

Technical Information

Liquiphant FTL51B

Vibronic



Limit switch for liquids

Application

- Point level switch for minimum or maximum detection in tanks, vessels and pipes with all kinds of liquids, even in hazardous areas
- Process temperature range: -50 to $+150$ °C (-58 to $+302$ °F)
- Pressures up to 100 bar (1 450 psi)
- Viscosities up to 10 000 mPa·s
- Ideal substitute for float switches, as reliable function is not affected by flow, turbulence, bubbles, foam, vibration, solids content or buildup.
- Extension pipe up to 6 m (20 ft)

Advantages

- Approved for safety systems with functional safety requirements up to SIL2/SIL3 in accordance with IEC 61508
- Quick and cost-effective commissioning, as no adjustment required
- Design in accordance with ASME B31.3 and CRN approval
- No mechanically moving parts: no maintenance, no wear, and a long operating life
- Functional safety: monitoring of oscillation frequency of tuning fork
- RFID TAG - easy measuring point identification and easier data access
- Functional testing by means of test button on electronic insert
- Heartbeat Technology via free iOS/Android SmartBlue app
- Measuring device with Bluetooth® wireless technology

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About this document

Symbols

Safety symbols



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



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

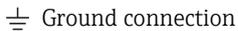


This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.



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

Electrical symbols



Grounded clamp, which is grounded via a grounding system.



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



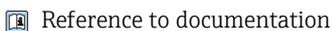
Procedures, processes or actions that are permitted.



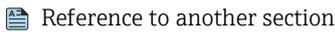
Procedures, processes or actions that are forbidden.



Indicates additional information



Reference to documentation



Reference to another section

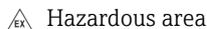


Series of steps

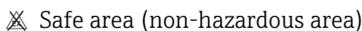
Symbols in graphics

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, dry-running protection, pump protection or overflow protection, 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 protection
- In MAX mode, the fork is not covered e. g. overflow protection

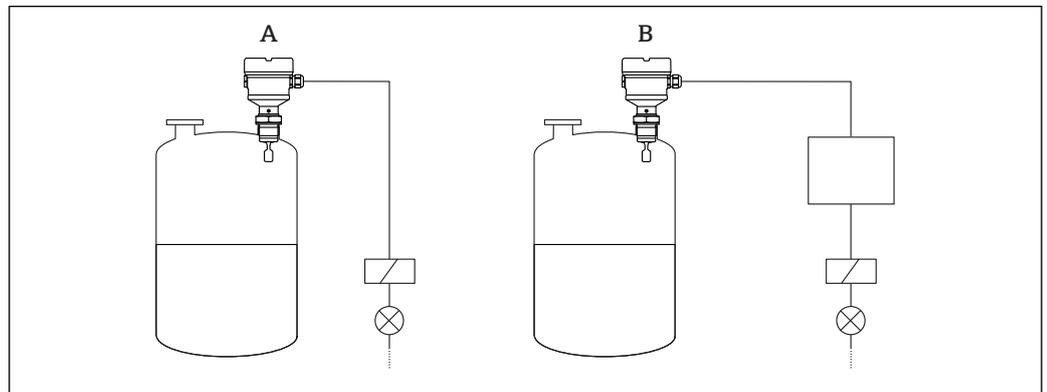
Demand mode

- In MIN mode, the fork is not covered e. g. pump protection
- In MAX mode, the fork is covered e. g. overflow protection

Measuring principle

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

Measuring system



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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

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 Maximum sensor length 6 m (20 ft)

Output

Output and input variants	<p>Electronic inserts</p> <p>2-wire AC (FEL61)</p> <ul style="list-style-type: none"> ▪ Two-wire AC version ▪ Switches the load directly into the power supply circuit via an electronic switch. <p>3-wire DC-PNP (FEL62)</p> <ul style="list-style-type: none"> ▪ Three-wire DC 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 for order Low-temperature electronic inserts are marked LT. <p>Universal current connection, relay output (FEL64)</p> <ul style="list-style-type: none"> ▪ Switches the loads via 2 potential-free changeover contacts ▪ Ambient temperature -60 °C (-76 °F), optionally available for order Low-temperature electronic inserts are marked LT. <p>Direct current connection, relay output (FEL64DC)</p> <ul style="list-style-type: none"> ▪ Switches the load via 2 potential-free changeover contacts ▪ Ambient temperature -60 °C (-76 °F), optionally available for order Low-temperature electronic inserts are marked LT. <p>PFM output (FEL67)</p> <ul style="list-style-type: none"> ▪ 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 -52 °C (-62 °F), optionally available for order The low-temperature electronic inserts are marked LT <p>2-wire NAMUR $> 2.2\text{ mA}/< 1.0\text{ mA}$ (FEL68)</p> <ul style="list-style-type: none"> ▪ 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 -52 °C (-62 °F), optionally available for order Low-temperature electronic inserts are marked LT. <p>2-wire density (FEL60D) for density measurement Connection to Density Computer FML621</p> <p> For more information, see the Technical Information for density measuring technology.</p>
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Output signal	<p>Switch output</p> <p>Preset switching times can be ordered. The following ranges can be ordered for point level switches without communication (AC two-wire, relays, DC-PNP, PFM, NAMUR):</p> <ul style="list-style-type: none"> ▪ 0.5 seconds when the fork is covered and 1.0 seconds when it is uncovered (factory setting) ▪ 0.25 seconds when the fork is covered and 0.25 seconds when it is uncovered (fastest setting) ▪ 1.5 seconds when the fork is covered and 1.5 seconds when it is uncovered ▪ 5 seconds when the fork is covered and 5 seconds when it is uncovered <p>COM interface</p> <p>For connecting to modules VU120 or VU121 (no modifying effect)</p>
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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

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

Residual voltage when switched through: maximum 12 V

i Pay attention to 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 line (not the neutral wire) of the supply circuit.

