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Technical Information
Liquiphant FTL64

Vibronic

Point level switch for liquids in high-temperature applications

Application

- Point level switch for all liquids, for minimum or maximum detection in tanks, vessels and piping, even in hazardous areas
- Particularly suitable for high-temperature applications with up to 280 °C (536 °F)
- Tuning fork and process connection with highly corrosion-resistant Alloy C22 (2.4602) material and PFA-coated (conductive) version available for very aggressive media
- Process temperature range: −60 to +280 °C (−76 to +536 °F)
- Pressures up to 100 bar (1 450 psi)
- Viscosities up to 10 000 mPa·s
- Ideal substitute for float switches; reliable function is not affected by flow, turbulence, air bubbles, foam, vibration, solids content or buildup.

Advantages

- Approved for safety systems with functional safety requirements up to SIL2/SIL3 in accordance with IEC 61508
- Maximum safety thanks to welded gas-tight feedthrough, even if sensor is damaged
- Functional safety: monitoring of the vibration frequency of the tuning fork
- Heartbeat Technology via the free iOS/Android SmartBlue app
- With *Bluetooth*® wireless technology

Endress+Hauser
People for Process Automation

Table of contents

About this document

Symbols

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.

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.

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

Symbols in graphics

A, B, C ... View

1, 2, 3 ... Item numbers

Hazardous area

Safe area (non-hazardous area)

Function and system design

point level detection

Maximum or minimum detection for liquids in tanks or pipes in all industries. Suitable for leakage monitoring, pump dry-running protection or overfill prevention, for example .

Specific versions are suitable for use in hazardous areas.

The point level switch differentiates between the "covered" and "not covered" conditions.

Depending on the MIN (minimum detection) or MAX (maximum detection) modes, there are two possibilities in each case: OK status and demand mode.

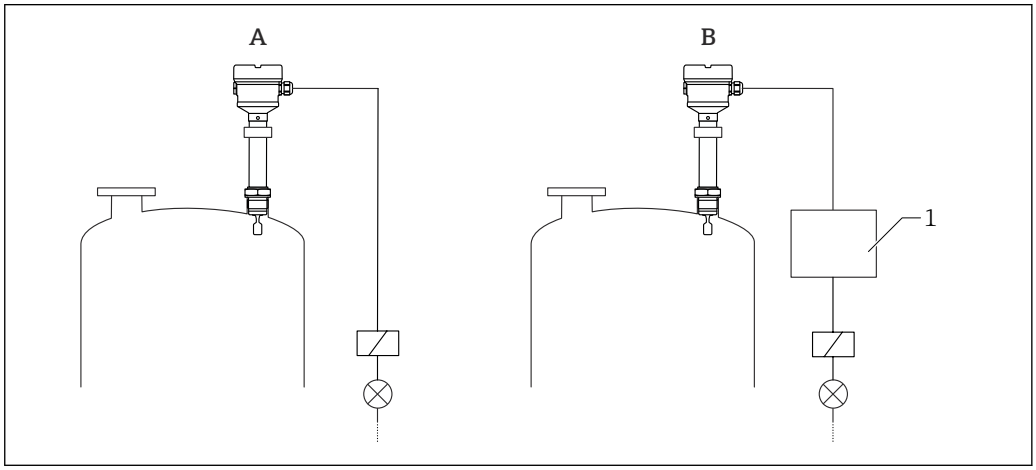
OK status
- In MIN mode, the fork is covered, e.g. Pump dry running protection
- In MAX mode, the fork is not covered e.g. overfill prevention

Demand mode
- In MIN mode, the fork is not covered e.g. pump dry running protection
- In MAX mode, the fork is covered e.g. overfill prevention

Measuring principle

The sensor's tuning fork vibrates at its intrinsic frequency. As soon as the liquid covers the tuning fork, the vibration frequency decreases. The change in frequency causes the point level switch to switch.

Measuring system



1 Example of a measuring system

A Device for direct connection of a load
B Device for connection to a separate switching unit or PLC
1 Switching unit, PLC etc.

Dependability

Device-specific IT security

The device settings and the diagnostic data can be read out via Bluetooth. Device settings cannot be changed via Bluetooth.

Input

Measured variable

Level (point level), MAX or MIN safety

Measuring range

Depends on the installation location and the pipe extension ordered

Standard pipe extension up to 3 m (9.8 ft) and up to 6 m (20 ft) on request.

Output

Output and input variants

Electronic inserts

2-wire AC (FEL61)
- Two-wire AC version
- Switches the load directly into the power supply circuit via an electronic switch

3-wire DC-PNP (FEL62)
- Three-wire direct current version
- Switches the load via the transistor (PNP) and separate connection, e. g. in conjunction with programmable logical controllers (PLC)
- Ambient temperature −60 °C (−76 °F), optionally available to order
  Low-temperature electronic inserts are marked LT

Universal current connection, relay output (FEL64)
- Switches the loads via 2 floating change-over contacts
- Ambient temperature −60 °C (−76 °F), optionally available to order
  Low-temperature electronic inserts are marked LT

Direct current connection, relay output (FEL64DC)
- Switches the load via 2 potential-free changeover contacts
- Ambient temperature −60 °C (−76 °F), optionally available to order
  Low-temperature electronic inserts are marked LT

PFM output (FEL67)
- For separate switching device (Nivotester FTL325P, FTL375P)
- PFM signal transmission; current pulses are superimposed on the power supply along the two-wire cabling
- Ambient temperature −50 °C (−58 °F), optionally available to order
  The low-temperature electronic inserts are marked LT

2-wire NAMUR > 2.2 mA/< 1.0 mA (FEL68)
- For separate switching device, e. g. Nivotester FTL325N
- Signal transmission H-L edge 2.2 to 3.8/0.4 to 1.0 mA as per IEC 60917-5-6 (NAMUR) on two-wire cable
- Ambient temperature −50 °C (−58 °F), optionally available to order
  Low-temperature electronic inserts are marked LT

Output signal

Switch output

The following default switching delay times can be ordered for electronic inserts FEL61, FEL62, FEL64, FEL64DC, FEL67 and FEL68:
- 0.5 s when the tuning fork is covered and 1.0 s when it is uncovered (factory setting)
- 0.25 s when the tuning fork is covered and 0.25 s when it is uncovered (fastest configuration)
- 1.5 s when the tuning fork is covered and 1.5 s when it is uncovered
- 5.0 s when the tuning fork is covered and 5.0 s when it is uncovered

COM interface

For connecting to modules VU120 or VU121 (no modifying effect)

Bluetooth® wireless technology (optional)

The device has a Bluetooth® wireless technology interface. Device data and diagnostic data can be read out using the free "SmartBlue" app.

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 Ex devices.

2-wire AC (electronic insert FEL61)

- Two-wire AC version
- Switches the load directly into the power supply circuit via an electronic switch; always connect in series with a load
- Functional testing without level change
  A functional test can be performed on the device using the test button on the electronic insert.

Supply voltage

U = 19 to 253 V_{AC}, 50 Hz/60 Hz

Residual voltage when switched through: typically 12 V

Observe the following as per IEC/EN61010-1: Provide a suitable circuit breaker for the device, and limit the current to 1 A, e.g. by installing a 1 A fuse (slow-blow) in the phase (not the neutral conductor) of the supply circuit.

Power consumption

S ≤ 2 VA

Current consumption

Residual current when blocked: I ≤ 3.8 mA

The red LED flashes in the event of an overload or short-circuit. Check for an overload or short-circuit every 5 s. The test is deactivated after 60 s.

Connectable load

- Load with a minimum holding power/rated power of 2.5 VA at 253 V (10 mA) or 0.5 VA at 24 V (20 mA)
- Load with a maximum holding power/rated power of 89 VA at 253 V (350 mA) or 8.4 VA at 24 V (350 mA)
- With overload and short-circuit protection

Behavior of output signal

- OK status: load on (switched through)
- Demand mode: load off (blocked)
- Alarm: load off (blocked)

Terminals

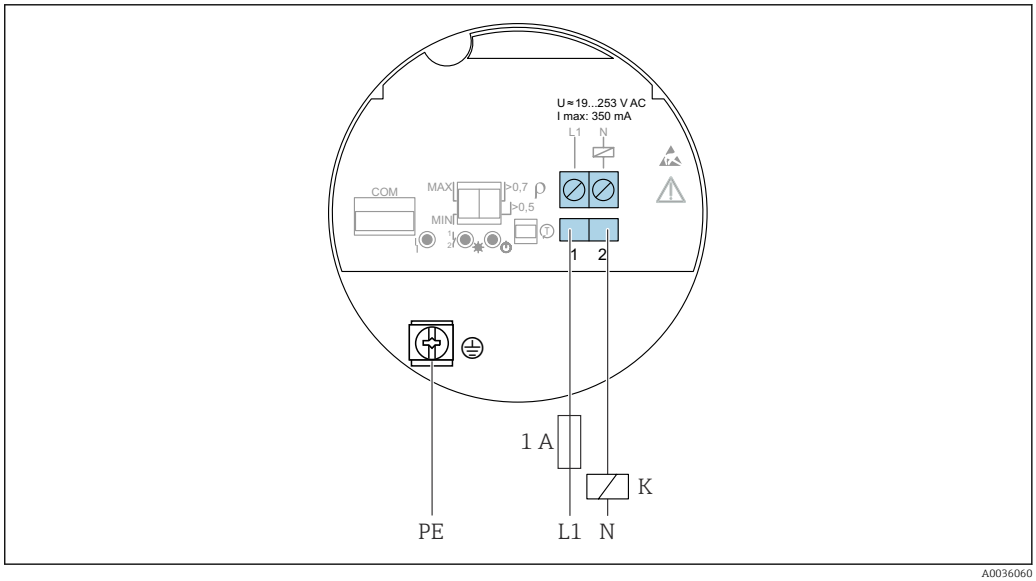
Terminals for cable cross-section up to 2.5 mm^2 (14 AWG). Use ferrules for the wires.

Overvoltage protection

Overvoltage category II

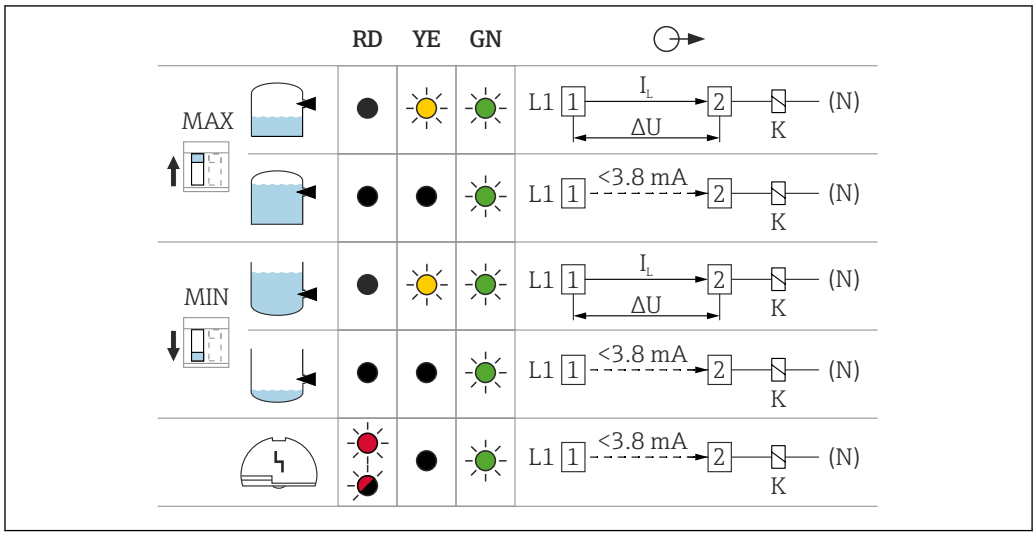
Terminal assignment

Always connect an external load. The electronic insert has integrated short-circuit protection.



2 *2-wire AC, electronic insert FEL61*

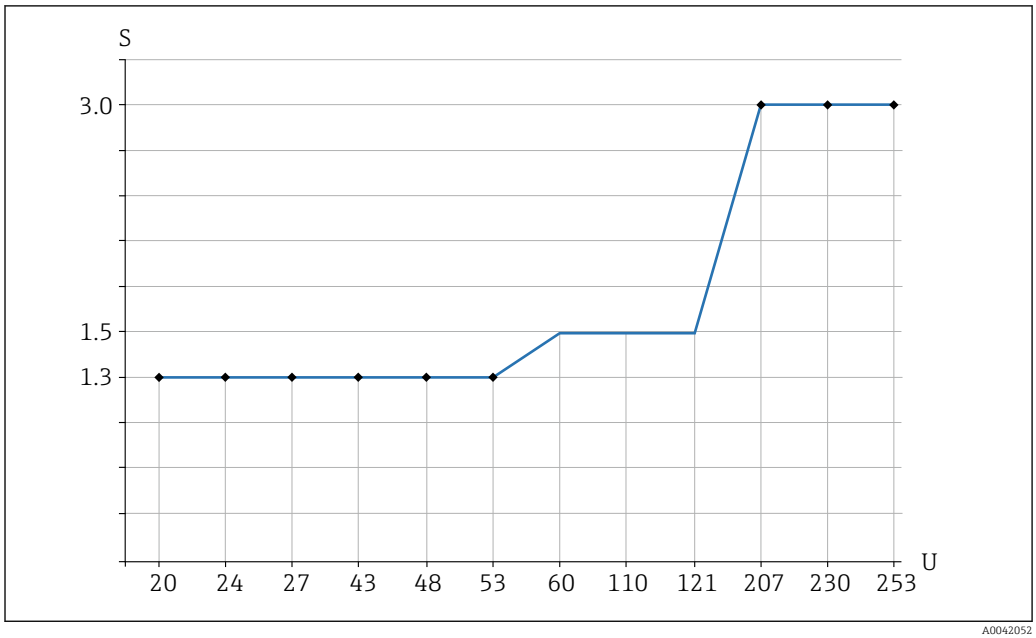
Behavior of switch output and signaling



3 *Behavior of switch output and signaling, electronic insert FEL61*

MAX DIP switch for setting MAX safety mode
MIN DIP switch for setting MIN safety mode
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

Selection tool for relays



4 *Recommended minimum holding power/rated power for load*

S Holding power/rated power in [VA]
U Operating voltage in [V]

AC mode

- Operating voltage: 24 V, 50 Hz/60 Hz
- Holding power/rated power: > 0.5 VA, < 8.4 VA
- Operating voltage: 110 V, 50 Hz/60 Hz
- Holding power/rated power: > 1.1 VA, < 38.5 VA
- Operating voltage: 230 V, 50 Hz/60 Hz
- Holding power/rated power: > 2.3 VA, < 80.5 VA

3-wire DC-PNP (electronic insert FEL62)

- Three-wire DC version
- Preferably in conjunction with programmable logic controllers (PLC), DI modules as per EN 61131-2. Positive signal at switch output of electronics module (PNP)
- Functional testing without level change
  A functional test can be performed on the device using the test button on the electronic insert or using the test magnet (can be ordered as an option) with the housing closed.

Supply voltage

WARNING

Failure to use the prescribed power unit.
Risk of potentially life-threatening electric shock!
▶ The FEL62 may only be powered by devices with safe galvanic isolation, as per IEC 61010-1.

