.

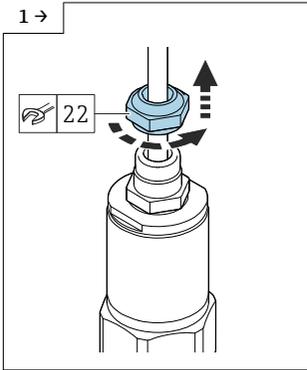
The maximum connection length between the probe and the separate housing is 6 m (20 ft).

When ordering a device with separate housing, the desired length must be specified.

If the cable connection has to be shortened or led through a wall, it must be separated from the process connection.

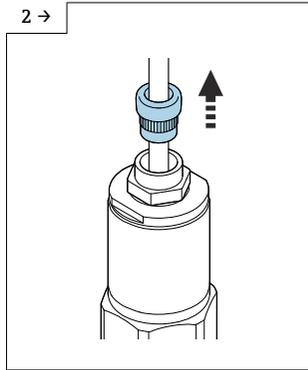
Disconnecting the connection cable

i Make sure that the connecting cable and the probe is not turning with the pressing screw.



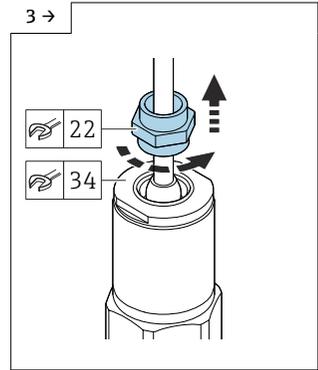
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▶ Loosen the pressing screw with an open-end wrench AF22.



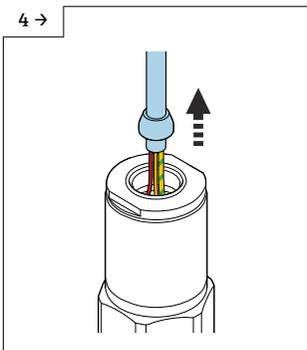
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▶ Pull the insert seal out of the cable gland.



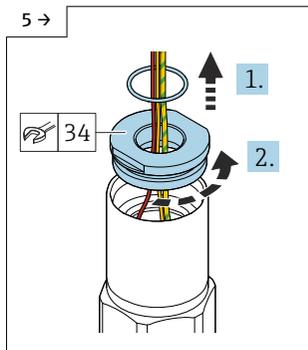
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▶ Block the adapter disk with the open-end wrench AF34 and loosen the cable gland with the open-end wrench AF22.



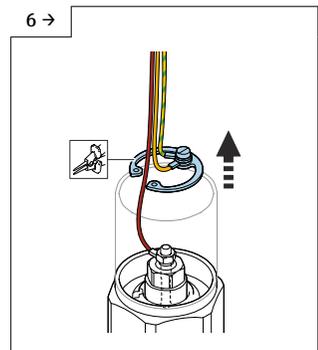
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▶ Pull out the cable with the cone.



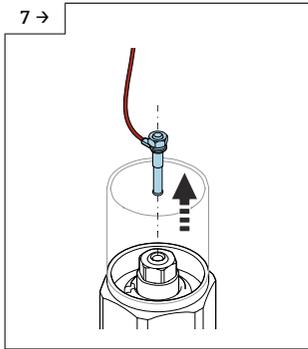
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▶ Remove the seal and loosen the adapter disk with the open-end wrench AF34.

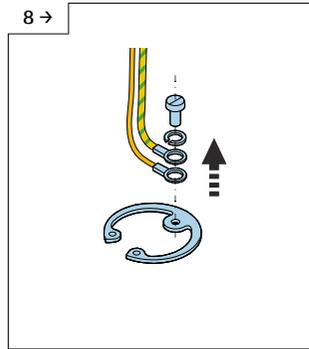


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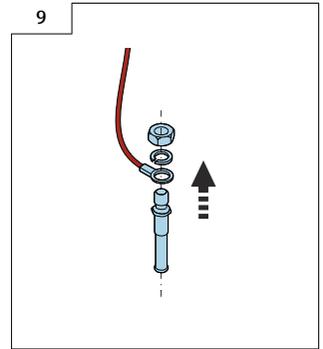
▶ Remove the snap ring with a snap ring pliers.