Power consumption

$P \leq 2 \text{ VA}$

Current consumption

Residual current when blocked: $I \leq 3.8 \text{ mA}$

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

Power output and load current

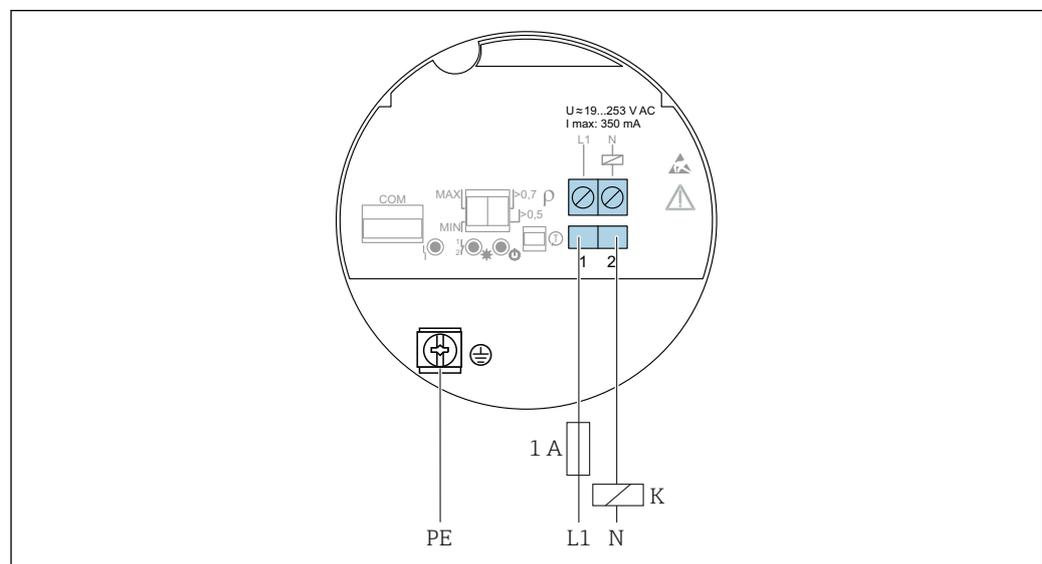
- Max 89 VA/253 V (350 mA); max 8.4 VA/24 V (350 mA)
- Min 2.5 VA/253 V (10 mA); min $\geq 0.5 \text{ VA}/24 \text{ V}$ (20 mA)
- With overload and short-circuit protection.

Behavior of output signal

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

Terminal assignment

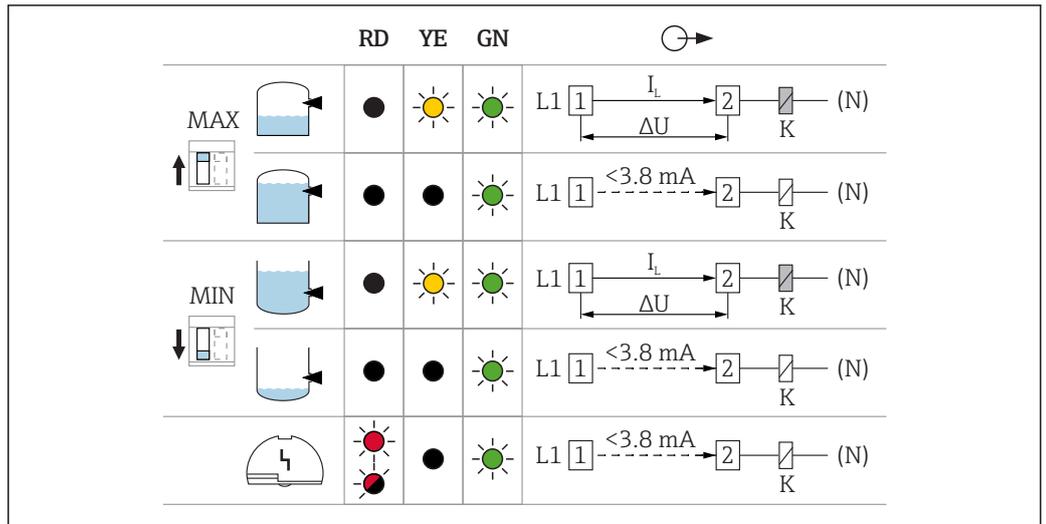
Always connect an external load. The electronic insert has integrated short-circuit protection.



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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

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 with the housing closed.

Supply voltage



Failure to use the prescribed power unit.

Risk of fatal injury due to 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}



Pay attention to the following as per 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 line (not the neutral wire) of the supply circuit.

Power consumption

P ≤ 0.5 W

Current consumption

I ≤ 10 mA (without load)

The red LED flashes in the event of an overload or short-circuit.

Load current

I ≤ 350 mA with overload and short-circuit protection

Capacitance load

C ≤ 0.5 μF at 55 V, C ≤ 1.0 μF at 24 V

Residual current

I < 100 μA (with transistor blocked)

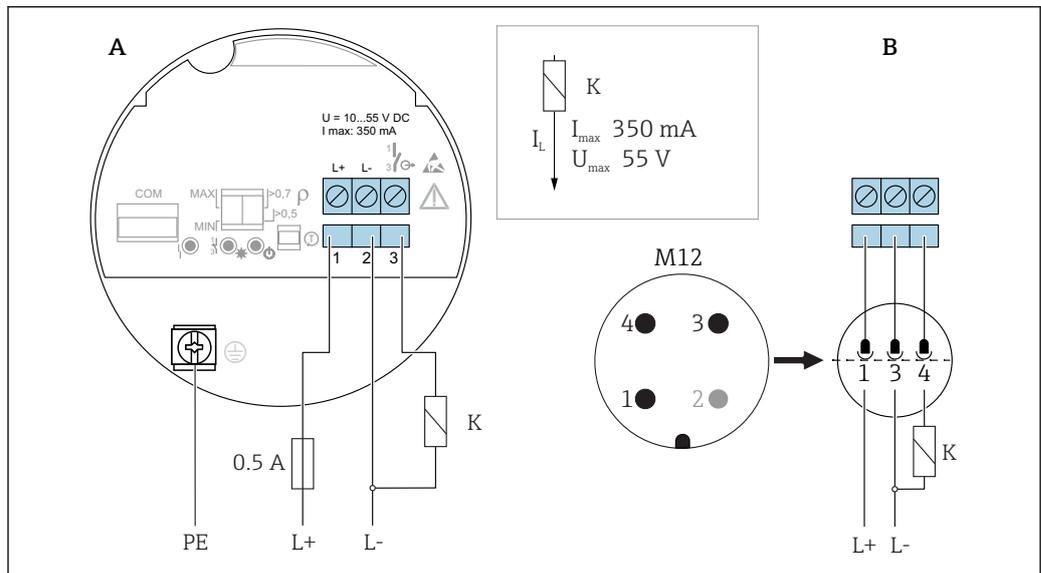
Residual voltage

U < 3 V (with transistor switched through)

Behavior of output signal

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

Terminal assignment

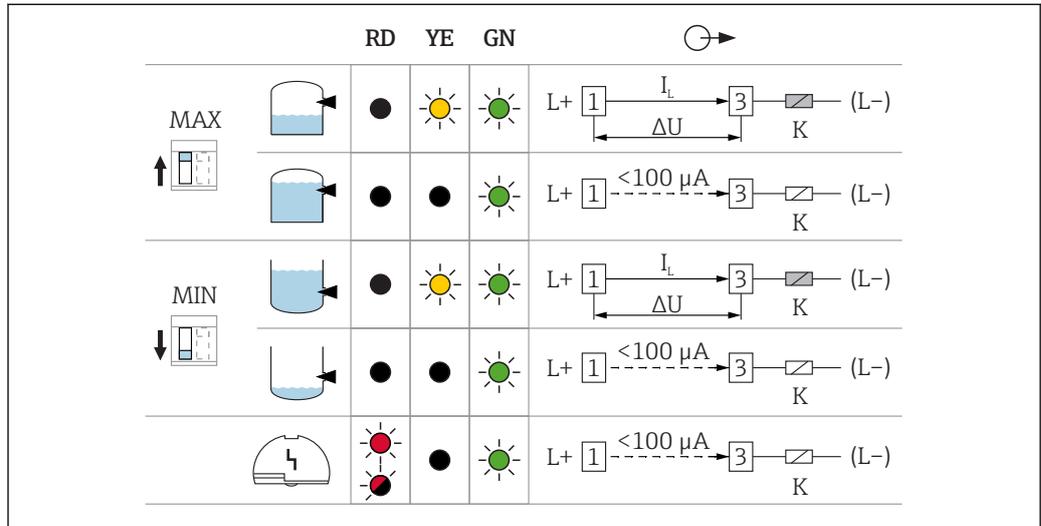


4 3-wire DC-PNP, electronic insert FEL62

A Connection wiring with terminals

B Connection wiring with M12 connector in housing as per EN61131-2 standard

Behavior of switch output and signaling



5 Behavior of switch output and signaling, electronic insert FEL62

MAXDIP 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 changeover contacts
- Two 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 with the housing closed.