$U = 10$ to $55\ V_{DC}$

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

$P \leq 0.5$ W

Current consumption

$I \leq 10$ 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

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

Capacitance load

$C \leq 0.5$ µF at 55 V, $C \leq 1.0$ µF at 24 V

Residual current

$I < 100$ µA (for blocked transistor)

Residual voltage

$U < 3$ V (for switched through transistor)

Behavior of output signal

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

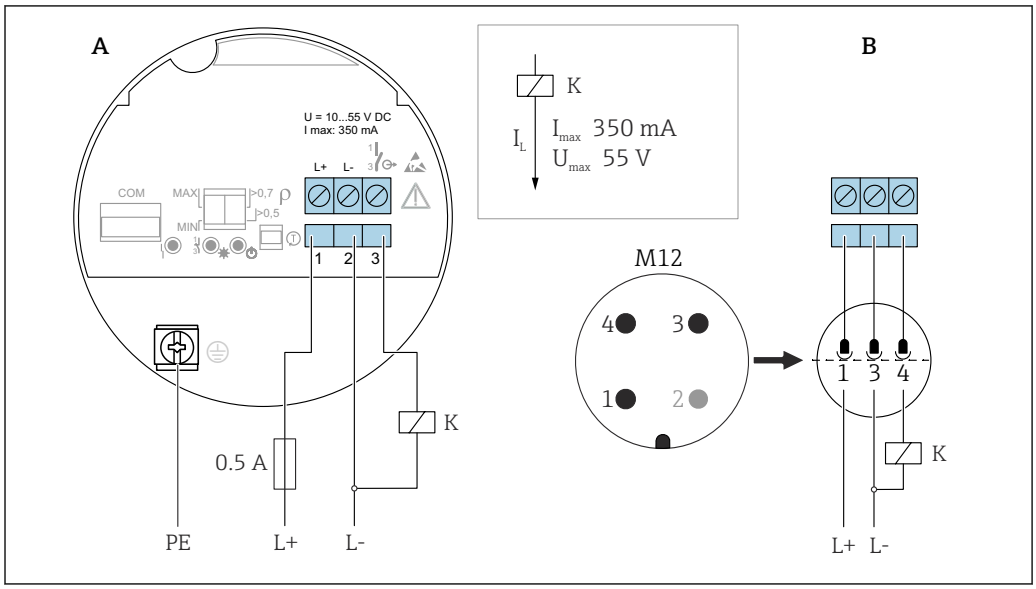
Terminals

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

Overvoltage protection

Overvoltage category II

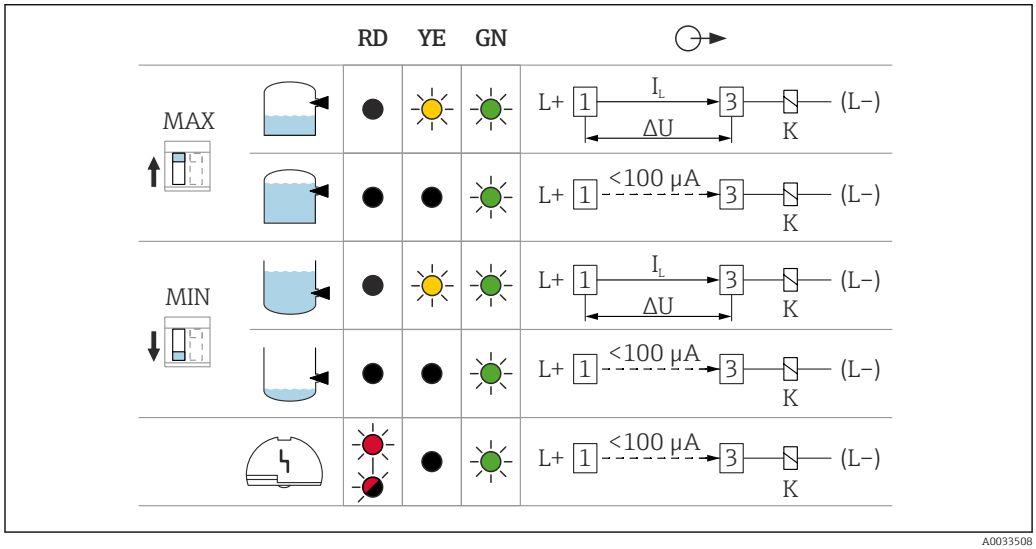
Terminal assignment



5 *3-wire DC-PNP, electronic insert FEL62*

A Connection wiring with terminals
B Connection wiring with M12 plug in housing as per EN61131-2 standard

Behavior of switch output and signaling



6 *Behavior of switch output and signaling, electronic insert FEL62*

MAX DIP switch for setting MAX safety mode
MIN DIP switch for setting MIN safety mode
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

Universal current connection with relay output (electronic insert FEL64)

- Switches the loads via 2 potential-free change-over contacts
- 2 galvanically isolated change-over contacts (DPDT), both change-over contacts switch simultaneously
- Functional testing without level change. A functional test can be performed on the device using the test button on the electronic insert or using the test magnet (can be ordered as an option) with the housing closed.

⚠ 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 to 253 V_{AC}, 50 Hz/60 Hz / 19 to 55 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 VA, P < 1.3 W

Connectable load

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

- I_{AC} ≤ 6 A (Ex de 4 A), U~ ≤ AC 253 V; P~ ≤ 1 500 VA, cos φ = 1, P~ ≤ 750 VA, cos φ > 0.7
- I_{DC} ≤ 6 A (Ex de 4 A) to DC 30 V, I DC ≤ 0.2 A to 125 V

According to IEC 61010, the following applies: Total voltage from relay outputs and power supply ≤ 300 V.

Use electronic insert FEL62 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

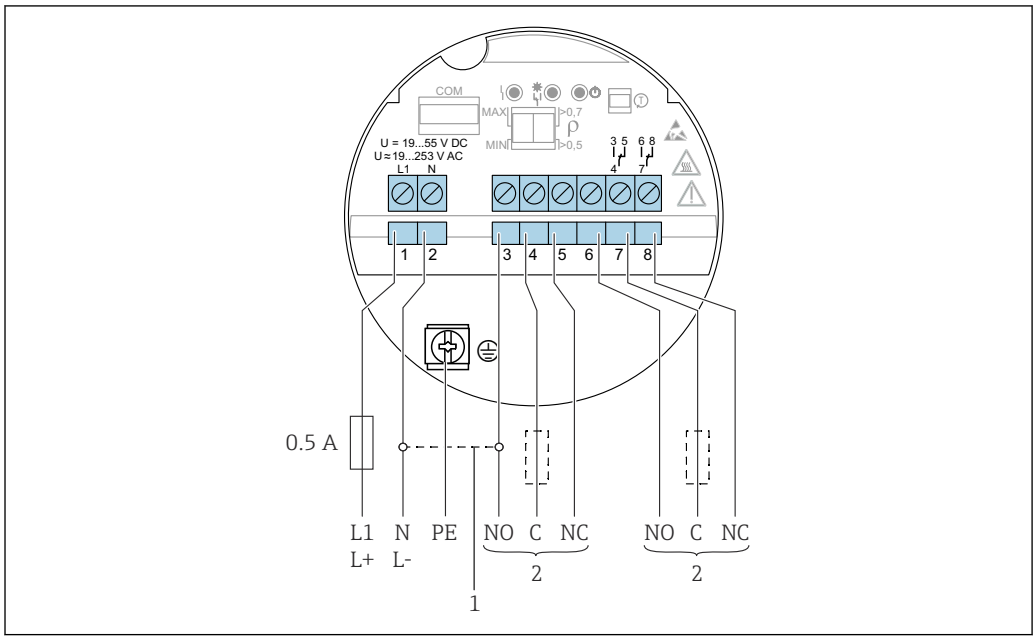
Terminals

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



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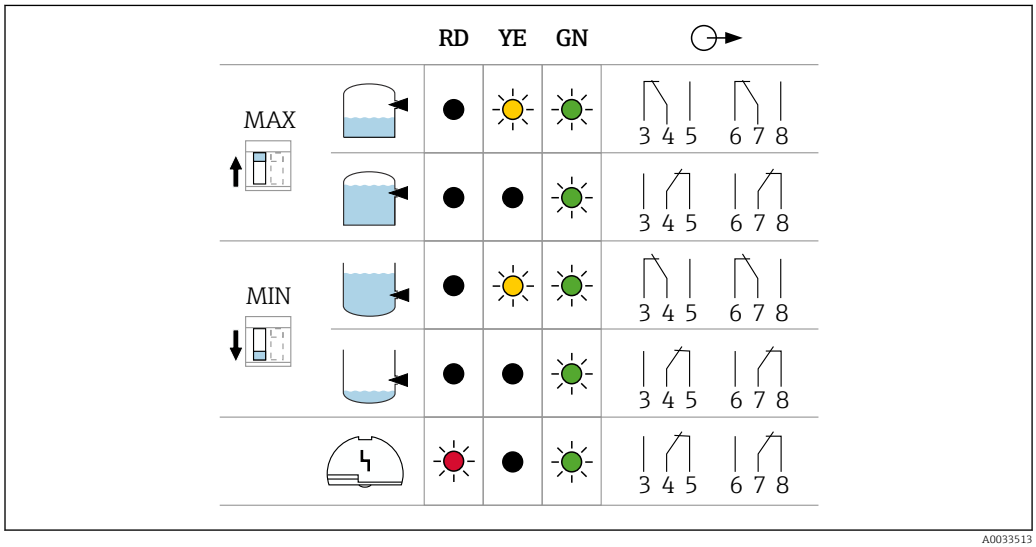
7 *Universal current connection with relay output, electronic insert FEL64*

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

Behavior of switch output and signaling



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8 *Behavior of switch output and signaling, electronic insert FEL64*

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

DC connection, relay output (electronic insert FEL64 DC)

- Switches the loads via 2 potential-free change-over contacts
- 2 galvanically isolated change-over contacts (DPDT), both change-over contacts switch simultaneously
- Functional testing without level change. Functional testing of the entire device can be performed using the test button on the electronic insert or with the test magnet (can be ordered as an option) with the housing closed.

Supply voltage

U = 9 to 20 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

P < 1.0 W

Connectable load

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

- I_{AC} ≤ 6 A (Ex de 4 A), U~ ≤ AC 253 V; P~ ≤ 1 500 VA, cos φ = 1, P~ ≤ 750 VA, cos φ > 0.7
- I_{DC} ≤ 6 A (Ex de 4 A) to DC 30 V, I DC ≤ 0.2 A to 125 V

According to IEC 61010, the following applies: Total voltage from relay outputs and power supply ≤ 300 V

Preferably use electronic insert FEL62 DC PNP for small DC load currents, e.g. connection to a PLC.

Relay contact material: silver/nickel AgNi 90/10

When connecting a device with high inductance, provide spark quenching 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.

Behavior of output signal

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

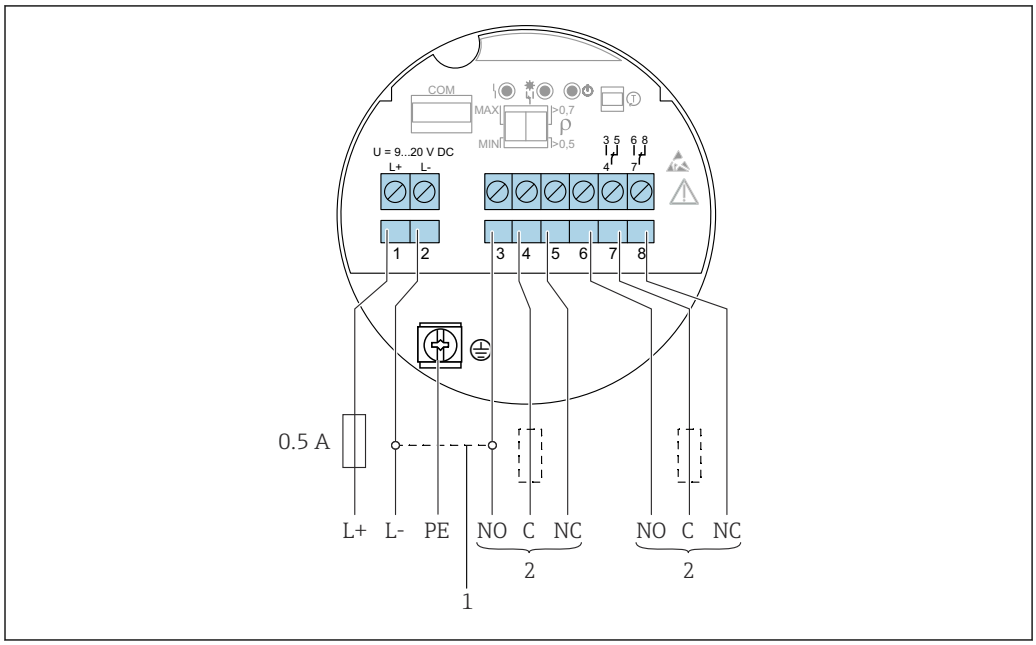
Terminals

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

Overvoltage protection

Overvoltage category II

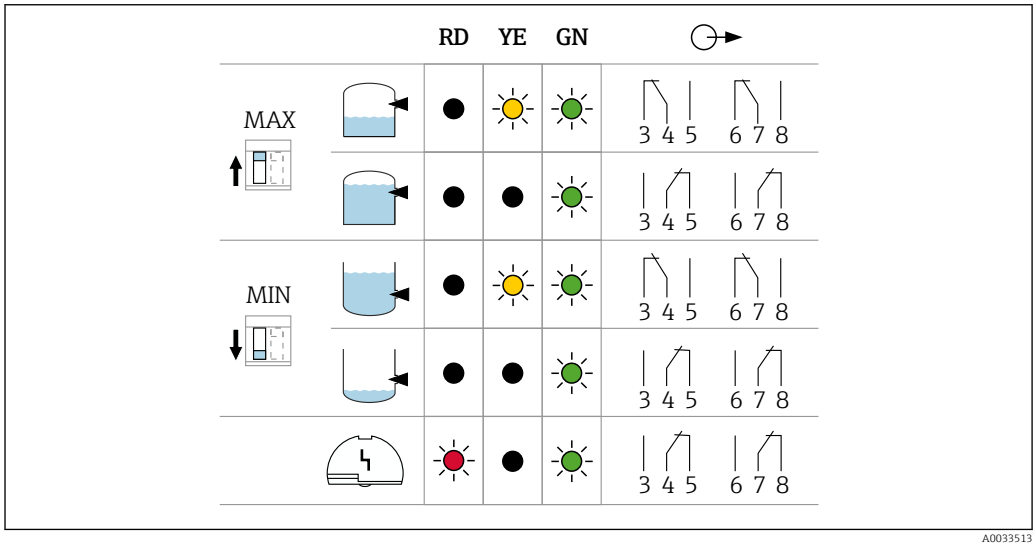
Terminal assignment



9 *DC connection with relay output, electronic insert FEL64 DC*

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

Behavior of switch output and signaling



10 *Behavior of switch output and signaling, electronic insert FEL64 DC*

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

PFM output (electronic insert FEL67)

- For connecting to the Nivotester FTL325P and FTL375P switching units from Endress+Hauser
- PFM signal transmission; pulse frequency modulation, superimposed on the power supply along the two-wire cabling
- Functional testing without level change:
  - A functional test can be performed on the device using the test button on the electronic insert.
  - The functional test can also be prompted by disconnecting the supply voltage or triggered directly by the Nivotester FTL325P and FTL375P switching unit.

Supply voltage

U = 9.5 to 12.5 V_{DC}

Reverse polarity protection

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

Power consumption

P ≤ 150 mW with Nivotester FTL325P or FTL375P

Behavior of output signal

- OK status: MAX operating mode 150 Hz, MIN operating mode 50 Hz
- Demand mode: MAX operating mode 50 Hz, MIN operating mode 150 Hz
- Alarm: MAX/MIN operating mode 0 Hz

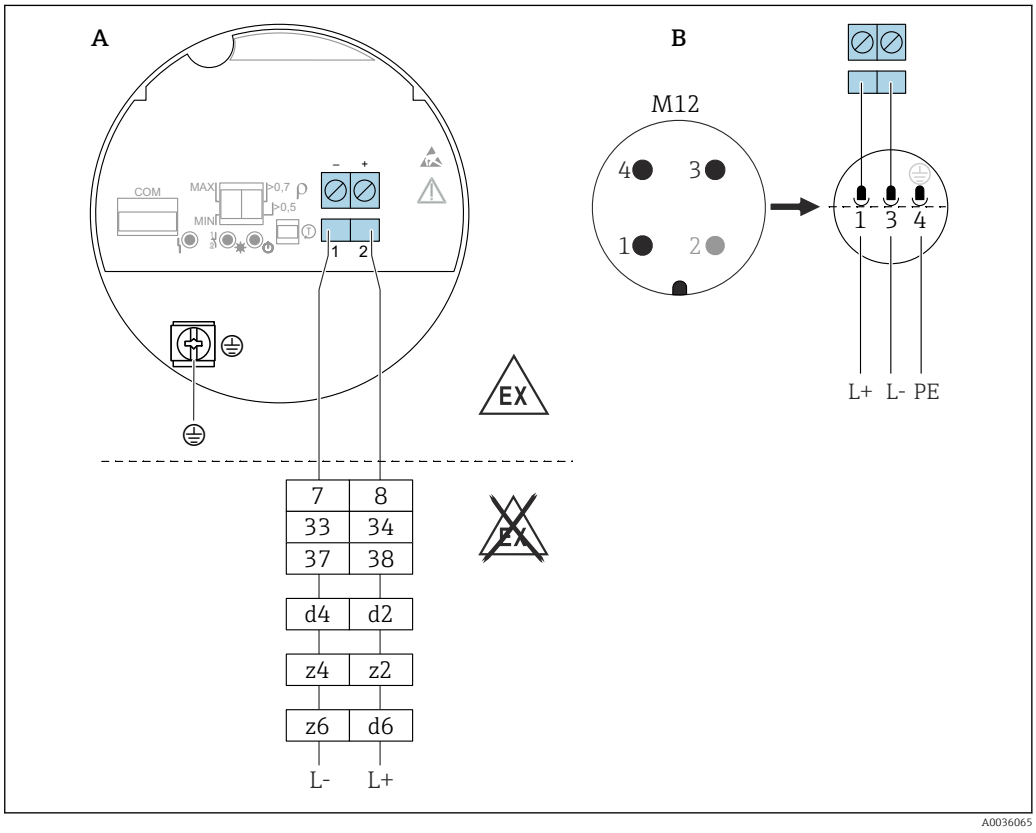
Terminals

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



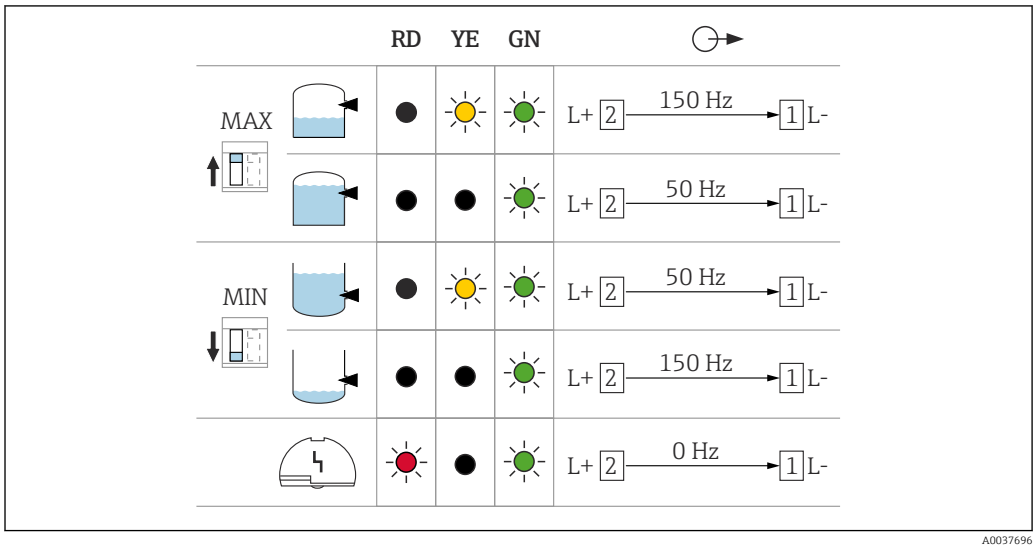
11 PFM output, electronic insert FEL67

A Connection wiring with terminals
B Connection wiring with M12 plug in housing according to EN61131-2 standard
7/ 8: Nivotester FTL325P 1 CH, FTL325P 3 CH input 1
33/ 34: Nivotester FTL325P 3 CH input 2
37/ 38: Nivotester FTL325P 3 CH input 3
d4/ d2: Nivotester FTL375P input 1
z4/ z2: Nivotester FTL375P input 2
z6/ d6: Nivotester FTL375P input 3

Connection cable

- Maximum cable resistance: 25 Ω per core
- Maximum cable capacitance: < 100 nF
- Maximum cable length: 1 000 m (3 281 ft)

Behavior of switch output and signaling



12 *Switching behavior and signaling, electronic insert FEL67*

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

The switches for MAX/MIN on the electronic insert and the FTL325P switching unit must be set according to the application. Only then is it possible to perform the functional test correctly.