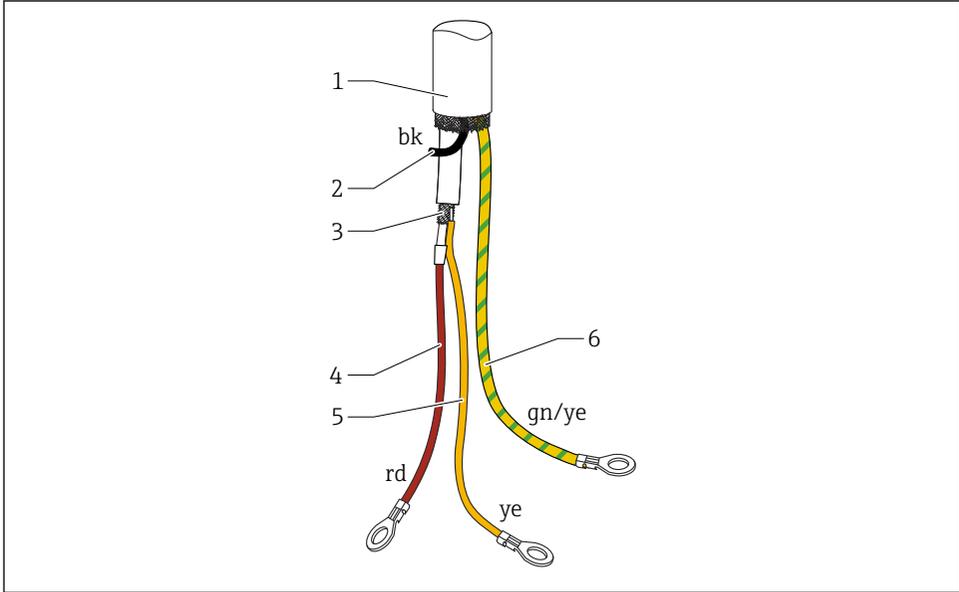
- ▶ Remove the blade plug from the socket.



- ▶ Loosen the screw to disconnect the yellow and yellow-green cables.



- ▶ Loosen the nut (M4) of the blade plug.



A0040734

9 Cable connections

- 1 External screening (not required)
- 2 Strand black (bk) (not required)
- 3 Coaxial cable with central core and screening
- 4 Solder the red (rd) strand with the central core of the coaxial cable (probe)
- 5 Solder the strand with the screening of the yellow (ye) coaxial cable (ground)
- 6 Strand yellow and green (gn/ye) with a ring terminal

- i** We recommend reusing all strands with ring terminals in case of shortening the connecting cable
 - To avoid the risk of short-circuiting when the strands are not to be reused, the connections of the new ring terminals must be insulated with a heat shrinking sleeve
 - Use heat-shrink tubes to insulate all soldered joints

4.4 Installation instructions

NOTICE

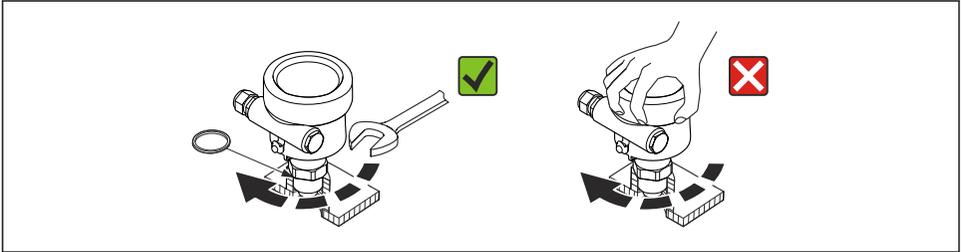
Do not damage the probe insulation during installation!