WARNING

In the event of an error, the electronic insert can exceed the limit temperature for touchable surfaces, resulting in a risk of burns.

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

Supply voltage

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



Pay attention to the following as per 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 line (not the neutral wire) of the supply circuit.

Power consumption

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

Connectable load

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

- $I_{AC} \leq 6 \text{ A}$ (Ex de 4 A), $U \sim \leq \text{AC } 253 \text{ V}$; $P \sim \leq 1500 \text{ VA}$, $\cos \varphi = 1$, $P \sim \leq 750 \text{ VA}$, $\cos \varphi > 0.7$
- $I_{DC} \leq 6 \text{ A}$ (Ex de 4 A) to DC 30 V, $I_{DC} \leq 0.2 \text{ A}$ to 125 V

According to IEC 61010: the sum of the voltages of the relay outputs and power supply $\leq 300 \text{ V}$

Preferably use electronic insert FEL62 DC PNP for low DC current loads, e. g. connection to a PLC.

Relay contact material: silver/nickel AgNi 90/10

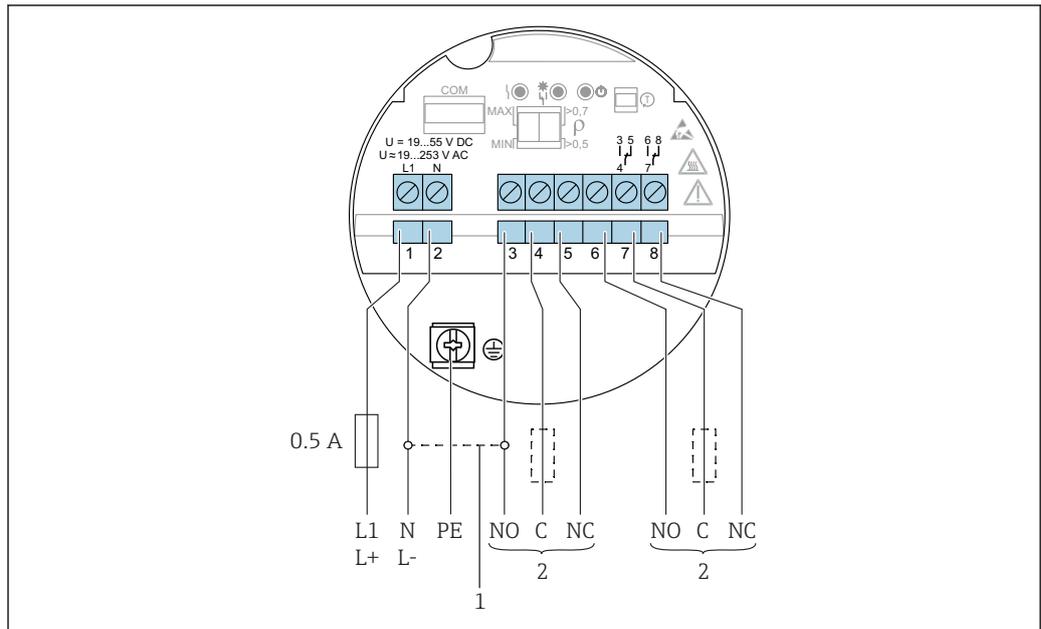
When connecting a device with high inductance, fit a spark suppressor to protect the relay contact. Depending on the connected load, a fine-wire fuse protects the relay contact in the event of a short-circuit.

Both relay contacts switch simultaneously.

Behavior of output signal

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

Terminal assignment

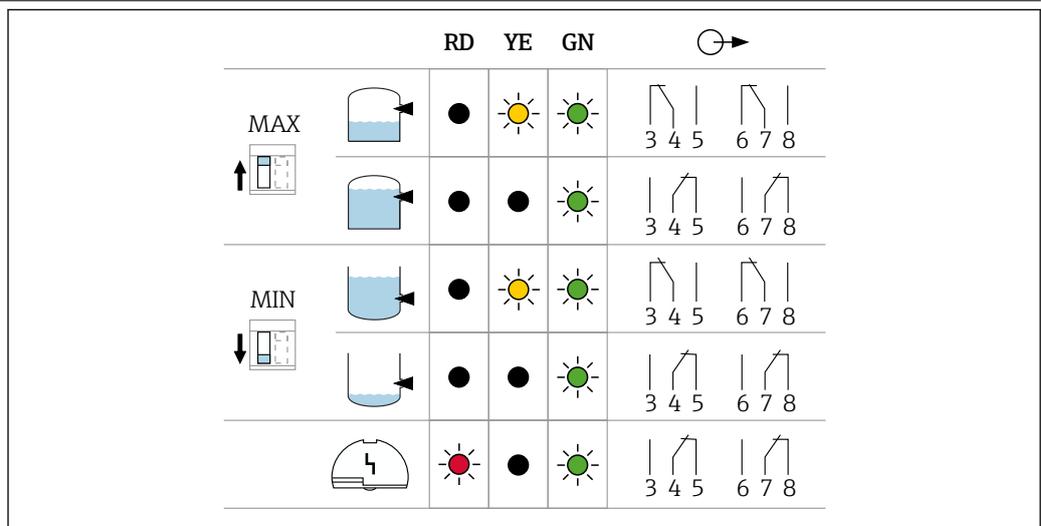


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6 Universal current connection with relay output, electronic insert FEL64

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

Behavior of switch output and signaling



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7 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 changeover contacts
- Two 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 with the housing closed.

Supply voltage

$U = 9 \text{ to } 20 \text{ V}_{\text{DC}}$



Pay attention to the following as per 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 circuit.

Power consumption

$P < 1.0 \text{ W}$

Connectable load

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

- $I_{\text{AC}} \leq 6 \text{ A}$ (Ex de 4 A), $U \sim \leq \text{AC } 253 \text{ V}$; $P \sim \leq 1500 \text{ VA}$, $\cos \varphi = 1$, $P \sim \leq 750 \text{ VA}$, $\cos \varphi > 0.7$
- $I_{\text{DC}} \leq 6 \text{ A}$ (Ex de 4 A) to DC 30 V, $I_{\text{DC}} \leq 0.2 \text{ A}$ to 125 V

According to IEC 61010: the sum of the voltages of the relay outputs and power supply $\leq 300 \text{ V}$

Preferably use electronic insert FEL62 DC PNP for low DC current loads, e. g. connection to a PLC.