2-wire NAMUR > 2.2 mA/ < 1.0 mA (electronic insert FEL68)

- 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 FEL68 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
- Functional testing without level change. A functional test can be performed on the device using the test button on the electronic insert or using the test magnet (can be ordered as an option) with the housing closed.
  The functional test can also be triggered by interrupting the supply voltage or activated directly from the Nivotester FTL325N.

Supply voltage

$U = 8.2\ V_{DC} \pm 20\ \%$

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

Power consumption

NAMUR IEC 60947-5-6

< 6 mW with I < 1 mA; < 38 mW with I = 3.5 mA

Connection data interface

NAMUR IEC 60947-5-6

Behavior of output signal

- OK status: output current 2.2 to 3.8 mA
- Demand mode: output current 0.4 to 1.0 mA
- Alarm: output current < 1.0 mA

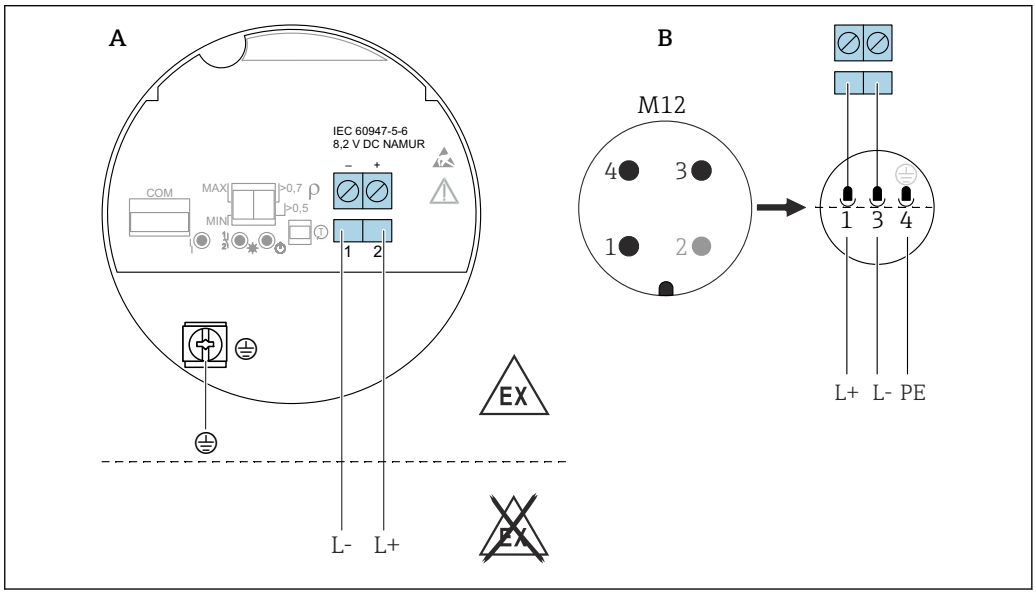
Terminals

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

Overvoltage protection

Overvoltage category II

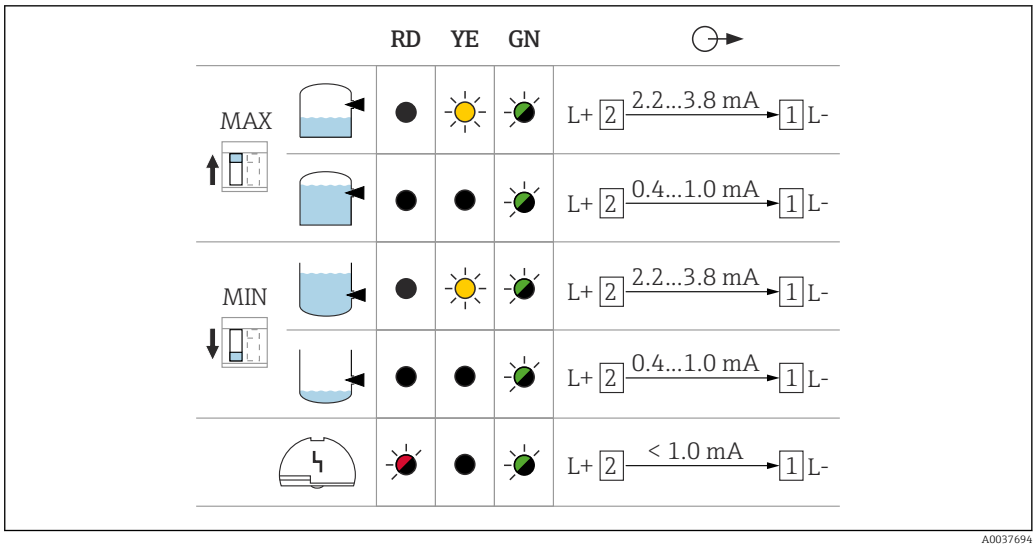
Terminal assignment



13 *2-wire NAMUR ≥ 2.2 mA/≤ 1.0 mA, electronic insert FEL68*

A Connection wiring with terminals
B Connection wiring with M12 plug in housing according to EN61131-2 standard

Behavior of switch output and signaling



14 *Behavior of switch output and signaling, electronic insert FEL68*

MAX DIP switch for setting MAX safety mode
MIN DIP switch for setting MIN safety mode
RD Red LED for alarm
YE Yellow LED, switch status
GN Green LED, operational status, device on

Electronic insert FEL68 with Bluetooth module

The Bluetooth module for use in conjunction with the electronic insert FEL68 (2-wire NAMUR) must be ordered separately with the necessary battery.

The following versions can be optionally selected in the Product Configurator:
Application package: Heartbeat Verification + Monitoring for NAMUR output
Accessory mounted: Bluetooth for NAMUR output

The order number of the **Bluetooth module, including the required battery,** are subsequently displayed in the Product Configurator.

LED module VU120 (optional)

Supply voltage

U = 12 to 55 V_{DC},

U = 19 to 253 V_{AC}, 50 Hz/60 Hz

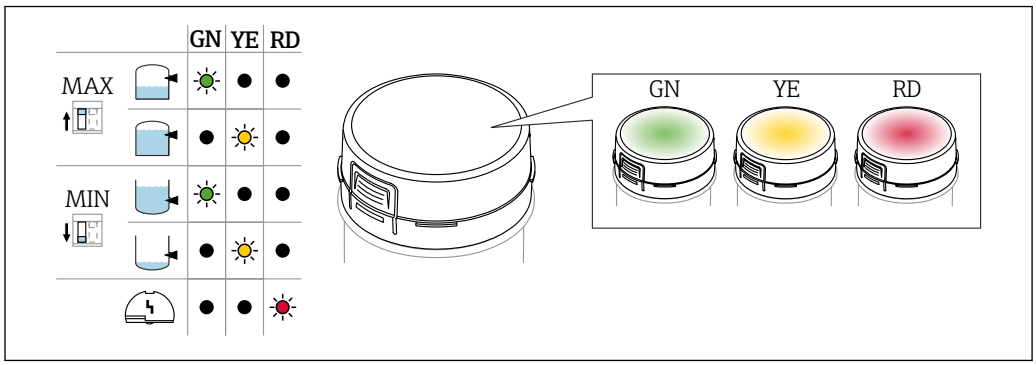
Power consumption

P ≤ 0.7 W, S < 6 VA

Current consumption

I_{max} = 0.4 A

Signaling of operational status



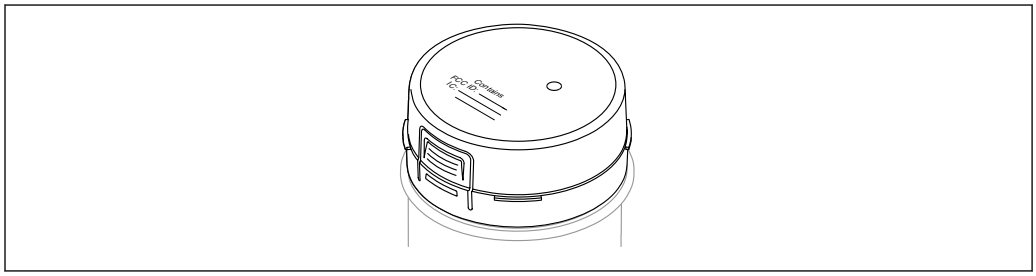
15 *LED module, the LED lights up in green (GN), yellow (YE) or red (RD)*

A brightly lit LED indicates the operational status (switch status or alarm status). The LED module can be connected to the following electronic inserts: FEL62, FEL64, FEL64DC.

See the accompanying Operating Instructions for more detailed information on connection and the switching states. The documentation currently available can be found on the Endress+Hauser website: www.endress.com → Downloads.

Bluetooth module and Heartbeat Technology

Bluetooth module VU121 (optional)



16 *Bluetooth module VU121*

- The Bluetooth module can be connected via the COM interface to the following electronic inserts: FEL61, FEL62, FEL64, FEL64 DC, FEL67, FEL68 (2-wire NAMUR).
- The Bluetooth module is only available in conjunction with the Heartbeat Verification + Monitoring application package.
- The Bluetooth module with battery is suitable for use in hazardous areas.
- The Bluetooth module must be ordered separately, including the required battery, for use in conjunction with electronic insert FEL68 (2-wire NAMUR).

For additional information about the connection, see the Operating Instructions for the device. Documentation currently available on the Endress+Hauser- website: www.endress.com → Downloads.

Batteries - use and handling

Use of a special battery in conjunction with electronic insert FEL68 (2-wire NAMUR):
- For energy reasons, the Bluetooth module VU121 requires a special battery when operated with the electronic insert FEL68 (2-wire NAMUR)
- Service life: At ambient temperatures from 10 to 40 °C (50 to 104 °F), the service life of the Bluetooth module without replacing the battery is at least 5 years, with a maximum of 60 downloads of complete datasets
  The battery service life is calculated based on the scenario that the sensor is connected and powered.

Additional information

The battery is categorized as dangerous goods when transported by air and may not be installed in the device when shipped.

Replacement batteries can be purchased from a specialist retailer.

Only the following types of AA 3.6 V lithium batteries made by the manufacturers listed below are suitable as replacement batteries:
- SAFT LS14500
- TADIRAN SL-360/s
- XENOENERGY XL-060F

Isolation lug in battery compartment

NOTICE

The removal of the isolation lug in the battery compartment of the Bluetooth module results in early discharging of the battery irrespective of whether the sensor is powered or not.
- ▶ When the sensors are in storage, the isolation lug must remain in the battery compartment of the Bluetooth module.

Approvals

The Bluetooth module is approved for use in the following types of protection for devices: Ex i, Ex d, Ex e or Ex t. The temperature class of the device is limited to T4 to T1 if the Bluetooth module is used in type of protection Ex i /IS in conjunction with electronic insert FEL68 (2-wire NAMUR) and the required battery in the Bluetooth module.

Additional technical data

- Free-field range: 50 m (165 ft) max.
- Operation radius with intervisibility around the device: 10 m (33 ft)

For documentation on radio approvals, see the Endress+Hauser website: www.endress.com → Downloads.

Heartbeat Technology

Heartbeat Technology module

The software package consists of 3 modules. These three modules combined check, evaluate and monitor device functionality and process conditions.

- Heartbeat Diagnostics
- Heartbeat Verification
- Heartbeat Monitoring

Performance characteristics

Reference operating conditions

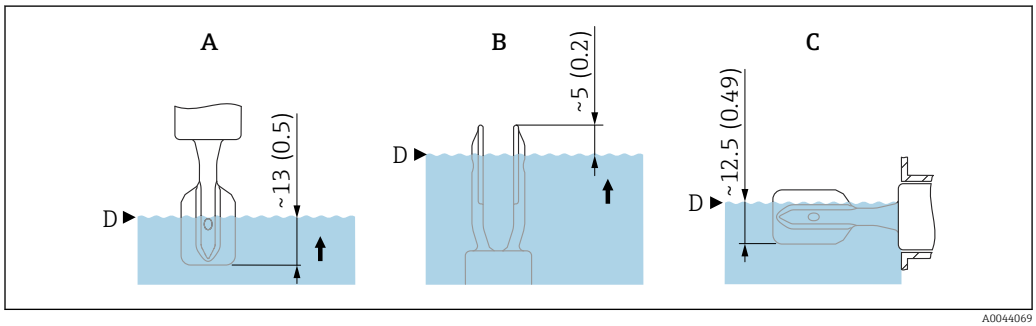
- Ambient temperature: +23 °C (+73 °F)
- Process temperature: +23 °C (+73 °F) ±5 °C (9 °F)
- Medium density (water): 1 g/cm³
- Medium viscosity: 1 mPa·s
- Process pressure: unpressurized
- Sensor installation: vertically from above
- Density selection switch: > 0.7 g/cm³ (SGU)
- Switch direction of sensor: uncovered to covered

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)

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



17 *Typical switch points. Unit of measurement mm (in)*

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

Maximum measured error

At reference operating conditions: max. ± 1 mm (0.04 in) at switch point

Hysteresis

Typically 2.5 mm (0.1 in)

Non-repeatability

0.5 mm (0.02 in)

Influence of the process temperature

The switch point moves between +1.4 to −5.5 mm (+0.06 to −0.22 in) in the temperature range from −60 to +280 °C (−76 to +536 °F)

Influence of the process pressure

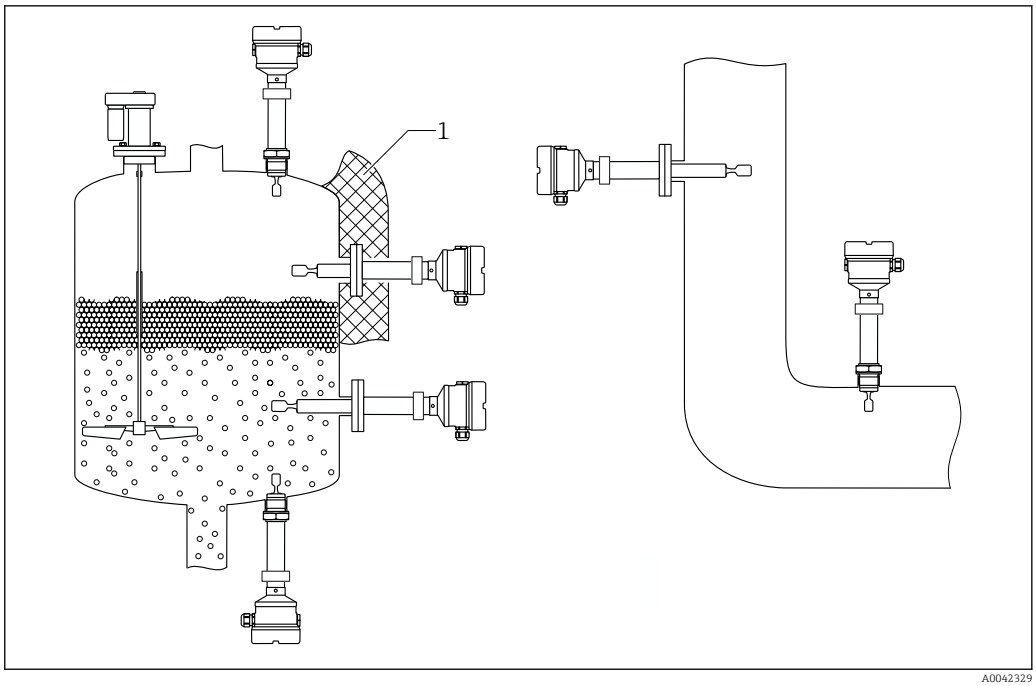
The switch point moves between 0 to −3.9 mm (0 to −0.15 in) in the pressure range from −1 to +100 bar (14.5 to 1 450 psi)

Mounting

Open the device only in a dry environment!