- ▶ Check the rod insulation.

NOTICE

Do not screw the probe using the probe housing!

- ▶ Use an open-end wrench to screw the probe.



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4.4.1 Probe installation

Probe with thread

Cylindrical threads G $\frac{1}{2}$, G $\frac{3}{4}$, G1, G1 $\frac{1}{2}$

To be used with the elastomer fiber seal supplied or another chemically resistant seal. Make sure that the temperature resistance of a seal is correct.



The following applies to probes with a parallel thread and supplied seal:

Thread G $\frac{1}{2}$

- for pressures up to 25 bar (362.5 psi): 25 Nm (18.4 lbf ft)
- maximum torque: 80 Nm (59.0 lbf ft)

Thread G $\frac{3}{4}$

- for pressures up to 25 bar (362.5 psi): 30 Nm (22.1 lbf ft)
- maximum torque: 100 Nm (73.8 lbf ft)

Thread G1

- for pressures up to 25 bar (362.5 psi): 50 Nm (36.9 lbf ft)
- maximum torque: 180 Nm (132.8 lbf ft)

Thread G1 $\frac{1}{2}$

- for pressures up to 100 bar (1450 psi): 300 Nm (221.3 lbf ft)
- maximum torque: 500 Nm (368.8 lbf ft)

Conical threads $\frac{1}{2}$ NPT, $\frac{3}{4}$ NPT, 1 NPT, 1 $\frac{1}{2}$ NPT

Wrap the thread with a suitable sealing material. Use conductive sealing material only.

Probe with Tri-Clamp, sanitary connection or flange

The process seal must meet the specifications of the application. Check the seal's resistance to temperature and medium.

If the flange is PTFE-clad, this generally suffices as the seal up to the permitted operating pressure.

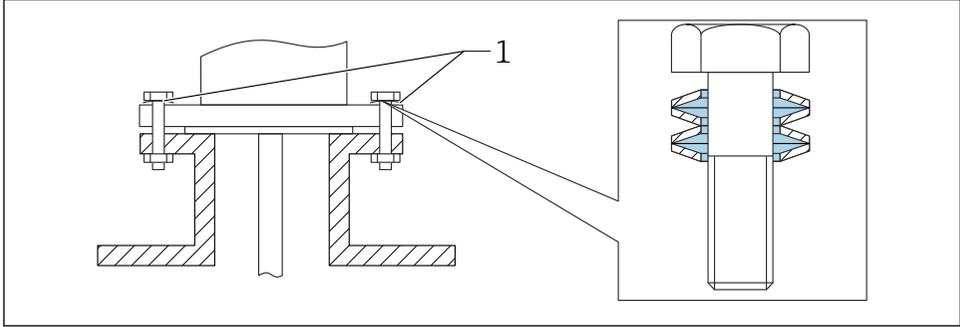
Probe with PTFE-clad flange



Use spring washers!

Depending on process pressure and process temperature, check and re-tighten the screws at regular intervals.

Recommended torque: 60 to 100 Nm (44.3 to 73.8 lbf ft).



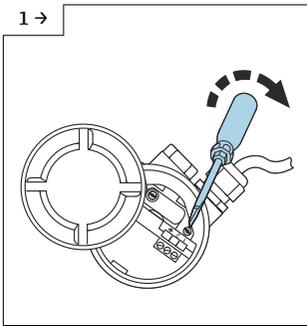
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1 Spring washer

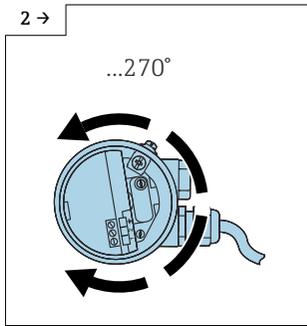
4.4.2 Aligning the housing

The housing can be rotated 270 ° to align with the cable entry. To prevent moisture penetration, route the connecting cable downwards in front of the cable gland and secure it with a cable tie. This is particularly recommended for outdoor mounting.