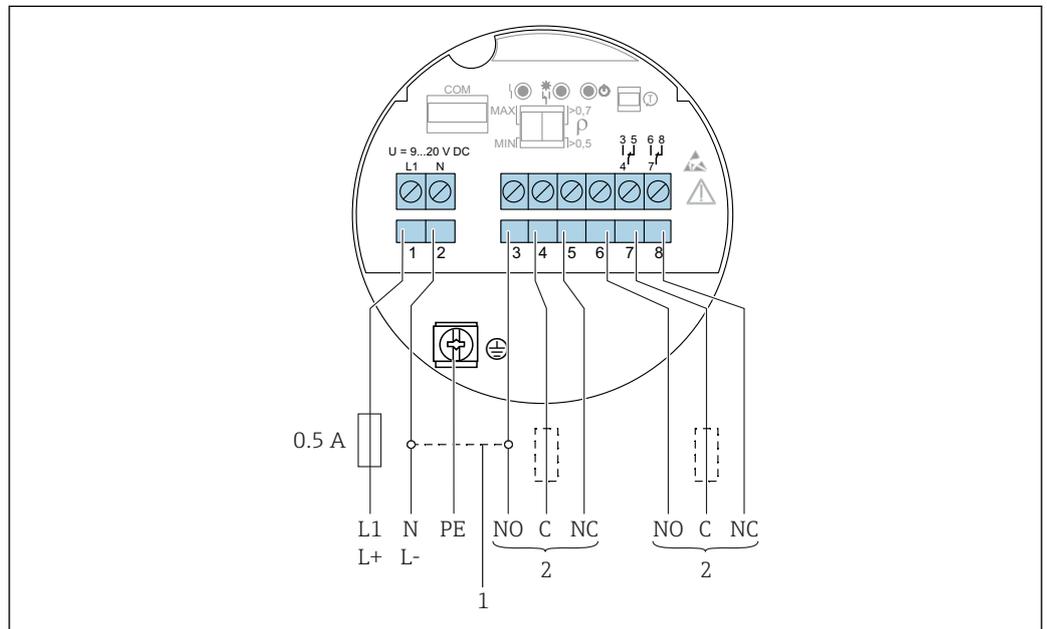
Relay contact material: silver/nickel AgNi 90/10

When connecting a device with high inductance, fit a spark suppressor to protect the relay contact. Depending on the connected load, a fine-wire fuse 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

Terminal assignment



8 DC connection with relay output, electronic insert FEL64 DC

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

Behavior of switch output and signaling

		RD	YE	GN	⊙ →
MAX ↑ 		●	☀	☀	
		●	●	☀	
MIN ↓ 		●	☀	☀	
		●	●	☀	
		☀	●	☀	

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9 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}

Pay attention to the following as per IEC/EN61010-1: Provide a suitable circuit breaker for the device.

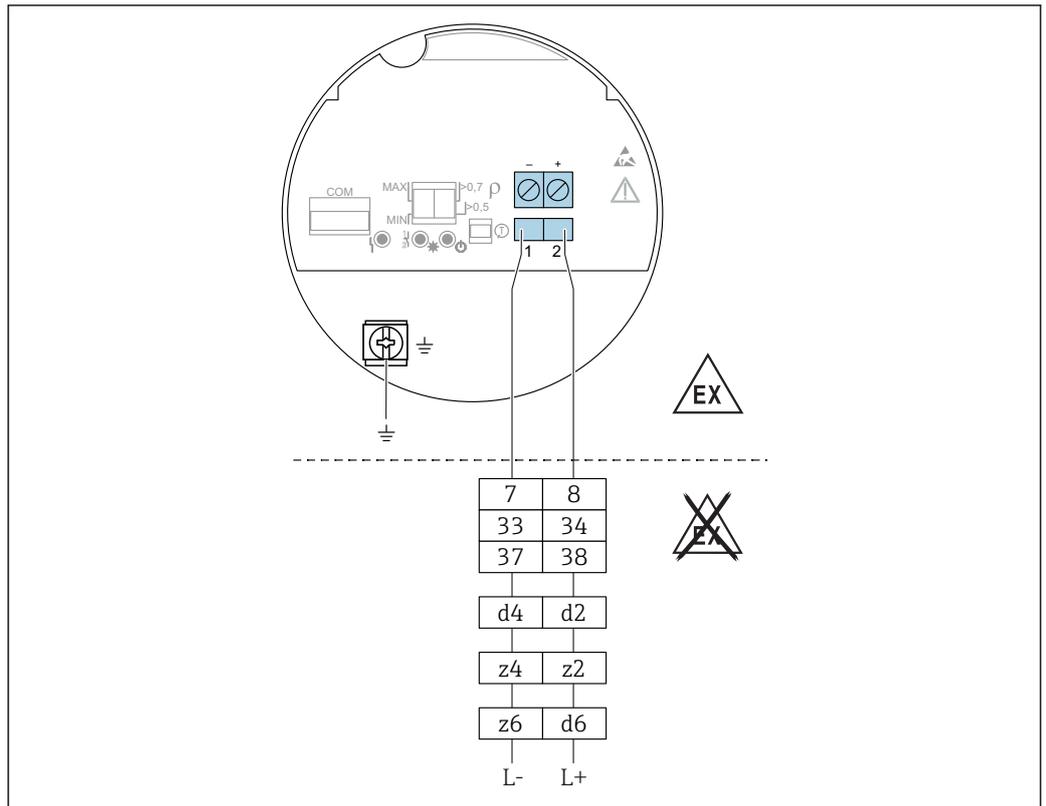
Power consumption

$P \leq 150$ mW with Nivotester FTL325P or FTL375P

Behavior of output signal

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

Terminal assignment



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10 PFM output, electronic insert FEL67

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

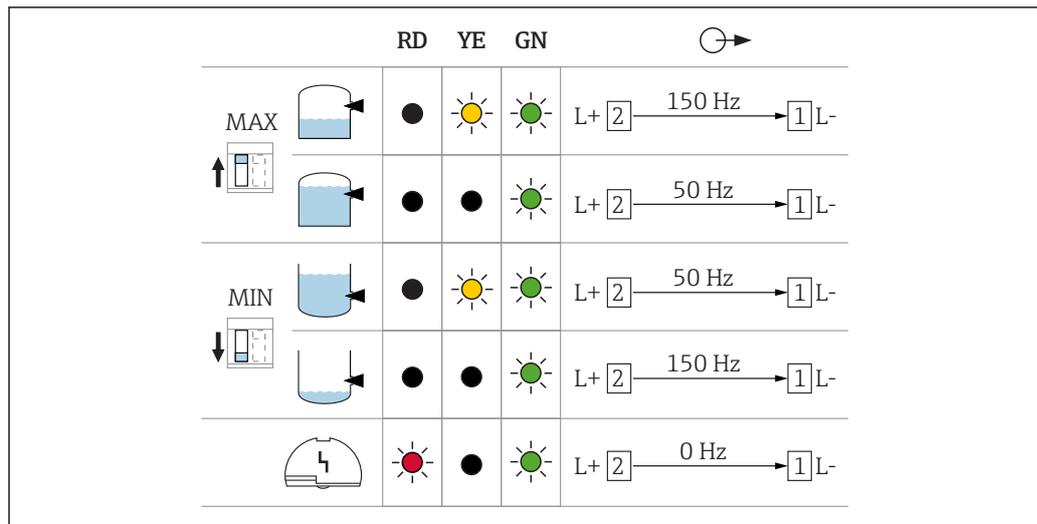
z4/ z2: Nivotester FTL375P input 2

z6/ d6: Nivotester FTL375P input 3

Connection cable

- Maximum cable resistance: 25 Ω per core
- Maximum cable capacitance: < 100 nF
- Maximum cable length: 1000 m (3 281 ft)