Mounting location, orientation

Mounting instructions
- Any orientation for device with short pipe up to approx. 500 mm (19.7 in)
- Vertical orientation from above for device with long pipe
- Minimum distance between the fork tip and the tank wall or pipe wall: 10 mm (0.39 in)



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

1 *Vessel insulation (example with temperature spacer)*
If process temperatures are high, the device should be included in a vessel insulation system to prevent the electronics from heating as a result of thermal radiation or convection.

Installation instructions

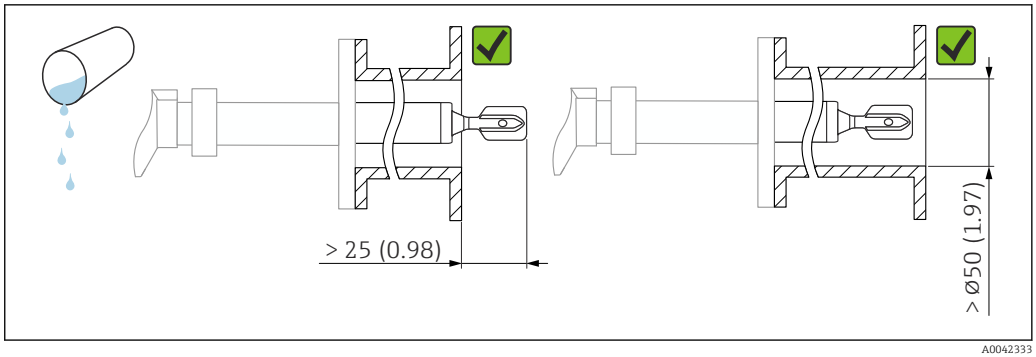
Take viscosity into consideration

Viscosity values
- Low viscosity : < 2 000 mPa·s
- High viscosity: > 2 000 to 10 000 mPa·s

Low viscosity

Low viscosity, e.g. water: < 2 000 mPa·s

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



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

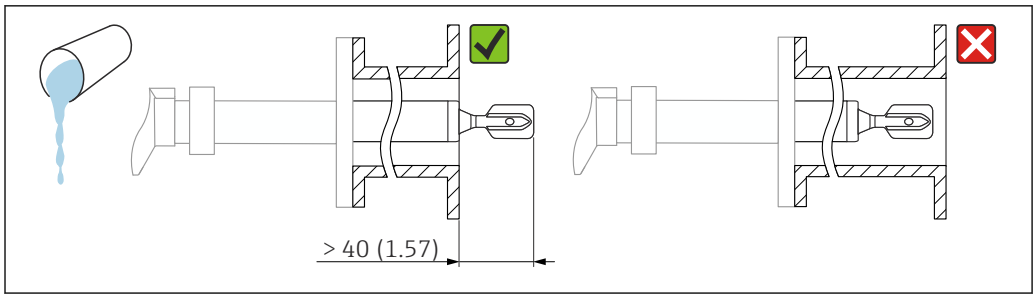
High viscosity

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: ≤ 10 000 mPa·s

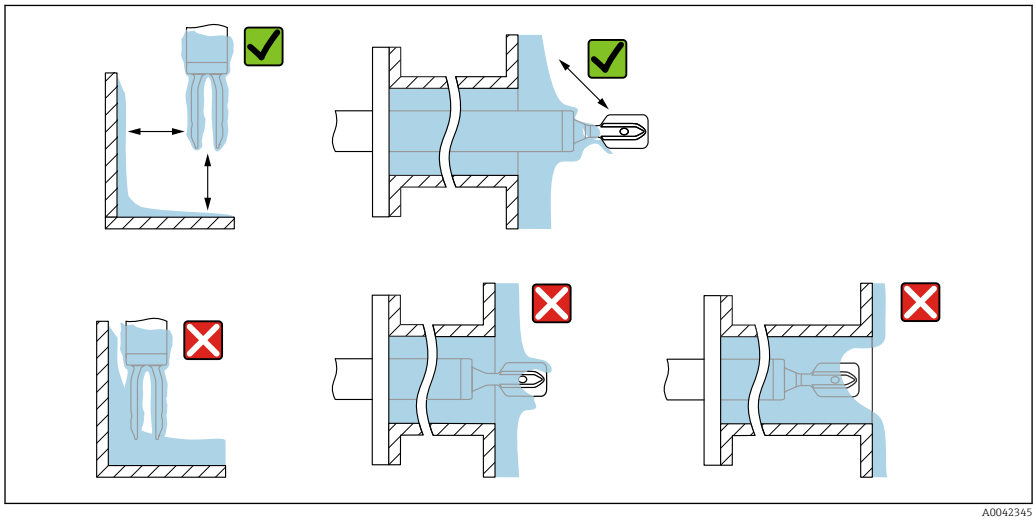
The tuning fork must be located outside the installation socket!



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

Avoid buildup

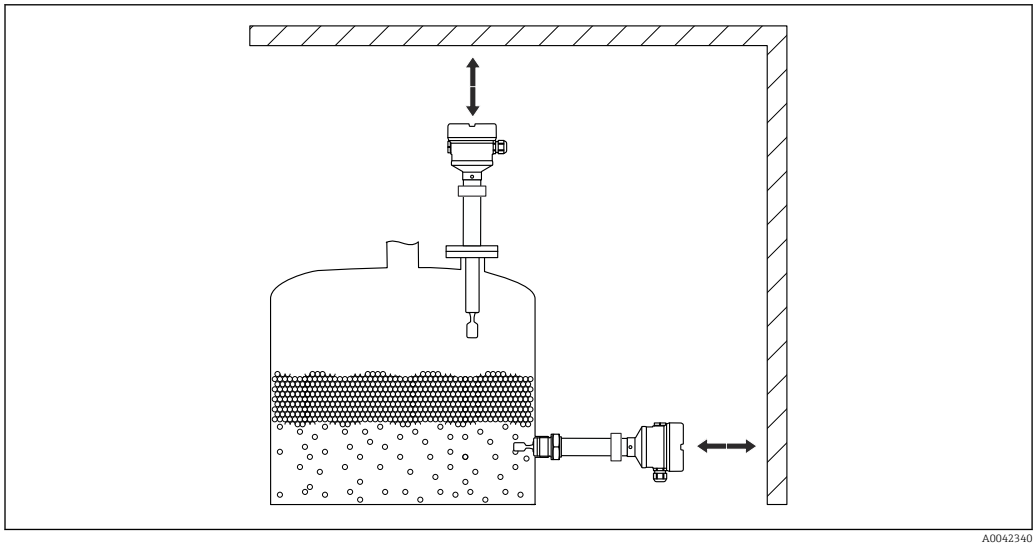
- Use short installation sockets to ensure that the tuning fork projects freely into the vessel
- Leave sufficient distance between the buildup expected on the tank wall and the tuning fork



21 *Installation examples for a highly viscous process medium*

Take clearance into consideration

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

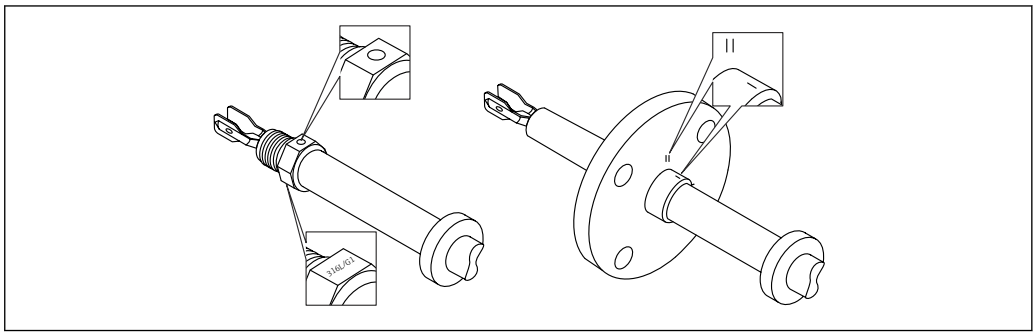


22 *Take clearance into consideration*

Align 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.

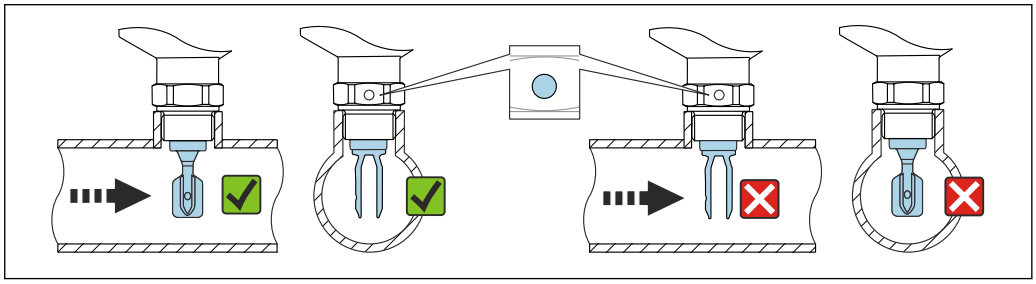
Markings may include the following:
- Material information, thread name or circle on the hexagonal nut
- II symbol on the back of the flange



23 *Markings to align the tuning fork*

Installing in pipes

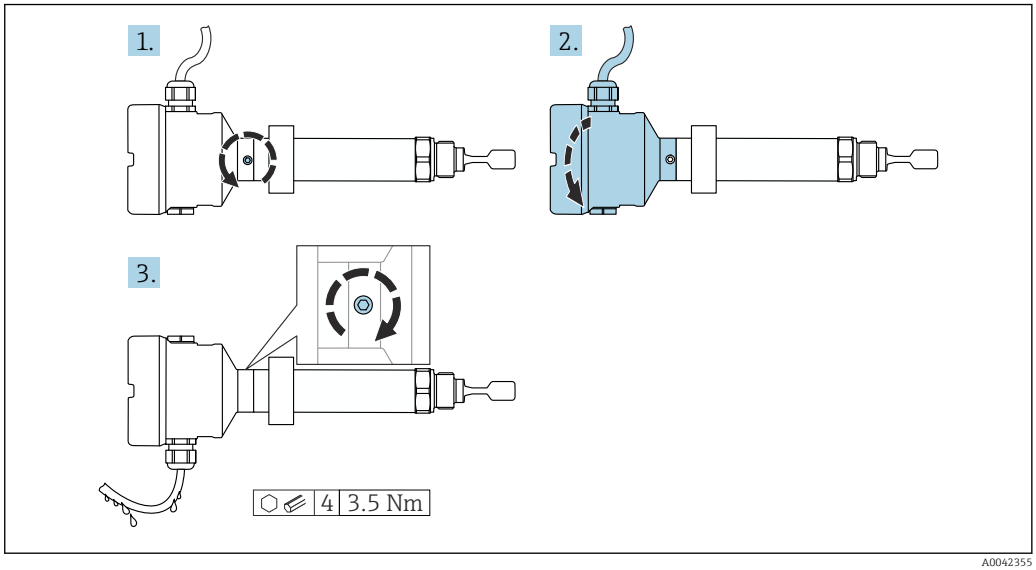
- Flow velocity up to 5 m/s with a viscosity of 1 mPa·s and density of 1 g/cm³ (SGU). Check for correct functioning in the event of other process medium conditions.
- The flow will not be significantly impeded if the tuning fork is correctly aligned and the marking is pointing in the direction of flow.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



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

Align the cable entry

The housing can be turned and the cable aligned by turning the locking screw.



25 *Housing with external locking screw and drip loop*

Special mounting instructions

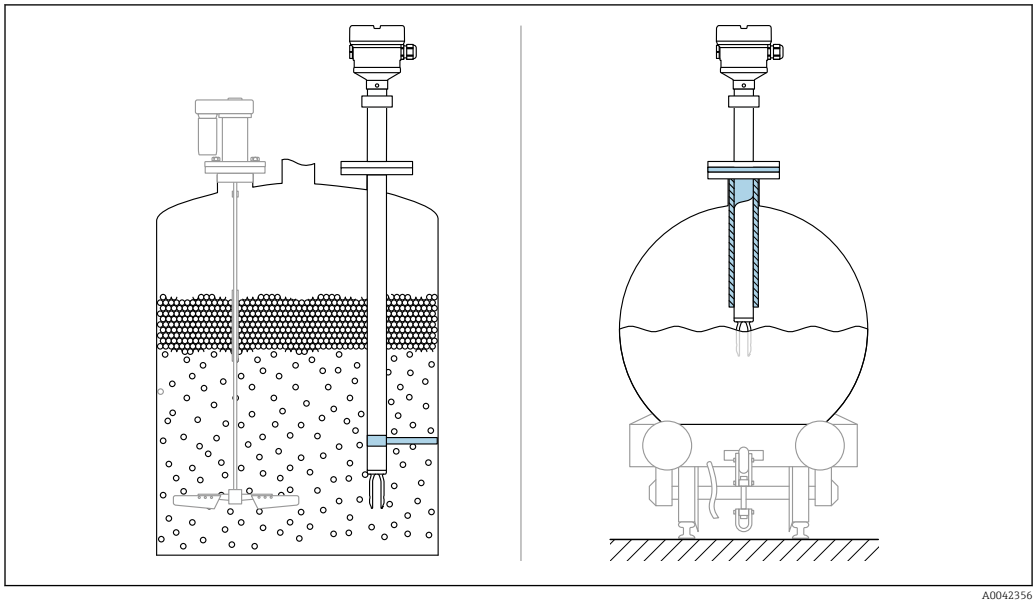
Support the device

NOTICE

If the device is supported incorrectly, shocks and vibrations can damage the coated surface.

► Only use suitable supports.

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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26 Examples of support in the event of dynamic load

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

Sliding sleeves

For more details, see the "Accessories" section.

Environment

Ambient temperature range

WARNING

Permitted connection voltage exceeded!

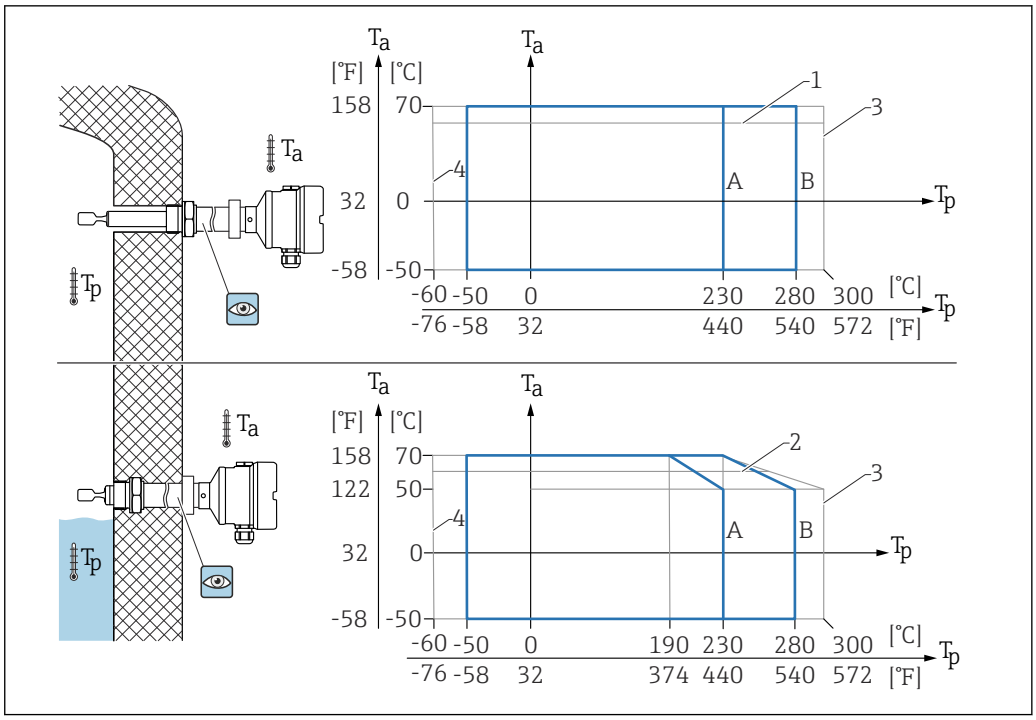
► For electrical safety reasons, the maximum connection voltage for all electronic inserts at ambient temperatures below −40 °C (−40 °F) is limited to a maximum of 35 V DC.

−40 to +70 °C (−40 to +158 °F)

Optionally available:
- −50 °C (−58 °F)
- −60 °C (−76 °F)

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

Low-temperature electronic inserts are marked LT.



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27 *Permitted ambient temperature T_a at the housing as a function of the process temperature T_p in the vessel*

A 230 °C (446 °F) sensor
B 280 °C (536 °F) sensor
1 Exceptions for electronic insert FEL64:
Without LED module: Relay current = 6 A, T_a max. = 60 °C (140 °F);
Relay current = 4 A, T_a max. = 65 °C (149 °F)
With LED module: T_a max. −10 K
2 Exceptions for electronic insert FEL64:
Without LED module: Relay current = 6 A, T_a max. = 65 °C (149 °F);
Relay current = 4 A, T_a max. = 70 °C (158 °F)
With LED module: T_a max. −10 K
3 Max. 50 h on cumulative basis
4 Only for ATEX and CSA certificates

- Low temperatures are not possible for SIL
- Bluetooth module:
  - −50 °C (−58 °F) for non-Ex, Ex ia and Ex d
  - −60 °C (−76 °F) for non-Ex
- LED module:
  - −50 °C (−58 °F) for non-Ex, Ex ia and Ex d
  - −60 °C (−76 °F) for non-Ex

Outdoor operation in strong sunlight:
- Mount the device in a shaded location
- Avoid direct sunlight, particularly in warmer climatic regions
- Use a weather protection 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).