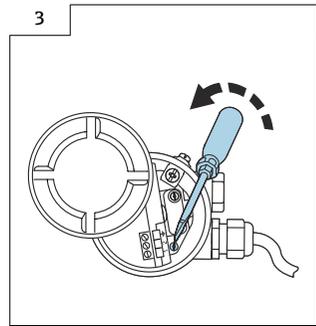
Aligning the housing



A0042107



A0042108



A0042109

▶ Loosen the clamping screw.

▶ Align the housing into the needed position.

▶ Tighten the clamping screw with torque < 1 Nm (0.74 lbf ft).

i The clamping screw for aligning the housing type T13 is located in the electronics compartment.

4.4.3 Sealing the probe housing

Make sure that the cover is sealed. Water cannot enter into the device when performing installation, connection and configuration tasks. Always seal the housing cover and cable entries securely.

The O-ring seal on the housing cover is shipped with a coat of special lubricant applied. In this way, the cover can be sealed tight and the aluminum thread does not bite when screwing down.

Never use mineral oil-based grease as this destroys the O-ring.

4.5 Post-installation check

After installing the measuring device, carry out the following checks:

- Do a visual check for damages.
- Does the device meet the specifications at the measuring point with regard to process temperature and pressure, ambient temperature, measuring range?
- Has the process connection been tightened with the tightening torque?
- Check if the measuring points are correctly labeled.
- Is the device adequately protected against precipitation and direct sunlight?

5 Electrical connection



Before connecting the power supply, note the following:

- the supply voltage must match the data specified on the nameplate
- switch off the supply voltage before connecting the device
- connect the potential equalization to the ground terminal on the sensor



When using the probe in hazardous areas, the relevant national standards and the information in the safety instructions (XA) must be observed.

Use the specified cable gland only.

5.1 Connecting requirements

5.1.1 Potential equalization



Risk of explosion!

- ▶ Connect the cable screen on the sensor side only if installing the probe in Ex-areas!

Connect the potential equalization to the outer ground terminal of the housing (T13, F13, F16, F17, F27). In the case of the stainless steel housing F15, the ground terminal can also be located in the housing. For further safety instructions, please refer to the separate documentation for applications in hazardous areas.

5.1.2 Electromagnetic compatibility (EMC)

Interference emission to EN 61326, Electrical Equipment Class B. Interference immunity to EN 61326, Annex A (Industrial) and NAMUR Recommendation NE 21 (EMC).

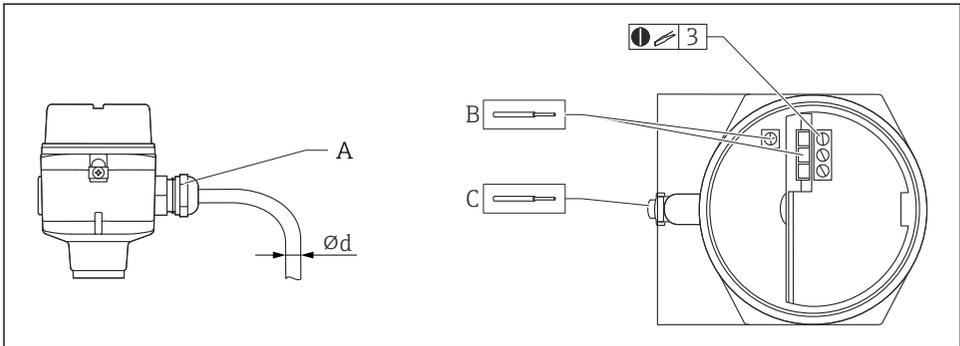
Failure current is in accordance with NAMUR NE43: FEI50H = 22 mA.

A standard commercial instrument cable can be used.

 Information on connecting shielded cables is provided in Technical Information TI00241F "EMC test procedures".

5.1.3 Cable specification

Connect the electronic inserts by using commercially available instrument cables. If a potential equalization is present, and the shielded instrument cables are used, connect the shielding on both sides to optimize the shielding effect.