Behavior of switch output and signaling



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 11 Switching behaviour 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 MAX/MIN switch must be set in accordance with 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)

- For connecting to isolating amplifier as per NAMUR (IEC 60947-5-6), e.g. the Nivotester FTL325N from Endress+Hauser
- Signal transmission H-L edge 2.2 to 3.8 mA / 0.4 to 3.8 mA as per IEC 60947-5-6 (NAMUR) on two-wire cable
- 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 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

$U = 8.2 V_{DC}$

 Pay attention to the following as per IEC/EN61010-1: Provide a suitable circuit breaker for the device.

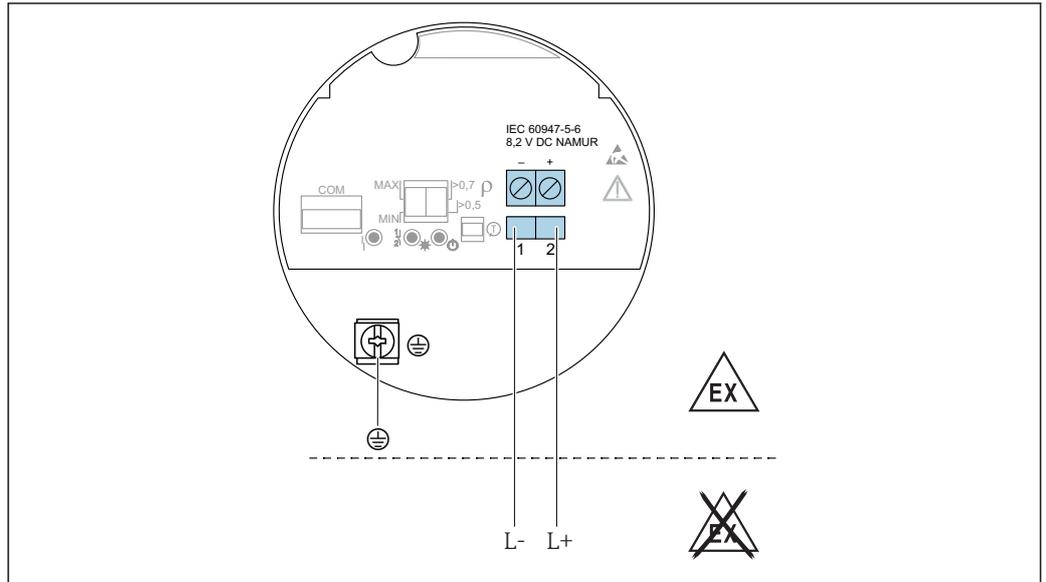
Power consumption

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 0.4 to 1.0 mA

Terminal assignment



12 2-wire NAMUR > 2.2 mA / < 1.0 mA, electronic insert FEL68

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Behavior of switch output and signaling

		RD	YE	GN	⊖ →
MAX ↑		●	☀	●	L+ 2 → 2.2...3.8 mA → 1 L-
		●	●	●	L+ 2 → 0.4...1.0 mA → 1 L-
MIN ↓		●	☀	●	L+ 2 → 2.2...3.8 mA → 1 L-
		●	●	●	L+ 2 → 0.4...1.0 mA → 1 L-
		●	●	●	L+ 2 → < 1.0 mA → 1 L-

13 Behavior of switch output and signaling, electronic insert FEL68

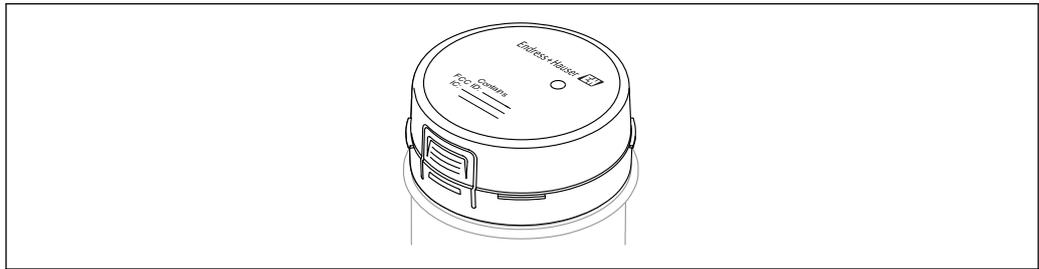
A0037694

- MAXDIP 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

- When using the device with the electronic insert FEL68 (2-wire NAMUR), the Bluetooth module must be ordered separately, including the required battery.
Product Configurator, order code for "Accessory mounted", option NG "Prepared for Heartbeat Verification + Monitoring + Bluetooth".

Bluetooth module and Heartbeat Technology

Bluetooth module VU121 (optional)



A0039257

14 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 with battery is suitable for use in hazardous areas.
- For energy-related reasons, the Bluetooth module requires a special battery when operated with the 2-wire NAMUR electronics.

i When using the device with the electronic insert FEL68 (2-wire NAMUR), the Bluetooth module must be ordered separately, including the required battery.

Product Configurator, order code for "Accessory mounted", option NG "Prepared for Heartbeat Verification + Monitoring + Bluetooth".

Batteries

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

i 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

Heartbeat Technology

Heartbeat Technology module

Heartbeat Diagnostics

Continuously monitors and evaluates the device status 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 status upon request and generates a Heartbeat Technology verification report showing the result of the verification.

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.

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 seconds after the Bluetooth search commences
- Data can be read from the Bluetooth module 60 seconds after the supply voltage has been switched on.
- Display of the current vibration frequency and the switching state of the device

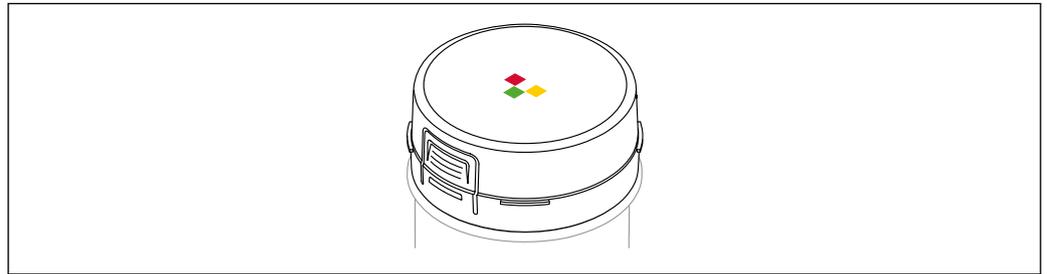
The yellow LED flashes when the Bluetooth module is connected to another Bluetooth device, e.g. a cellular phone.