Storage temperature

−40 to +80 °C (−40 to +176 °F)
Optional: −50 °C (−58 °F), −60 °C (−76 °F)

Humidity

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

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

Climate class

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

Degree of protection

In accordance with DIN EN 60529, NEMA 250

IP66/IP68 NEMA 4X/6P
Types of housing:
- Single compartment; plastic
- Single compartment; aluminum, coated; Ex d/XP
- Single compartment; 316L, cast; Ex d/XP
- Dual compartment L-shaped, aluminum, coated; Ex d/XP

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

Ordering information: Select the required option in the order code for "Electrical connection". Exclusion criteria are taken into account automatically.

Vibration resistance

As per IEC60068-2-64-2008
a(RMS) = 50 m/s², f = 5 to 2 000 Hz, t = 3 axes x 2 h

Shock resistance

In accordance with IEC60068-2-27-2008: 300 m/s² [= 30 g_n] + 18 ms

g_n: standard acceleration of gravity

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.

Pollution degree

Pollution degree 2

Electromagnetic compatibility

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

For more details, see the Functional Safety Manual.

Process

Process temperature range

- −60 to +230 °C (−76 to +446 °F)
- −60 to +280 °C (−76 to +536 °F)/to 300 °C (572 °F) for max. 50 h on cumulative basis
- −50 to +230 °C (−58 to +446 °F) with PFA coating (conductive)

The device can be ordered for use in very aggressive media with a highly corrosion-resistant PFA coating. At medium temperatures up to ≥ 150 °C (302 °F), pay attention to the chemical durability and the increasing risk of damage to the coating from diffusion.

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

Medium conditions

The service life of the device can be impacted in applications where increased hydrogen diffusion through the metallic membrane can be expected.
Typical conditions:
- Temperature: > 180 °C (356 °F)
- Pressure: > 64 bar (928 psi)

Thermal shock

Without restrictions within the process temperature range.

With PFA coating (conductive): ≤ 120 K/s

Process pressure range

⚠ 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.

- ▶ For pressure specifications, see the "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.

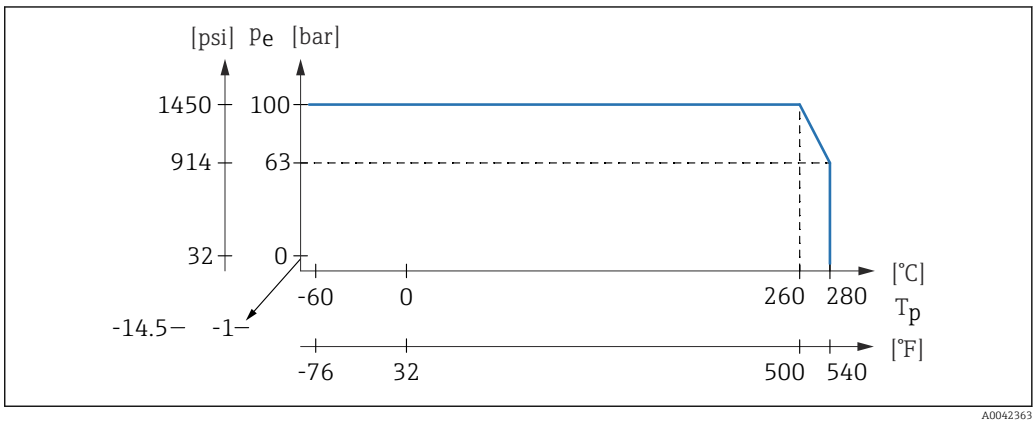
Refer to the following standards for the permitted pressure values of the flanges at higher temperatures:

- 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.

Devices with CRN approval: maximum 90 bar (1 305 psi) for devices with a pipe extension. Information on the Endress+Hauser website: www.endress.com → Downloads.

Process pressure range of the sensors



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Ordering information: Product Configurator, feature "Application":

- PN: max. 100 bar (1 450 psi) max. 230 °C (446 °F)
- PN: max. 100 bar (1 450 psi) max. 280 °C (536 °F)
- With PFA coating (conductive): max. 40 bar (580 psi) max. 230 °C (446 °F)

Test pressure

Test pressure = 1.5 · PN

- Maximum 100 bar (1 450 psi) at 230 °C (446 °F) and 280 °C (536 °F)
- Membrane burst pressure at 200 bar (2 900 psi)

The device function is limited during the pressure test.

The mechanical integrity is guaranteed at pressures up to 1.5 times the process nominal pressure PN.

Density

Liquids with density > 0.7 g/cm³
Switch position > 0.7 g/cm³ (as-delivered state)

Liquids with density 0.5 g/cm³
Switch position > 0.5 g/cm³ (can be set via DIP switch)

Liquids with density > 0.4 g/cm³

- Optionally available, not suitable for SIL applications
- Fixed value that cannot be edited
  The function of the DIP switch is interrupted

For distinguishing between media/density detection, use the Liquiphant Density (FEL60D) with a density computer.

Viscosity	≤ 10 000 mPa·s
Pressure tightness	Up to vacuum In vacuum evaporation plants, select the 0.4 g/cm³ density setting.
Solids contents	Ø ≤ 5 mm (0.2 in)

Mechanical construction

For the dimensions, see the Product Configurator: www.endress.com

Search for product → click "Configuration" to the right of the product image → after configuration click "CAD"

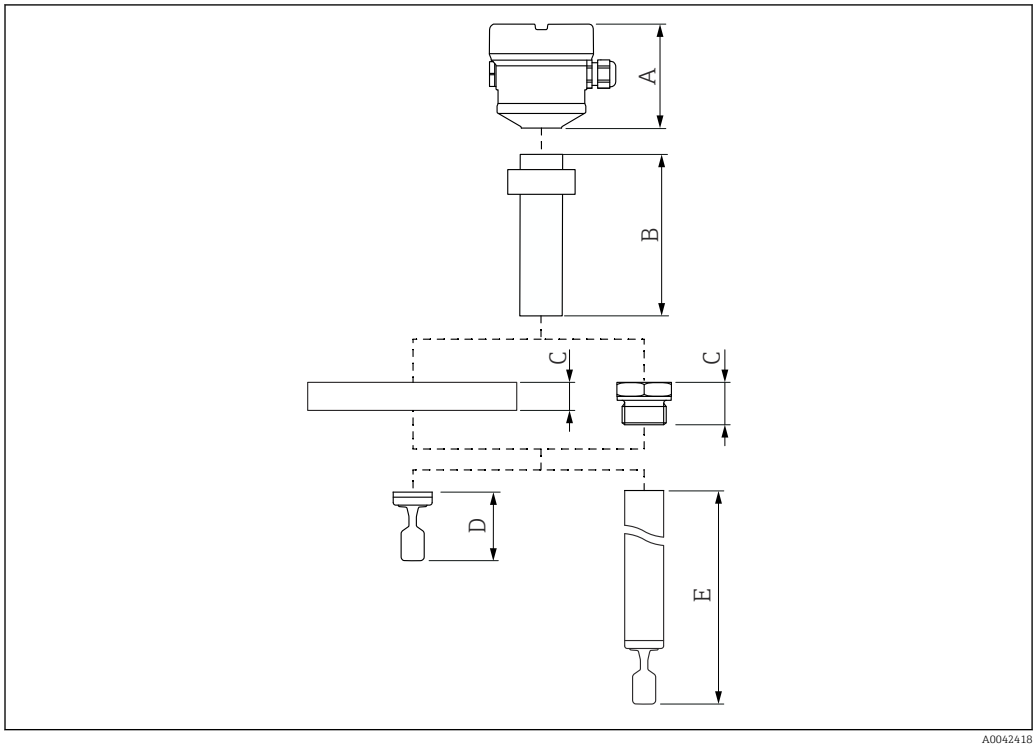
The following dimensions are rounded values. For this reason, they may deviate slightly from the dimensions given on www.endress.com.

Design, dimensions

Device height

The device height consists of the following components:
- Housing including cover
- Temperature spacer with gas-tight glass feedthrough (second line of defense)
- Compact version or pipe extension
- Process connection (flange, thread)

The individual heights of the components can be found in the following sections:
- Determine device height and add individual heights
- Take the installation clearance into consideration (space that is needed to install the device)



28 Components to determine the device height

A Housing including cover
B Temperature spacer with gas-tight glass feedthrough → 2 lengths available, depending on the process temperature
C Process connection (flange, thread)
D Tuning fork
E Pipe extension with tuning fork

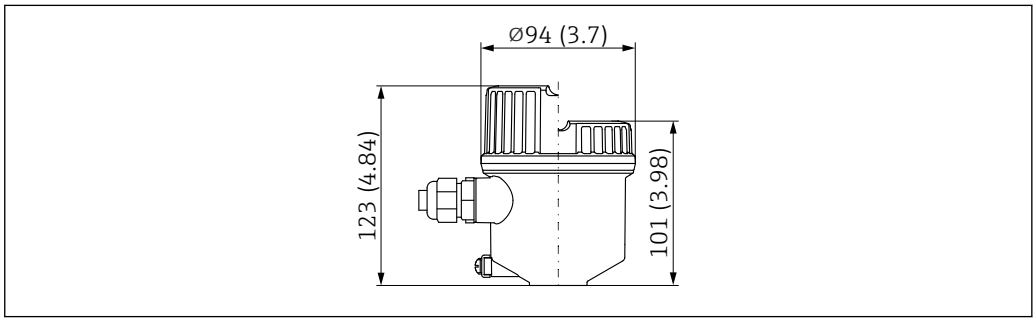
Dimensions

Housing and cover

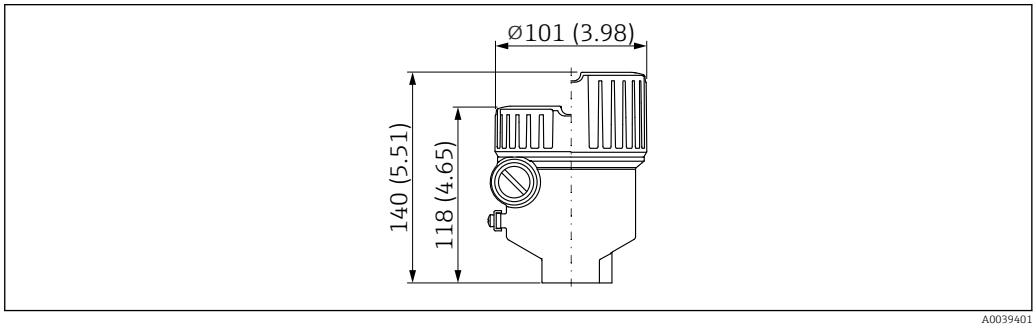
All housings can be aligned. In the case of metal housings, the housing alignment can also be fixed with the locking screw.

Devices with a Bluetooth or LED module require a high cover (transparent plastic cover or aluminum cover with sight glass). The Bluetooth or LED module cannot be used in conjunction with the 316L single compartment housing, cast.

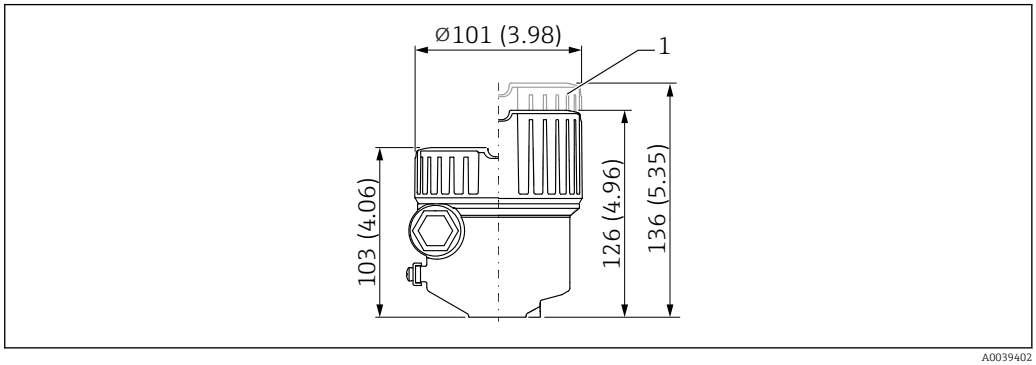
Single compartment housing; material



29 Single compartment; plastic housing. Unit of measurement mm (in)

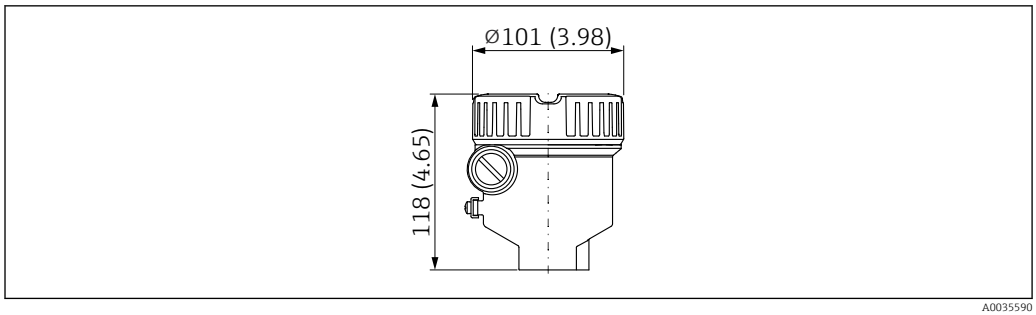


30 Single compartment; aluminum, coated; with Ex d/XP approval. Unit of measurement mm (in)



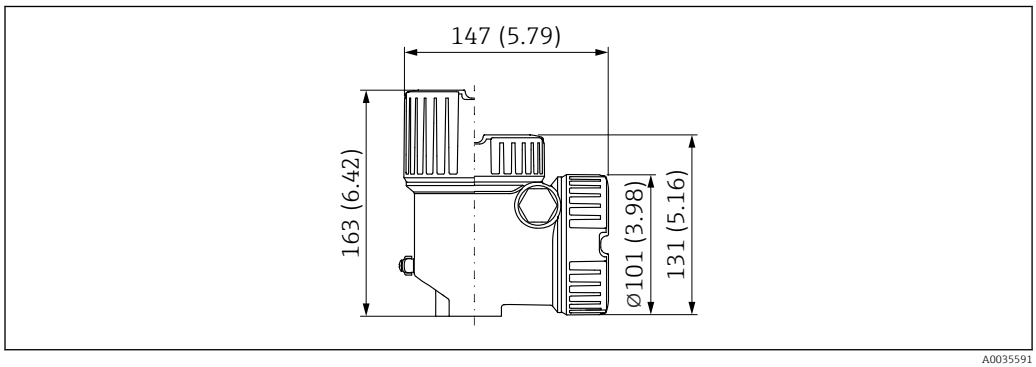
31 Single compartment; aluminum, coated. Unit of measurement mm (in)

1 Cover for Ex ec approval



32 *Single compartment; 316L, cast; also with Ex d/XP approval. Unit of measurement mm (in)*

Dual compartment, L-shaped housing; material



33 *Dual compartment; L-shaped; aluminum, coated; also with Ex d/XP approval. Unit of measurement mm (in)*

Ground terminal

- Ground terminal inside the housing, max. conductor cross-section 2.5 mm^2 (14 AWG)
- Ground terminal outside the housing, max. conductor cross-section 4 mm^2 (12 AWG)
- If safety extra-low voltage is used to supply power to electronic inserts, do not connect protective ground

Cable glands

Cable diameter:
- Plastic: Ø5 to 10 mm (0.2 to 0.38 in)
- Nickel-plated brass: Ø7 to 10.5 mm (0.28 to 0.41 in)
- Stainless steel: Ø7 to 12 mm (0.28 to 0.47 in)

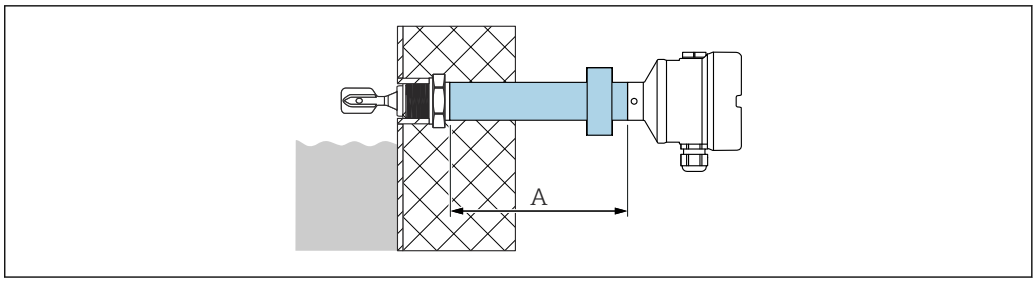
The scope of delivery comprises:
- 1 cable gland installed
- 1 cable gland sealed with dummy plug

A second cable gland (not mounted) is also included in the scope of delivery of the relay electronics.

Exceptions: with Ex d/XP, only threaded entries are permitted.