A0040478

A Cable entry

B Electronic insert connections: cable size max. 2.5 mm² (14 AWG)

C The ground connection outside the housing, cable size max. 4 mm² (12 AWG)

$\varnothing d$ Cable diameter

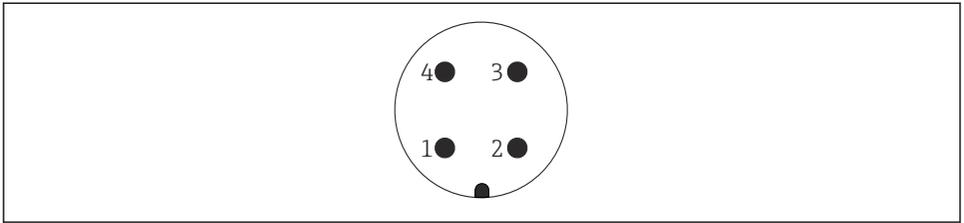
Cable entries

- Nickel-plated brass: $\varnothing d = 7$ to 10.5 mm (0.28 to 0.41 in)
- Synthetic material: $\varnothing d = 5$ to 10 mm (0.2 to 0.38 in)
- Stainless steel: $\varnothing d = 7$ to 12 mm (0.28 to 0.47 in)

5.1.4 Connector

For the version with a connector M12, the housing does not have to be opened for connecting the signal line.

PIN assignment for M12 connector



A0011175

- 1 *Positive potential*
- 2 *Not used*
- 3 *Negative potential*
- 4 *Ground*

5.1.5 Supply voltage

All of the following voltage is terminal voltage directly at the device:

14.8 V_{DC} from associated supply unit

5.2 Wiring and connecting

5.2.1 Connection compartment

Depending on explosion protection, the connection compartment is available in the following variants:

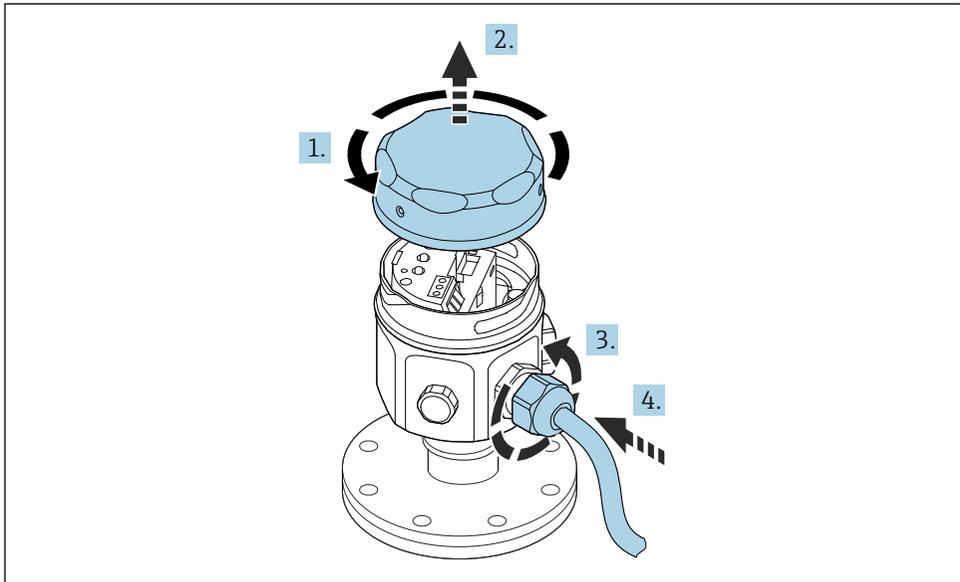
Standard protection, Ex ia protection

- polyester housing F16
- stainless steel housing F15
- aluminum housing F17
- aluminum housing F13 with gas-tight process seal
- stainless steel housing F27
- aluminum housing T13, with the separate connection compartment