Technical data

- Approval: intrinsically safe Ex ia, IS or ec/ic
- NAMUR electronics (electronic insert FEL68):
For energy-related reasons, the Bluetooth module VU121 requires a special battery when operated with the 2-wire NAMUR electronics. 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 (at ambient temperatures between 10 to 40 °C (50 to 104 °F)).
- Maximum free-field range 50 m (165 ft)
- Operation radius with intervisibility 10 m (33 ft) around the device



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

LED module VU120 (optional)

A0039258

15 LED module

The bright LED display indicates the switch status or the alarm condition and can be connected to the following electronic inserts: FEL62, FEL64, FEL64DC

Supply voltage	$U = 12 \text{ to } 55 \text{ V}_{\text{DC}}, 19 \text{ to } 253 \text{ V}_{\text{AC}}$
Power consumption	$U \leq 0.7 \text{ W}, < 6 \text{ VA}$
Current consumption	$I_{\text{max}} = 0.4 \text{ A}$

Performance characteristics

Reference operating conditions

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

Taking the switch point into consideration

Typical switch points, depending on the orientation of the point level switch
(water +23 °C (+73 °F))

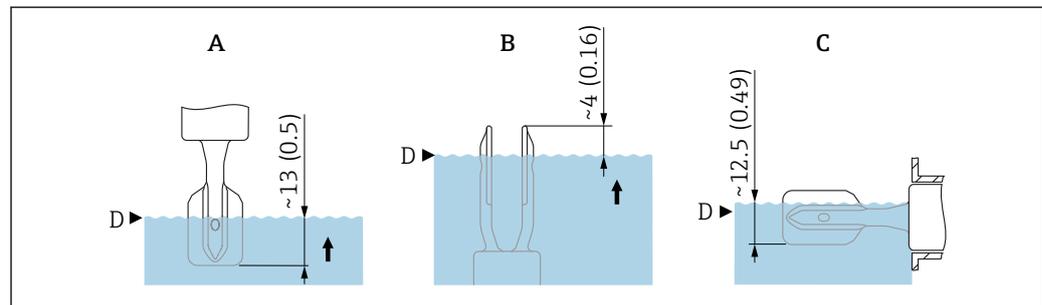
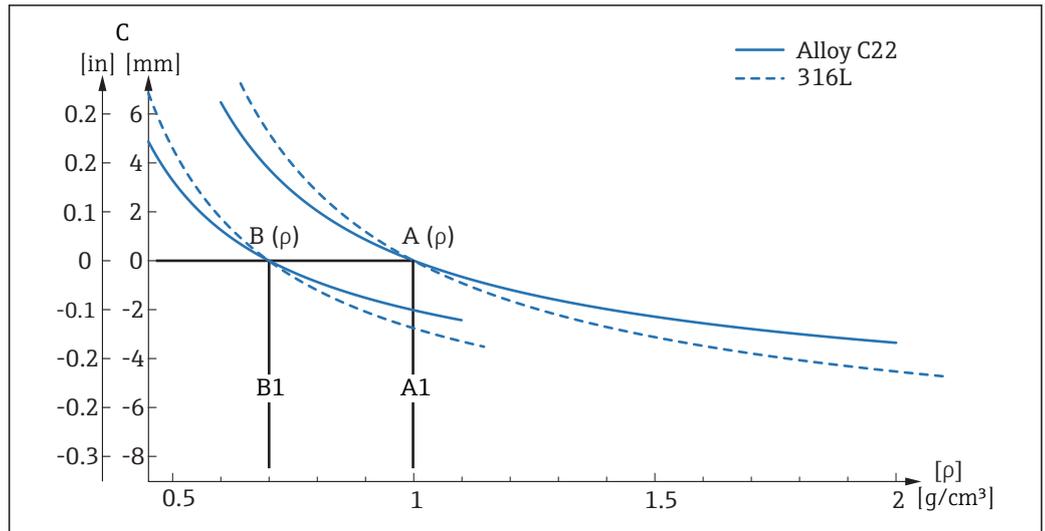


Fig. 16 Typical switch points. Unit of measurement mm (in)

- 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)
Hysteresis	Typically 2.5 mm (0.1 in)
Non-repeatability	2 mm (0.08 in)
Influence of the process temperature	The switch point moves between +1.4 to -2.6 mm (+0.06 to -0.1 in) in the temperature range from -50 to +150 °C (-58 to +302 °F)
Influence of the process pressure	The switch point moves between 0 to 2.6 mm (0 to 0.1 in) in the pressure range from -1 to +64 bar (14.5 to 928 psi)

Influence of the density of the process medium (at room temperature and normal pressure)



A0037670

17 Switch point deviation over density

- A Density switch setting ($\rho > 0.7$)
- A1 Reference condition $\rho = 1 \text{ g/cm}^3$
- B Density switch setting ($\rho > 0.5$)
- B1 Reference condition $\rho = 0.7 \text{ g/cm}^3$
- C Switch point deviation

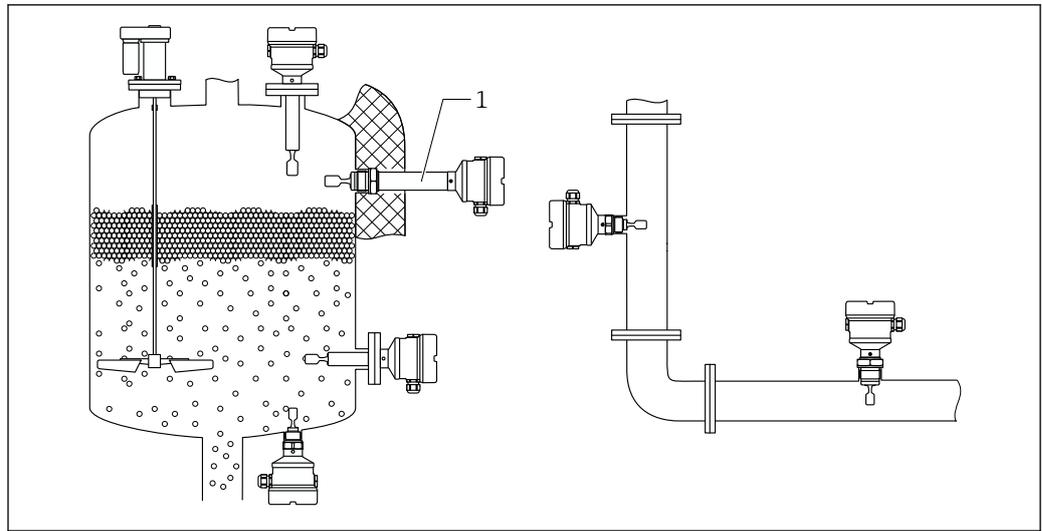
Density setting

- TK_{typ} , [mm/10 k]
 - $\rho > 0.7$: -0.2
 - $\rho > 0.5$: -0.2
- $\text{Pressure}_{\text{typ}}$, [mm/10 bar]
 - $\rho > 0.7$: -0.3
 - $\rho > 0.5$: -0.4

Installation

i Open the device only in a dry environment!