Temperature spacer

- Provides sealed insulation for the vessel and a normal ambient temperature for the housing
- If the sensor is damaged, protects the housing from vessel pressures up to 100 bar (1 450 psi)



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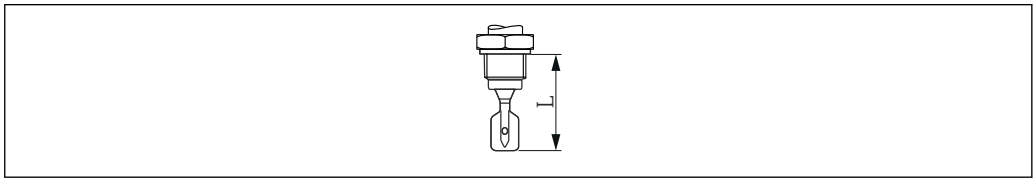
34 *Temperature spacer with gas-tight glass feedthrough*

A 2 lengths available depending on the process temperature

Product Configurator, "Application" feature:
- 230 °C (446 °F): approx. 160 mm (6.3 in)
- 280 °C (536 °F): approx. 200 mm (7.87 in)
- PFA (conductive) 230 °C (446 °F): approx. 160 mm (6.3 in)

Probe design

Compact
- Material: 316L or Alloy C22
- Sensor length L: depends on process connection
  See section on process connections: thread ASME B1.20.3, MNPT, EN10226, R, ISO228, G



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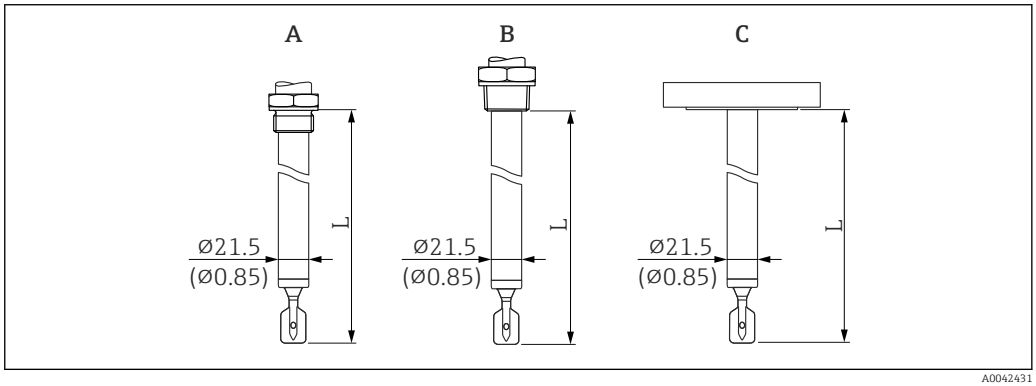
35 *Compact, sensor length L*

Pipe extension
- Material: 316L, sensor length L: 148 to 3 000 mm (5.83 to 118.11 in)
- Material: Alloy C22, sensor lengths L: 148 to 3 000 mm (5.83 to 118.11 in)
- Material: 316L substrate material coated with PFA (conductive), sensor lengths L: 148 to 3 000 mm (5.83 to 118.11 in)
  Only available with flange as a process connection.
- Length tolerances L: < 1 m (3.3 ft) = −5 mm (−0.2 in), 1 to 3 m (3.3 to 9.8 ft) = (−10 mm (−0.39 in)



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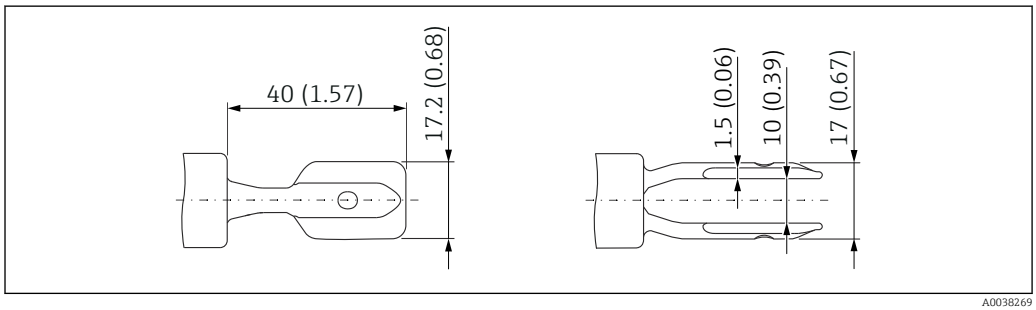
36 *Pipe extension, sensor length L. Unit of measurement mm (in)*

A G ¾, G 1
B NPT ¾, NPT 1, R ¾, R 1
C Flange

Coating material and layer thickness

PFA (conductive), optional
- Lower limit: 0.45 mm (0.02 in)
- Upper limit: 1.6 mm (0.06 in)
- Maximum diameter: Ø 24.6 mm (0.97 in)

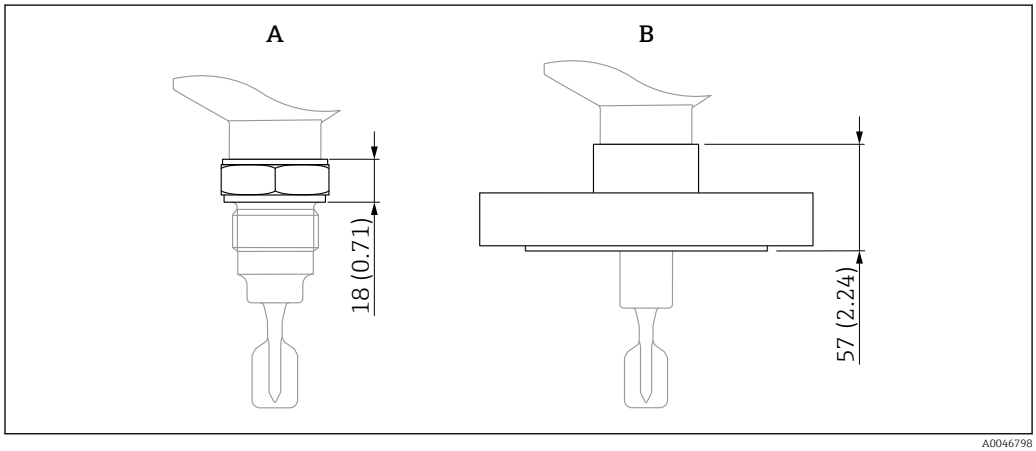
Tuning fork



37 Tuning fork. Unit of measurement mm (in)

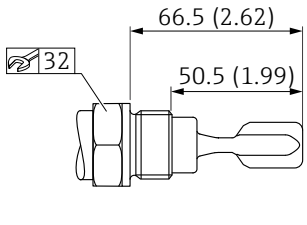
Process connections

Height of process connection



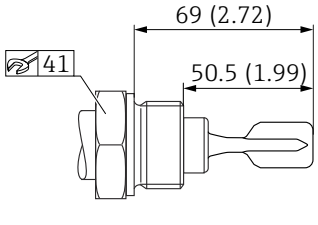
A Process connection with threaded connection
B Process connection with flange

Thread ISO228 G



38 Thread ISO228 G ¾. Unit of measurement mm (in)

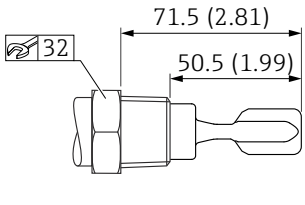
≤ 100 bar (1 450 psi), ≤ 280 °C (536 °F)



39 Thread ISO228 G 1. Unit of measurement mm (in)

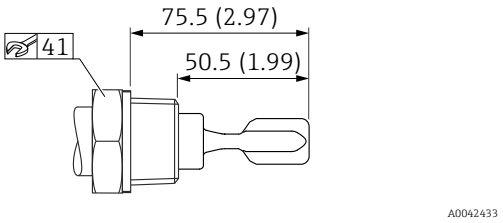
≤ 100 bar (1 450 psi), ≤ 280 °C (536 °F)

Thread ASME B1.20.3, MNPT



40 *Thread ASME B1.20.3, MNPT ¾. Unit of measurement mm (in)*

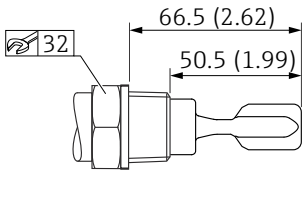
≤ 100 bar (1450 psi), ≤ 280 °C (536 °F)



41 *Thread ASME B1.20.3, MNPT 1. Unit of measurement mm (in)*

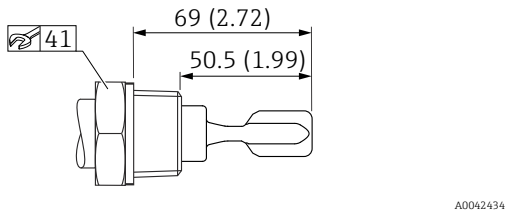
≤ 100 bar (1450 psi), ≤ 280 °C (536 °F)

Thread EN10226, R



42 *Thread EN10226, R ¾. Unit of measurement mm (in)*

≤ 100 bar (1450 psi), ≤ 280 °C (536 °F)

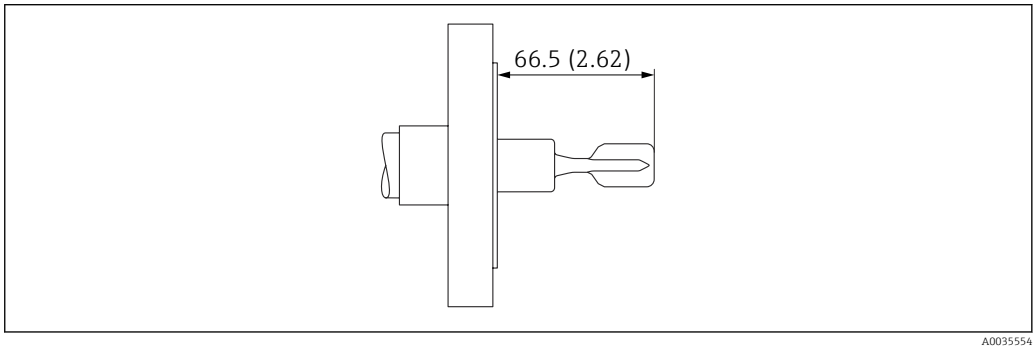


43 *Thread EN10226, R 1. Unit of measurement mm (in)*

≤ 100 bar (1450 psi), ≤ 280 °C (536 °F)

Flanges

AlloyC22-plated flanges are available for higher chemical resistance.
The flange carrier material is made of 1.4462 and is welded to an AlloyC22 disk.



44 *Example with flange. Unit of measurement mm (in)*

In the event of high temperatures: pay attention to the pressure loading capacity of the flange depending on the temperature!

ASME B16.5 flanges, RF

Pressure rating	Type	Material	Weight
Cl.150	NPS 1"	316/316L	1.0 kg (2.21 lb)
Cl.150	NPS 1-½"	316/316L	1.5 kg (3.31 lb)
Cl.150	NPS 2"	316/316L	2.4 kg (5.29 lb)
Cl.150	NPS 2"	Alloy C22>1.4462	2.4 kg (5.29 lb)
Cl.150	NPS 3"	316/316L	4.9 kg (10.8 lb)

Pressure rating	Type	Material	Weight
Cl.150	NPS 4"	316/316L	7.0 kg (15.44 lb)
Cl.300	NPS 1-½"	316/316L	2.7 kg (5.95 lb)
Cl.300	NPS 2"	316/316L	3.2 kg (7.06 lb)
Cl.300	NPS 2"	Alloy C22>1.4462	3.2 kg (7.06 lb)
Cl.300	NPS 3"	316/316L	6.8 kg (14.99 lb)
Cl.300	NPS 4"	316/316L	11.5 kg (25.6 lb)
Cl.600	NPS 2"	Alloy C22>1.4462	6.8 kg (14.99 lb)
Cl.600	NPS 2"	316/316L	4.2 kg (9.26 lb)
Cl.600	NPS 3"	316/316L	6.8 kg (14.99 lb)
Cl.600	NPS 4"	316/316L	17.3 kg (38.15 lb)

ASME B16.5 flanges, FF

Pressure rating	Type	Material	Weight
Cl.150	NPS 1"	316/316L	1.0 kg (2.21 lb)
Cl.150	NPS 2"	316/316L	2.4 kg (5.29 lb)
Cl.300	NPS 1-½"	316/316L	2.7 kg (5.95 lb)
Cl.300	NPS 2"	316/316L	3.2 kg (7.06 lb)
Cl.300	NPS 4"	316/316L	11.5 kg (25.36 lb)
Cl. 600	NPS 2"	Alloy C22>1.4462	4.2 kg (9.26 lb)
Cl. 600	NPS 2"	316/316L	4.2 kg (9.26 lb)
Cl. 600	NPS 3"	316/316L	6.8 kg (14.99 lb)
Cl. 600	NPS 4"	316/316L	17.3 kg (38.15 lb)

ASME B16.5 flanges, RTJ

Pressure rating	Type	Material	Weight
Cl.300	NPS 2"	316/316L	3.2 kg (7.06 lb)
Cl.300	NPS 3"	316/316L	6.8 kg (14.99 lb)
Cl.300	NPS 4"	316/316L	11.5 kg (25.36 lb)
Cl.600	NPS 2"	316/316L	17.3 kg (38.15 lb)

EN flanges EN 1092-1, A

Pressure rating	Type	Material	Weight
PN25/40	DN25	316L (1.4404)	1.3 kg (2.87 lb)
PN25/40	DN32	316L (1.4404)	2.0 kg (4.41 lb)
PN25/40	DN40	316L (1.4404)	2.4 kg (5.29 lb)
PN25/40	DN50	316L (1.4404)	3.2 kg (7.06 lb)
PN25/40	DN65	316L (1.4404)	4.3 kg (9.48 lb)
PN25/40	DN80	316L (1.4404)	5.9 kg (13.01 lb)
PN25/40	DN100	316L (1.4404)	7.5 kg (16.54 lb)
PN100	DN50	316L (1.4404)	5.5 kg (12.13 lb)

EN flanges EN 1092-1, B1

Pressure rating	Type	Material	Weight
PN10/16	DN50	316L (1.4404)	2.5 kg (5.51 lb)
PN10/16	DN80	316L (1.4404)	4.8 kg (10.58 lb)
PN10/16	DN100	316L (1.4404)	5.2 kg (11.47 lb)
PN25/40	DN25	Alloy C22>1.4462	1.4 kg (3.09 lb)
PN25/40	DN25	316L (1.4404)	1.4 kg (3.09 lb)
PN25/40	DN50	Alloy C22>1.4462	3.2 kg (7.06 lb)
PN25/40	DN50	316L (1.4404)	3.2 kg (7.06 lb)
PN25/40	DN80	316L (1.4404)	5.9 kg (13.01 lb)
PN25/40	DN80	Alloy C22>316L	5.2 kg (11.47 lb)
PN63	DN50	316L (1.4404)	4.5 kg (9.92 lb)

EN flanges EN 1092-1, E

Type	Material	Pressure rating	Weight
DN50	316L (1.4404)	PN25/40	3.2 kg (7.06 lb)

JIS flanges B2220

Pressure rating	Type	Material	Weight
20K	20K 50A	316L (1.4404)	1.9 kg (4.19 lb)

Process connection, sealing surface

- Thread ISO228, G
- Thread ASME, MNPT
- Thread EN10226, R
- Flange ASME B16.5, RF (Raised Face)
- Flange ASME B16.5, FF (Flat Face)
- Flange ASME B16.5, RTJ (Ring Type Joint)
- Flange EN1092-1, Form A
- Flange EN1092-1, Form B1
- Flange EN1092-1, Form E
- Flange JIS B2220, RF (Raised Face)
- Flange HG/T20592, RF (Raised Face)
- Flange HG/T20615, RF (Raised Face)
- Flange HG/T20615, RJ (Ring Joint)

Weight

Basic weight: 1.35 kg (2.98 lb)
The basic weight comprises:
- Sensor (compact), sensor with extension pipe
- Electronic insert
- Housing: single compartment, plastic with cover
- Thread, G ¾"

Differences in weight result from the housing, LED or Bluetooth module (incl. high cover).