Ex d protection, Gas-tight process seal

- aluminum housing F13 with gas-tight process seal
- stainless steel housing F27 with gas-tight process seal
- aluminum housing T13, with the separate connection compartment

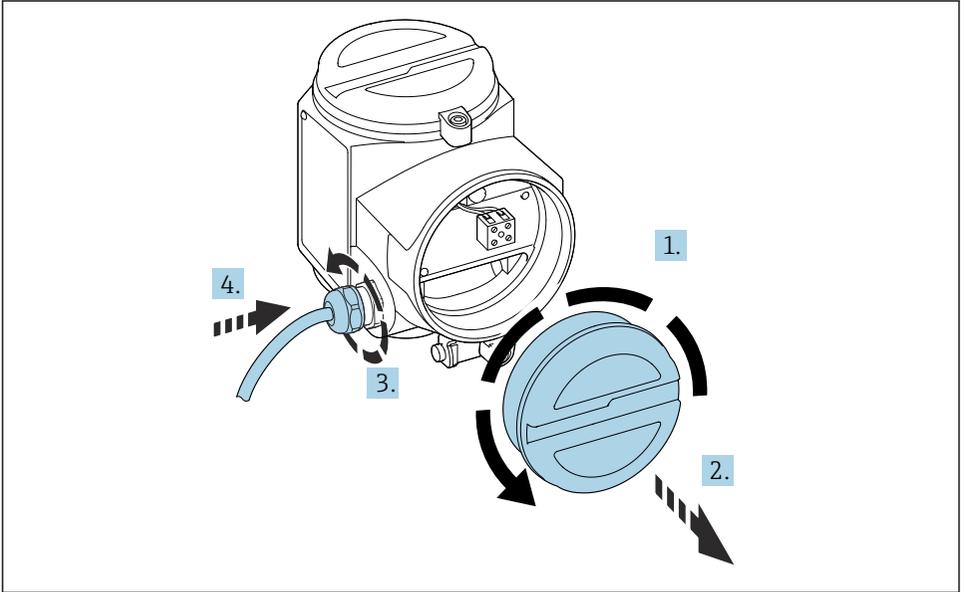
Connecting the electronic insert to the power supply:



A0040635

1. Unscrew the housing cover.
2. Remove the housing cover.
3. Release the cable gland.
4. Insert the cable.

Connecting the electronic insert to the power supply mounted in the housing T13:



A0040637

1. Unscrew the housing cover.
2. Remove the housing cover.
3. Release the cable gland.
4. Insert the cable.

5.2.2 Cable entry

Cable gland: M20x1.5 Cable entry: G ½ or NPT ½, NPT ¾

5.2.3 Supply voltage

14.8 V_{DC} from associated supply unit

5.2.4 Power consumption

Approximately 150 mW

5.2.5 Current consumption

Maximum 10 mA.