Mounting location, orientation



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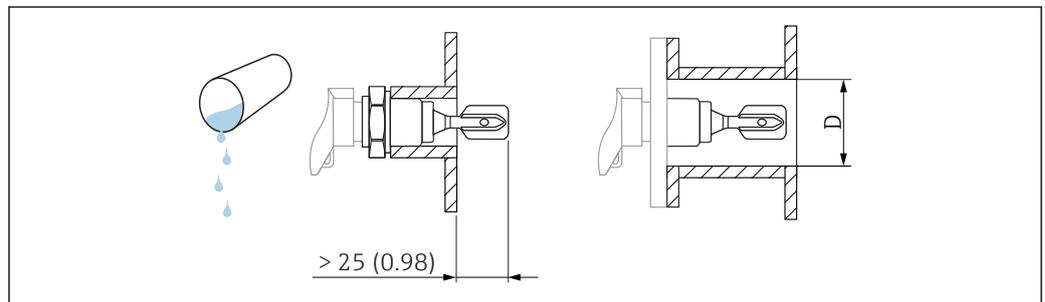
18 Installation in any position in a vessel, pipe or tank

1 Temperature spacer for tank with insulation and/or high process temperatures

Installation instructions

Take viscosity into consideration

Low viscosity



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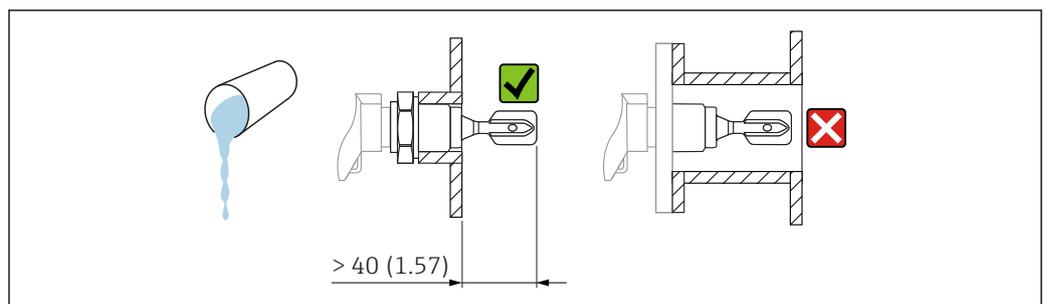
19 Installation example for low-viscosity liquids. Unit of measurement mm (in)

D Diameter of installation socket: at least 50 mm (2.0 in)

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

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

High viscosity



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

NOTICE

Highly viscous liquids may cause switching delays.

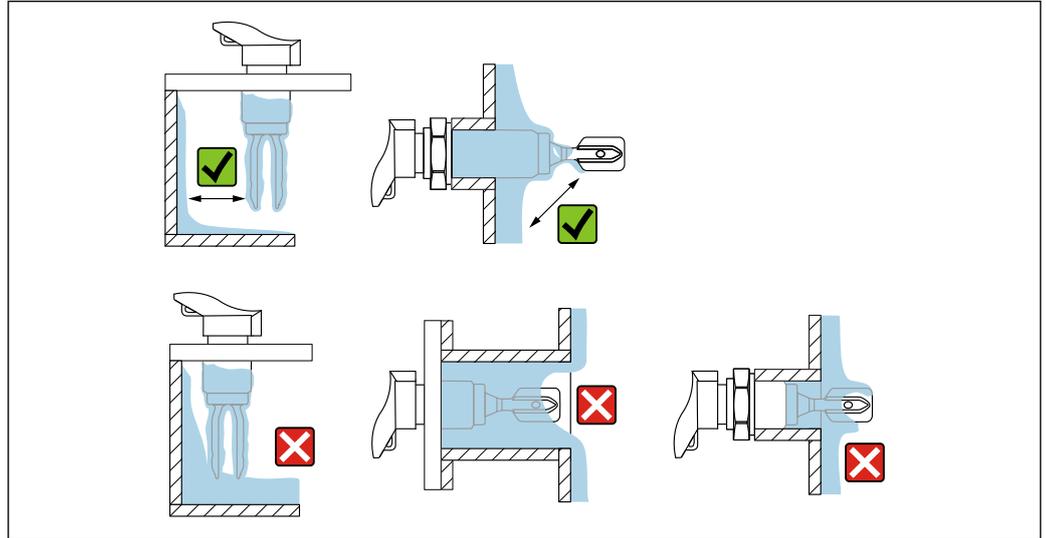
- ▶ Make sure that the liquid can run off the tuning fork easily.
- ▶ Deburr the socket surface.



High viscosity, e. g. viscous oils: < 10 000 mPa·s

The tuning fork must be located outside the installation socket!

Avoiding buildup

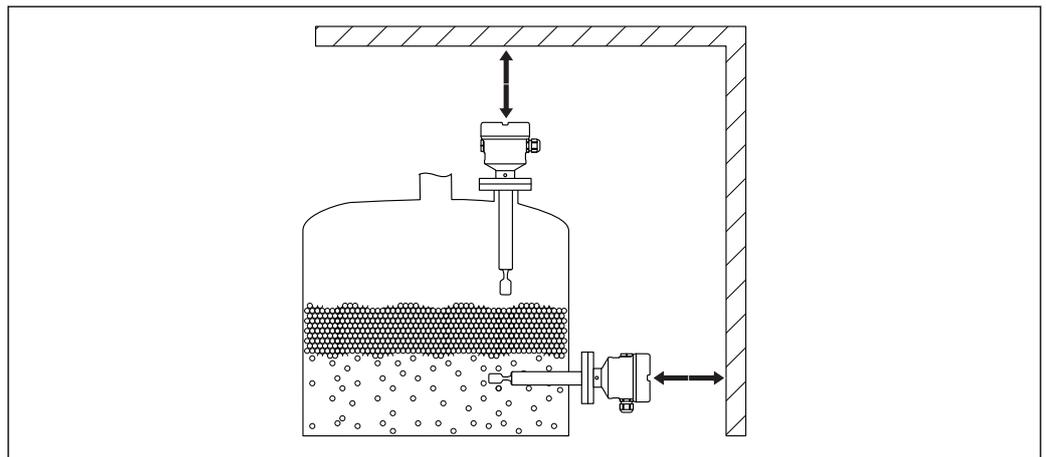


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21 Installation examples for a highly viscous process medium

- Use short installation sockets to ensure that the tuning fork can project freely into the vessel.
- Install preferably flush-mounted on vessels or in pipes.
- Leave sufficient distance between the buildup expected on the tank wall and the tuning fork.