Bluetooth module
0.1 kg (0.22 lb)

LED module
0.1 kg (0.22 lb)

Housing
- Single compartment, aluminum, coated: 0.8 kg (1.76 lb)
  Optionally with LED module or Bluetooth module with high cover: 0.38 kg (0.84 lb)
- 316L cast: 2.1 kg (4.63 lb)
- Dual compartment L-shaped; aluminum coated: 1.22 kg (2.69 lb)
  Optionally with LED module or Bluetooth module with high cover: 0.38 kg (0.84 lb)

Gas-tight feedthrough
0.2 kg (0.44 lb)

Pipe extension
- 1000 mm: 0.9 kg (1.98 lb)
- 100 in: 2.3 kg (5.07 lb)

Process connection

See "Process connections" section

Weather protection cover, plastic
0.2 kg (0.44 lb)

Weather protection cover, metal
0.93 kg (2.05 lb)

Materials

Materials in contact with process

Process connection and pipe extension

316L (1.4435)
- Optional Alloy C22 (2.4602)
- Optional PFA coating (conductive)

Tuning fork

S31803 (1.4462)
- Optional 2.4602 (Alloy C22)
- Optional PFA coating (conductive)

Flanges

316L (1.4404)
- Optional PFA coating (conductive)
- Flange plating: AlloyC22

Materials not in contact with process

Plastic housing

- Housing: PBT/PC
- Dummy cover: PBT/PC
- Transparent cover: PBT/PC or PA12
- Cover seal: EPDM
- Potential equalization: 316L
- Seal under potential equalization: EPDM
- Plug: PBT-GF30-FR
- M20 cable gland: PA
- Seal on plug and cable gland: EPDM
- Adapter as replacement for cable glands: 316L
- Nameplate: plastic foil
- TAG plate: plastic foil, metal or provided by customer

Aluminum housing, coated

- Housing: aluminum EN AC 44300
- Dummy cover: aluminum EN AC 44300
- Cover with sight glass: EN AC 44300 aluminum, PC Lexan 943A synthetic glass
  Cover with polycarbonate sight glass optionally available. For Ex d applications, the sight glass is made from borosilicate.
- Cover seal materials: HNBR
- Cover seal materials: FVMQ (only for low temperature version)

- Nameplate: plastic foil
- TAG plate: plastic foil, stainless steel or provided by customer
- M20 cable glands: select material (stainless steel, nickel-plated brass, polyamide)

Stainless steel housing

- Housing: stainless steel AISI 316L (1.4409)
- Cover: AISI 316L (1.4409)
- Cover seal materials: FVMQ (only for low temperature version)
- Cover seal materials: HNBR
- Nameplate: stainless steel 316L
- TAG plate: plastic foil, stainless steel or provided by customer
- M20 cable glands: select material (stainless steel, nickel-plated brass, polyamide)

Process connections

- G ¾, G 1 according to DIN ISO 228/I, flat seal according to DIN 7603, at installation location
- R ¾, R 1 according to DIN 2999 Part 1
- ¾ -14 NPT, 1 - 11½ NPT according to ANSI B 1.20.1
- Flanges (standard specifications → Product Configurator)
  - according to EN/DIN from DN 25
  - according to ANSI B16.5 from 1"
  - according to JIS B 2220 (RF)

Surface roughness

The surface roughness of the metal surface in contact with the process is Ra < 3.2 µm (126 µin).

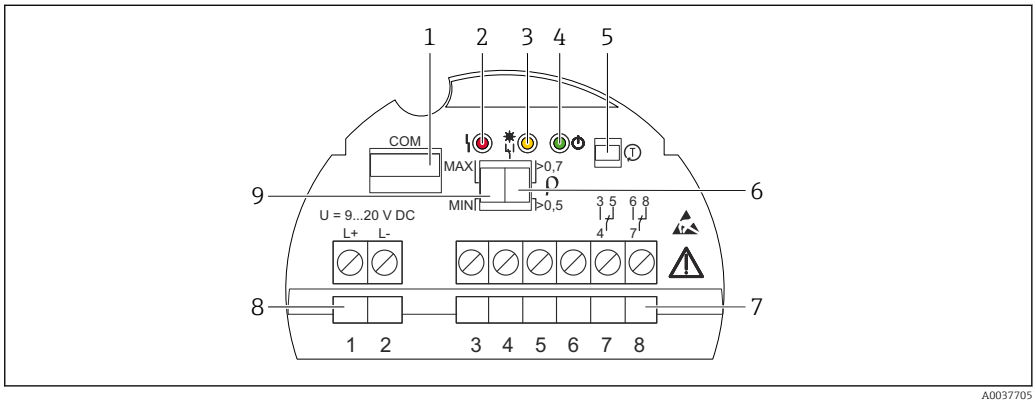
Display and user interface

Operating concept

- Operation with button and DIP switches on the electronic insert
- Display with optional Bluetooth module and SmartBlue app via Bluetooth® wireless technology
- Indication of operational status (switch status or alarm status) with optional LED module (signal lights visible from the outside)
  For plastic housing and aluminum housing (standard and Ex d) in conjunction with DC-PNP (electronic insert FEL62) and relay electronics (electronic inserts FEL64, FEL64DC

Local operation

Elements on the electronic insert

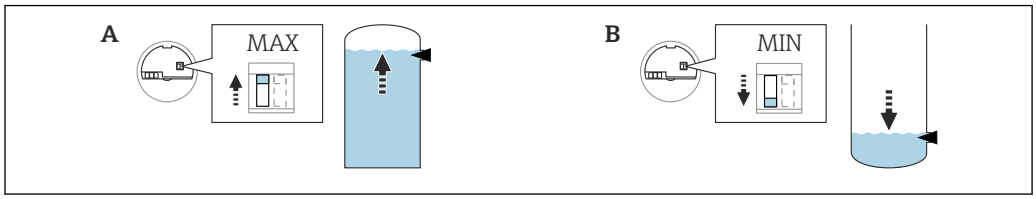


45 *Example of electronic insert FEL64DC*

1 *COM interface for additional modules (LED module, Bluetooth module)*
2 *LED, red, for warning or alarm*
3 *LED, yellow, switch status*
4 *LED, green, operational status (device is on)*
5 *Test button, activates functional test*
6 *DIP switch for setting density 0.7 or 0.5*
7 *Terminals (3 to 8), relay contact*
8 *Terminals (1 to 2), power supply*
9 *DIP switch for configuring MAX/MIN safety mode*

Operation at electronic insert

MAX/MIN fail-safe mode

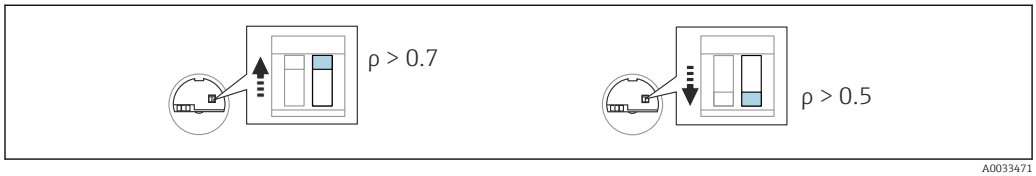


46 *Switch position on the electronic insert for fail-safe mode MAX/MIN*

A MAX (maximum fail-safe mode)
B MIN (minimum fail-safe mode)

- Minimum/maximum quiescent current safety can be switched at the electronic insert
- MAX = Maximum safety: When the tuning fork is covered, the output switches in the direction of demand. Use this for overfill prevention, for example.
- MIN = Minimum safety: When the tuning fork is uncovered, the output switches in the direction of demand. Use this for dry-running protection of pumps, for example.

Density switchover



47 *Switch position on the electronic insert for density*

Liquids with density > 0.7 g/cm³
Switch position > 0.7 g/cm³ (as-delivered state)

Liquids with density 0.5 g/cm³
Switch position > 0.5 g/cm³ (can be set via DIP switch)

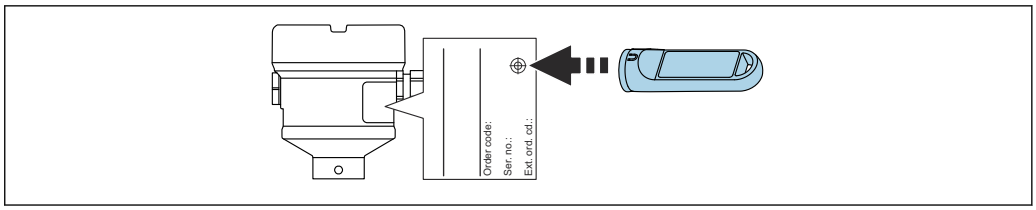
Liquids with density > 0.4 g/cm³
- Optionally available, not suitable for SIL applications
- Fixed value that cannot be edited
  The function of the DIP switch is interrupted

For distinguishing between media/density detection, use the Liquiphant Density (FEL60D) with a density computer.

Functional test of the electronic switch with a test magnet

The functional test with the test magnet can be performed without opening the device. To perform the test, hold the test magnet against the marking on the nameplate of the housing. The functional test with the test magnet acts in the same way as the functional test using the test button on the electronic insert.

The functional test can be applied for the following electronic inserts: FEL62, FEL64, FEL64DC, FEL68.



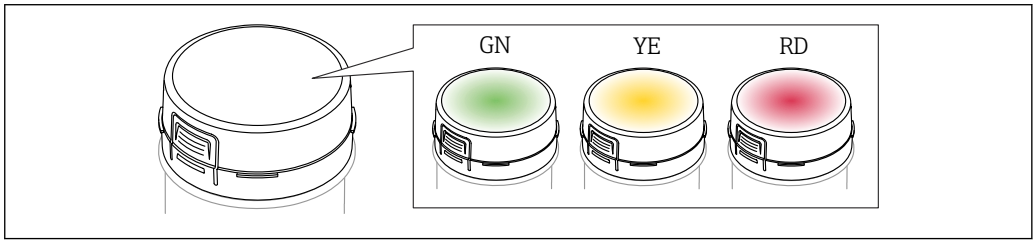
48 *Functional test with test magnet*

Product Configurator: the test magnet is optionally available.

Local display

LED module VU120 (optional)

A brightly lit LED indicates the operational status (switch status or alarm status). The LED module can be connected to the following electronic inserts: FEL62, FEL64, FEL64DC.



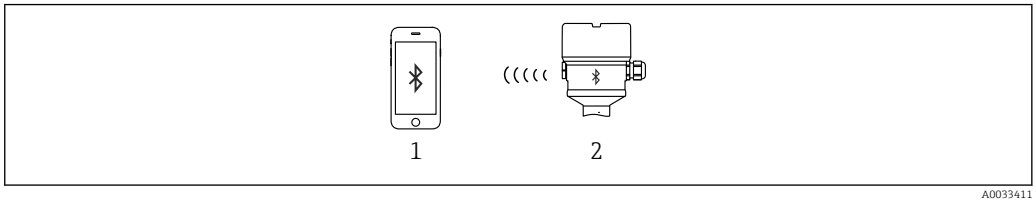
49 *LED module, the LED lights up in green (GN), yellow (YE) or red (RD)*

Additional information → 18 and in the "Accessories" section

Remote operation

Heartbeat diagnostics and verification with Bluetooth® wireless technology

Access via Bluetooth® wireless technology



50 *Remote operation via Bluetooth® wireless technology*

1 *Smartphone or tablet with SmartBlue app*
2 *Device with optional Bluetooth module*

Bluetooth module VU121 (optional)

Functions

- Connection via COM interface: Bluetooth module for device diagnostics via a smartphone app or tablet app
- Display the battery status via app when used with electronic insert FEL68 (NAMUR)
- User guidance (wizard) for SIL/WHG proof testing
- Visible in the livelist 10 s seconds after the Bluetooth search commences
- Data can be read from the Bluetooth module 60 s after the supply voltage is switched on
- Display of the current vibration frequency and the switching state of the device

The yellow LED flashes when the Bluetooth module is connected to another Bluetooth device, e.g. cellular phone.

Heartbeat Technology

Additional information in the "Application packages" section.

Diagnostic information

Heartbeat Technology

The electronics module and the tuning fork are checked using Heartbeat Technology, and a verification of the Liquiphant is performed. The switch output is not changed during this test. The test can be performed at any time and does not influence the switch output in the safety circuit. In the case of proof-testing, the SmartBlue app supports users in every step of the test. The switch output is also switched during this test. During the proof-test, alternative monitoring measures must be taken to ensure process safety.

Proof test

During the proof test, the SmartBlue app provides support for each individual stage of the test (proof-test wizard). The switch output is also switched during this test. During the proof test, alternative monitoring measures must be taken to ensure process safety.

Evaluation of the vibration frequency

If the vibration frequency exceeds the upper warning frequency, a warning is displayed. A warning is activated when the fork becomes corroded, for example. The switch output remains in the current state. The warning is displayed in the SmartBlue app and output in the Heartbeat Technology protocol. When a warning occurs, it is necessary to check the Liquiphant sensor.

The current oscillation frequency must be in the range between the upper and lower alarm frequency. If the current oscillation frequency is above the upper alarm frequency or below the lower alarm frequency, an alarm is output. The output switches to the safety-oriented state.

Certificates and approvals

Current certificates and approvals that are available for the product can be selected via the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

CE mark

The measuring system meets the legal requirements of the applicable EU Directives. These are listed in the corresponding EU Declaration of Conformity together with the standards applied. Endress +Hauser confirms successful testing of the device by affixing to it the CE mark.

RCM marking

The supplied product or measuring system meets the ACMA (Australian Communications and Media Authority) requirements for network integrity, interoperability, performance characteristics as well as health and safety regulations. Here, especially the regulatory arrangements for electromagnetic compatibility are met. The products bear the RCM marking on the nameplate.

A0029561

Ex approval

All data relating to explosion protection are provided in separate Ex documentation and are available from the Downloads Area. The Ex documentation is supplied as standard with all Ex devices.

Ex temperature class: T1 to T6

If using type of protection Ex i and electronic insert FEL68 (NAMUR) and the Bluetooth module in addition (battery required): T4 to T1.

Explosion-protected smartphones and tablets

If used in hazardous areas, mobile end devices with an Ex approval must be used.

Overfill protection

Before mounting the device, observe the documentation from the WHG approvals (German Federal Water Act).

Approved for overfill protection and leakage detection.

Product Configurator, feature "Additional approval"

Functional safety

The Liquiphant has been developed according to the IEC 61508 standard. The device is suitable for overfill protection and dry-running protection up to SIL 2 (SIL 3 with homogeneous redundancy). A detailed description of the safety functions with Liquiphant, settings and functional safety data is provided in the "Functional Safety Manual" on the Endress+Hauser website: www.endress.com → Downloads.

Product Configurator: feature "Additional approval"

Subsequent confirmation of usability according to IEC 61508 is not possible.

Marine approvals

Product Configurator: feature "Additional approval"

Radio approval

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

CRN approval

Versions with a CRN approval (Canadian Registration Number) are listed in the corresponding registration documents. CRN-approved devices are marked with a registration number.

Any restrictions regarding the maximum process pressure values are listed on the CRN certificate.

Product Configurator: feature "Additional approval"

Service

- Cleaned of oil+grease (wetted)
- Switching delay setting to be spec.
- Setting for MIN safety mode
- Default setting density > 0.4 g/cm^3
- Default setting density > 0.5 g/cm^3

Test reports

Test, certificate, declaration

Documents available for order in the Product Configurator, feature "Test, certificate, declaration":
- Inspection certificate 3.1, EN10204 (material certificate, wetted parts)
- NACE MR0175 / ISO 15156 (wetted parts), declaration
- NACE MR0103 / ISO 17945 (wetted parts), declaration
- AD 2000 (wetted parts), declaration, excluding cast parts
- ASME B31.3 process piping, declaration
- Pressure test, internal procedure, test report
- Helium leak test, internal procedure, test report
- PMI test, internal procedure (wetted parts), test report
- Penetrant testing AD2000-HP5-3 (PT), wetted/pressurized metallic parts, test report
- Penetrant testing ISO23277-1 (PT), wetted/pressurized metallic parts, test report
- Penetrant testing ASME VIII-1 (PT), wetted/pressurized metallic parts, test report
- Welding documentation, wetted/pressurized seams, declaration

Pressure Equipment Directive

Pressure equipment with allowable pressure ≤ 200 bar (2 900 psi)

Pressure instruments with a flange and threaded boss that do not have a pressurized housing do not fall within the scope of the Pressure Equipment Directive, irrespective of the maximum allowable pressure.

Reasons:

According to Article 2, point 5 of EU Directive 2014/68/EU, pressure accessories are defined as "devices with an operational function and having pressure-bearing housings".

If a pressure instrument does not have a pressure-bearing housing (no identifiable pressure chamber of its own), there is no pressure accessory present within the meaning of the Directive.

Process seal as per ANSI/ISA 12.27.01

North American practice for the installation of process seals. In accordance with ANSI/ISA 12.27.01, Endress+Hauser devices are designed as either single seal or dual seal devices with a warning message. This allows the user to waive the use of - and save the cost of installing - an external secondary process seal in the protective conduit as required in ANSI/NFPA 70 (NEC) and CSA 22.1 (CEC). These instruments comply with the North-American installation practice and provide a very safe and cost-saving installation for pressurized applications with hazardous fluids. More information is provided in the Safety Instructions (XA) for the relevant device.

Aluminum, stainless steel and plastic housing are approved as single-seal devices.

China RoHS symbol

China RoHS 1, Law SJ/T 11363-2006: The measuring system complies with the substance restrictions of the Directive on the Restriction of the Use of Certain Hazardous Substances (RoHS).

RoHS

The measuring system meets the substance restrictions of the Directive on the Restriction of the Use of Certain Hazardous Substances 2011/65/EU (RoHS 2) and the Delegated Directive (EU) 2015/863 (RoHS 3).

Additional certification

EAC conformity

The measuring system meets the legal requirements of the applicable EAC guidelines. These are listed in the corresponding EAC Declaration of Conformity together with the standards applied.

The manufacturer confirms successful testing of the device by affixing to it the EAC mark.

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

TAG

Measuring point (TAG)

The device can be ordered with a tag name.

Location of the tag name
Select in the additional specification:
- Stainless steel wired-on tag plate
- Plastic film
- Plate provided
- RFID TAG
- RFID TAG + stainless steel wired-on tag plate
- RFID TAG + plastic film
- RFID TAG + plate provided

Definition of tag name
Specify in the additional specification:
3 lines with a maximum of 18 characters per line
The specified tag name appears on the selected plate and/or on the RFID TAG.

Visualization in SmartBlue app
The first 32 characters of the tag name
The tag name can always be changed specifically for the measuring point via Bluetooth.