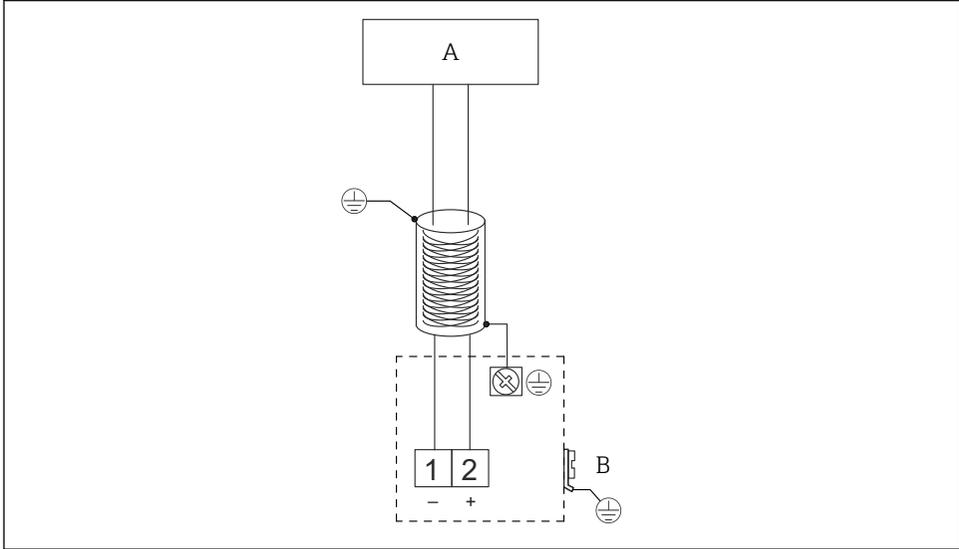
5.2.6 Terminal assignment

2-wire, PFM

The twin-core, shielded connecting cable with a cable resistance of max. 25 Ω per core is connected to the screw terminals (conductor cross-section 0.5 to 2.5 mm (0.02 to 0.1 in)) in the connection compartment.



The shielding must be connected at the sensor and power supply. Protective circuits against reverse polarity, HF influences and overvoltage peaks are integrated, for more information see document "EMC test procedures" TI00241F.



A0040776

- A *Switching unit*
 B *Grounding terminal*

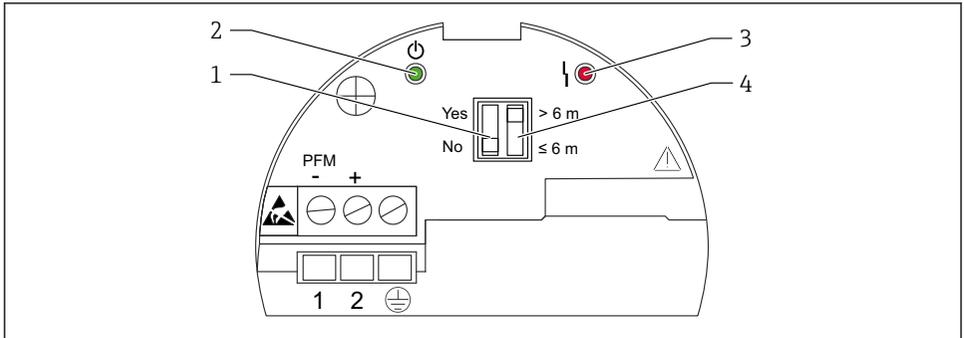
5.3 Post-connection check

After wiring the measuring device, carry out the following checks:

- Is the terminal assignment correct?
- Is the cable gland sealed tight?
- Is the housing cover fully screwed?
- Is the device operational and is the green LED flashing when the device is on?

6 Operation options

6.1 Display and operating elements



A0040775

- 1 Two-position DIP switch "Build up"
- 2 Green LED - operational status
- 3 Red LED - fault
- 4 Two-position DIP switch "Probe length"

Elements description

- Two-position DIP switch "Build up" (1):
 - YES: setting is recommended for media that cause heavy buildup, e.g. honey
 - NO: setting is recommended for media that do not cause buildup, e.g. water
- Green LED - operational status (2):
 - indicates that the device is ready for operation when flashes every 5 s
- Red LED - fault (3)
 - flashes 5x a second - Alarm. The PFM output signaled an error current signal and sets the output of the connected switching unit to 3.6 mA or 22 mA. The switching unit outputs an alarm itself
 - flashes 1x a second - Warning. The temperature in the electronic insert is outside the permitted temperature range
- Two-position DIP switch "Probe length" (4):
 - rod probe length ≤ 4 m (13 ft), measuring range 0 to 2 000 pF

7 Commissioning

7.1 Function check

Make sure that the post-installation check and final check have been completed before you start your measuring point:

- the "Post-installation check" checklist →  23
- the "Post-connection check" checklist →  23

7.2 Transmitter

 The settings on the electronic insert affect the function of the switching unit.

For further commissioning, please refer to the Operating Instructions of the transmitter power supply unit.

The device documentation of these devices is also available for download at www.endress.com-> Download -> e.g. product root: FMX570.



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www.addresses.endress.com