Test reports, declarations and inspection certificates

All test reports, declarations and inspection certificates are provided electronically in the *W@M Device Viewer*:
Enter the serial number from the nameplate (www.endress.com/deviceviewer)

Product documentation on paper
Test reports, declarations and inspection certificates in hard copy can optionally be ordered with feature 570 "Service", Version I7 "Product documentation on paper". The documents are then provided with the device upon delivery.

Application packages

The following versions can be optionally selected in the Product Configurator:

Application package: Heartbeat Verification + Monitoring, can only be selected in conjunction with the optional Bluetooth module
Accessories installed: Bluetooth

The Bluetooth module for use in conjunction with the electronic insert FEL68 (2-wire NAMUR) must be ordered separately with the necessary battery.
- Accessories installed: Bluetooth
- Application package: Heartbeat Verification + Monitoring for NAMUR output, can only be selected in conjunction with Bluetooth for the NAMUR output
  Accessory mounted, Bluetooth for NAMUR output

Heartbeat Technology module

Heartbeat Diagnostics
Continuously monitors and assesses the device condition and process conditions. Generates diagnostic messages when certain events occur and provides troubleshooting measures in accordance with NAMUR NE 107.

Heartbeat Verification
Performs a verification of the current device condition on demand and generates the Heartbeat Technology verification report showing the verification result.

Heartbeat Monitoring
Continuously provides device and/or process data for an external system. Analysis of this data forms the basis for process optimization and predictive maintenance.

Heartbeat Verification

The "Heartbeat Verification" module includes the Heartbeat Verification wizard, which performs a verification of the current device condition and generates the Heartbeat Technology verification report:
- The wizard can be used via the SmartBlue app.
- The wizard guides the user through the entire process of generating the verification report.
- The operating hours counter and minimum/maximum temperature indicator (peakhold) are displayed.
- In the event of an increase in the oscillation frequency of the fork, a corrosion warning will appear.
- The order configuration of the oscillation frequency in air is indicated in the verification report. An increased oscillation frequency indicates the presence of corrosion. A reduced oscillation frequency indicates that there is buildup present or that the sensor is covered by the medium. Deviations in the oscillation frequency compared to the oscillation frequency on delivery may occur due to the process temperature and process pressure.

Proof-testing for SIL/WHG devices

The proof test is only available for devices with SIL or WHG approval.

The "SIL Proof test" module, the "WHG Proof test" module or the "SIL/WHG Proof test" module contains a wizard for proof testing, which must be performed at appropriate intervals in the following applications: SIL (IEC61508/IEC61511), WHG (German Water Resources Act (Gesetz zur Ordnung des Wasserhaushalts)):
- The wizard can be used via the SmartBlue app.
- The wizard guides the user through the entire process for creating the verification report.
- The verification report can be saved as a PDF file.

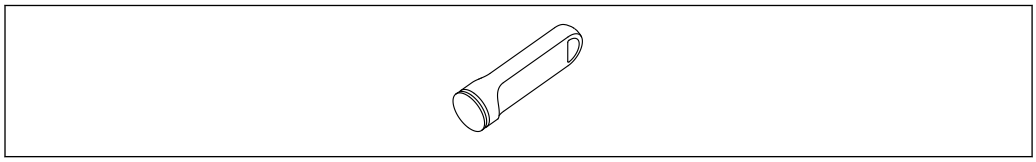
Accessories

Device Viewer

All the spare parts for the device, along with the order code, are listed in the *Device Viewer* (www.endress.com/deviceviewer).

Test magnet

Order number: 71437508

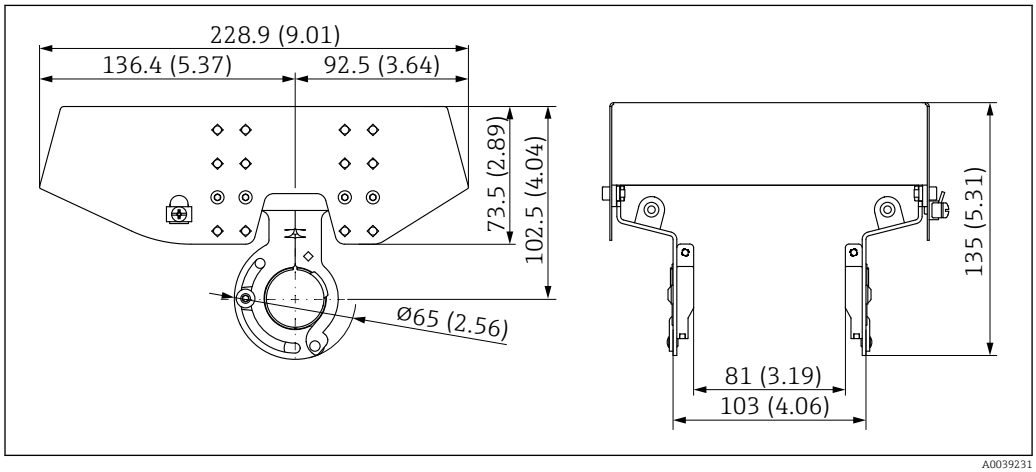


A0039209

51 Test magnet

Weather protection cover for dual compartment housing, aluminum

- Material: stainless steel 316L
- Order number: 71438303

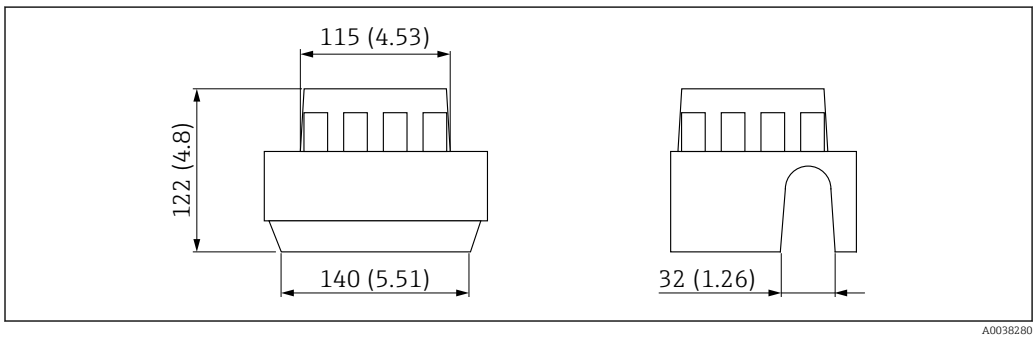


A0039231

52 Weather protection cover for dual compartment housing, aluminum. Unit of measurement mm (in)

Protective cover for single compartment housing, aluminum or 316L

- Material: plastic
- Order number: 71438291



A0038280

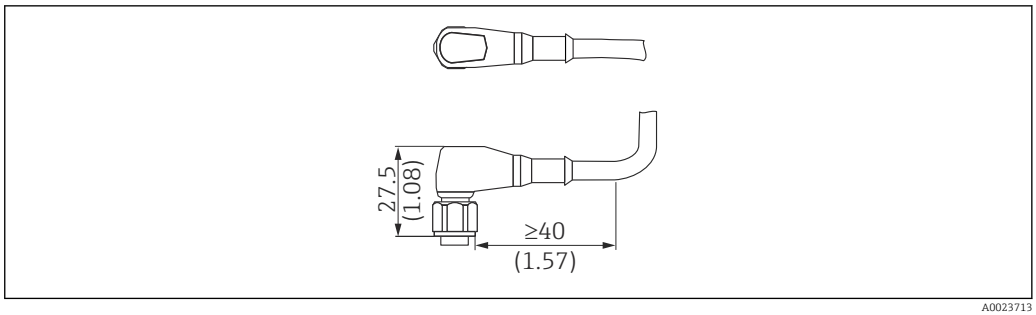
53 Protective cover for single compartment housing, aluminum or 316L. Unit of measurement mm (in)

Plug-in jack

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

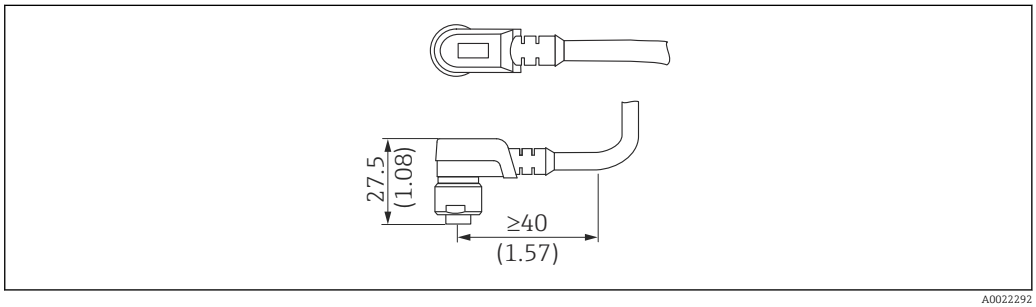
Plug-in jack M12 IP69

- Terminated at one end
- Elbowed 90 °
- 5 m (16 ft) PVC cable (orange)
- Slotted nut 316L (1.4435)
- Body: PVC (orange)
- Order number: 52024216



54 *Plug-in jack M12 IP69. Unit of measurement mm (in)*

Plug-in jack M12 IP67
- Elbowed 90 °
- 5 m (16 ft) PVC cable (gray)
- Slotted nut Cu Sn/Ni
- Body: PUR (black)
- Order number: 52010285

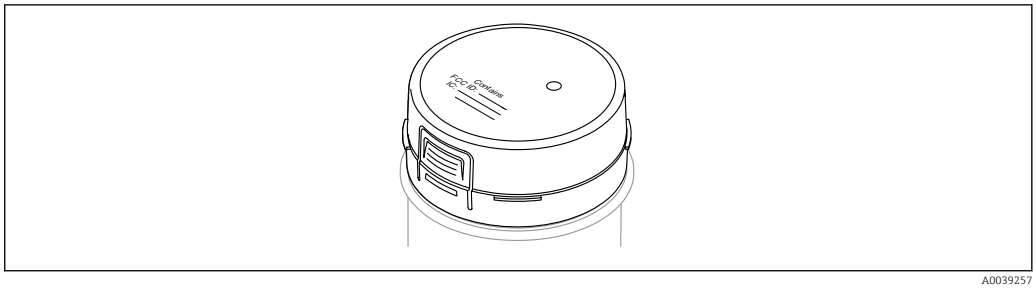


55 *Plug-in jack M12 IP67. Unit of measurement mm (in)*

Bluetooth module VU121 (optional)

The Bluetooth module can be connected to the following electronic inserts via the COM interface: FEL61, FEL62, FEL64, FEL64DC, FEL67, FEL68 (2-wire NAMUR).

- Bluetooth module without battery for use in conjunction with electronic inserts FEL61, FEL62, FEL64, FEL64DC and FEL67
  Order number: 71437383
- Bluetooth module with battery for use in conjunction with electronic insert FEL68 (2-wire NAMUR)
  Order number: 71437381



56 *Bluetooth module VU121*

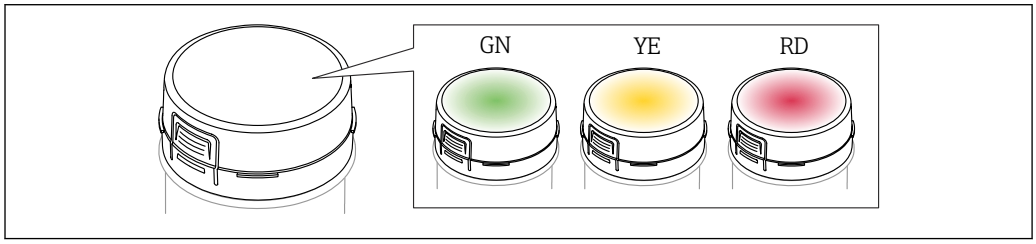
More detailed information and documentation are available:
- Product Configurator on the Endress+Hauser website www.endress.com
- Endress+Hauser sales organization www.addresses.endress.com

A tall cover is required (transparent plastic cover or aluminum cover with sight glass) when using or retrofitting the Bluetooth module. The Bluetooth module cannot be used in conjunction with the single compartment 316L housing, cast. The cover depends on the housing and approval of the device.

LED module VU120 (optional)

A brightly lit LED indicates the operational status (switch status or alarm status). The LED module can be connected to the following electronic inserts: FEL62, FEL64, FEL64DC.

Order number: 71437382



57 *LED module, the LED lights up in green (GN), yellow (YE) or red (RD)*

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

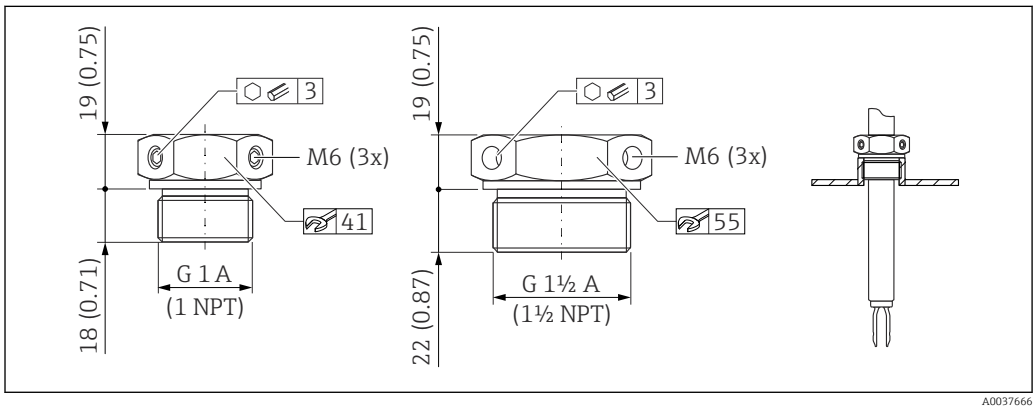
A tall cover is required (transparent plastic cover or aluminum cover with sight glass) when using or retrofitting the Bluetooth module. Use of the Bluetooth module is not possible in conjunction with the single compartment 316L housing, cast. The cover depends on the housing and approval of the device.

Sliding sleeves for unpressurized operation

Not suitable for devices with PFA (conductive) coating.

Not suitable for use in explosive atmospheres.

Switch point, infinitely adjustable.



58 *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

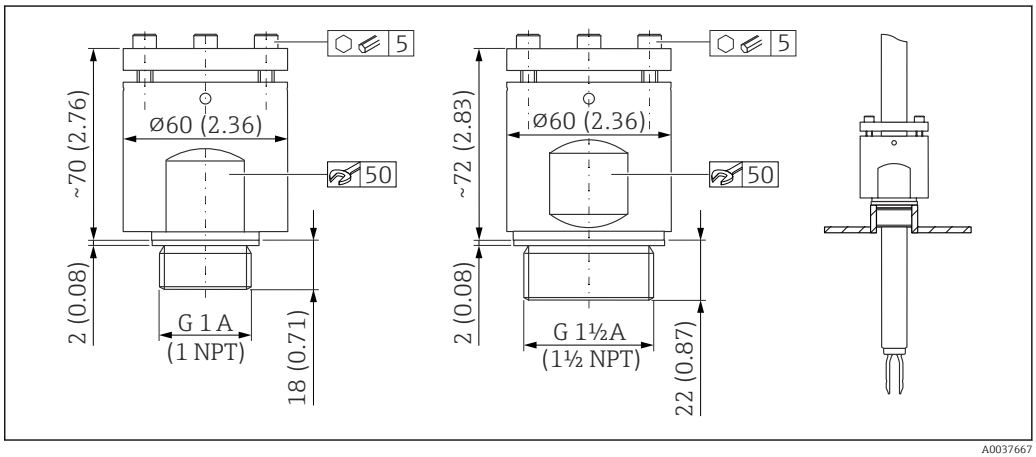
NPT 1½, ASME B 1.20.1
- Material: 1.4435 (AISI 316L)
- Weight: 0.54 kg (1.19 lb)
- Order number: 52003981
- Order number: 52011891, approval: with inspection certificate EN 10204 - 3.1 material

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

High pressure sliding sleeves

Not suitable for devices with PFA (conductive) coating.

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



59 *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: AlloyC22
- 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: AlloyC22
- 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: AlloyC22
- Weight: 1.32 kg (2.91 lb)
- Approval: with inspection certificate EN 10204 - 3.1 material

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: AlloyC22
- 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

Supplementary documentation

The certificates, approvals and other documentation currently available can be accessed as follows:
Endress+Hauser website: www.endress.com → Downloads.

Standard documentation

Document type: Operating Instructions (BA)
Installation and initial commissioning – contains all functions in the operating menu that are required for a typical measuring task. Functions beyond this scope are not included.
BA02037F

Document type: Brief Operating Instructions (KA)
Quick guide to the first measured value – includes all essential information from the incoming acceptance to the electrical connection.
KA01480F

Document type: Safety Instructions, certificates
Depending on the approval, Safety Instructions are also supplied with the device, e. g. XA. This documentation is an integral part of the Operating Instructions.
The nameplate indicates the Safety Instructions (XA) that are relevant to the device.

Supplementary device-dependent documentation

Special Documentation
- SD02662F: Heartbeat Verification + Monitoring application package
- SD02389F: Bluetooth module VU121, radio approval
- SD02398F: Sliding sleeve for Liquiphant (installation instructions)
- SD01622P: Weld-in adapter (installation instructions)
- TI00426F: Adapter and flanges (overview)

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