Take clearance into consideration

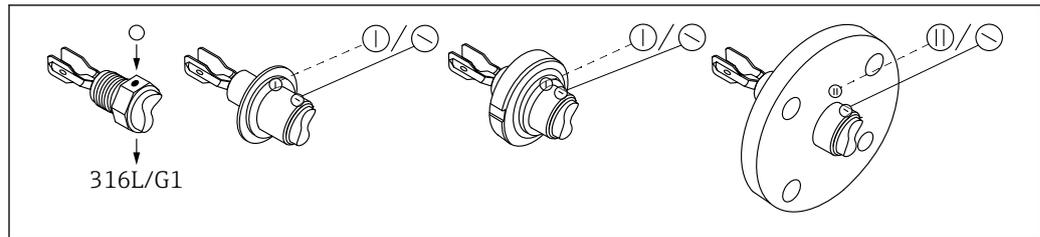


A0033236

22 Take clearance into consideration

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

Taking marking into account **Align the tuning fork in accordance with the marking.**



A0039125

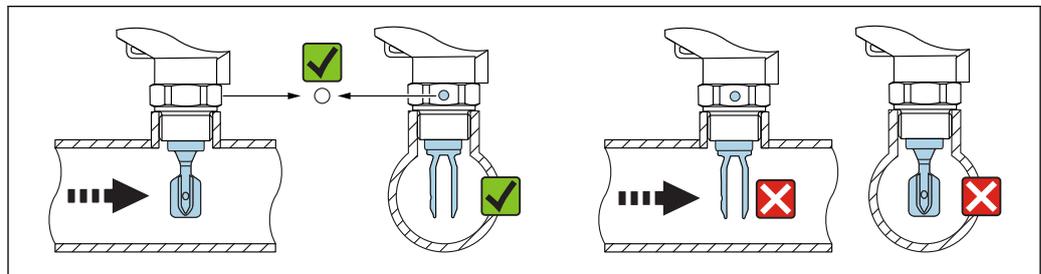
23 Markings for aligning the tuning fork

Using the marking, the tuning fork can be aligned in such a way that medium can run off easily and buildup is avoided.

Markings may include the following:

- material specification, thread description or circle on hexagonal nut or welding neck
- Symbol II on rear of flange or Tri-Clamp

Installing in pipes



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24 Installation in pipes

Flow velocities up to 5 m/s at a viscosity of 1 mPa·s and density of 1 g/cm³ (SGU)
Check the function in the event of other process medium conditions.

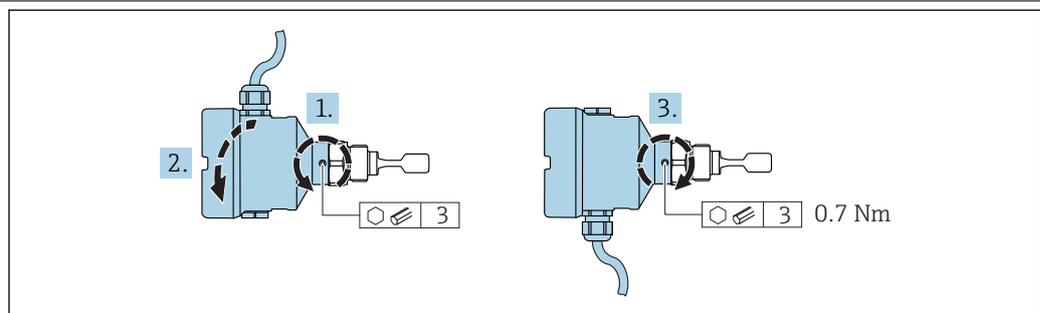
The flow will not be significantly impeded if the tuning fork is correctly aligned and the marking on the adapter is pointing in the direction of flow.

The marking is visible when installed.

Sliding sleeves

See the "Accessories" section.

Aligning the cable entry

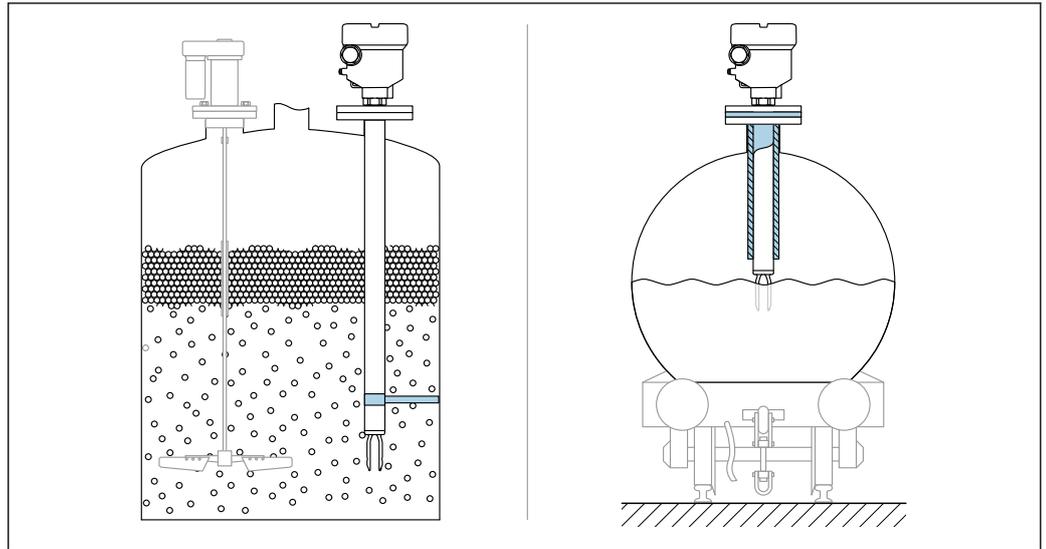


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25 Housing with external locking screw

Special mounting instructions

Support the device

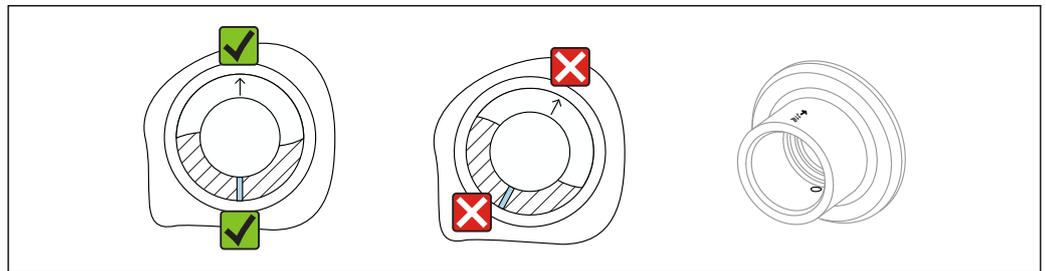


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26 Support in the event of dynamic load

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).

Weld-in adapter with leakage hole



A0039230

27 Weld-in adapter with leakage hole

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

Environment

Ambient temperature range -40 to +70 °C (-40 to +158 °F)

⚠ WARNING

Permitted connection voltage exceeded!

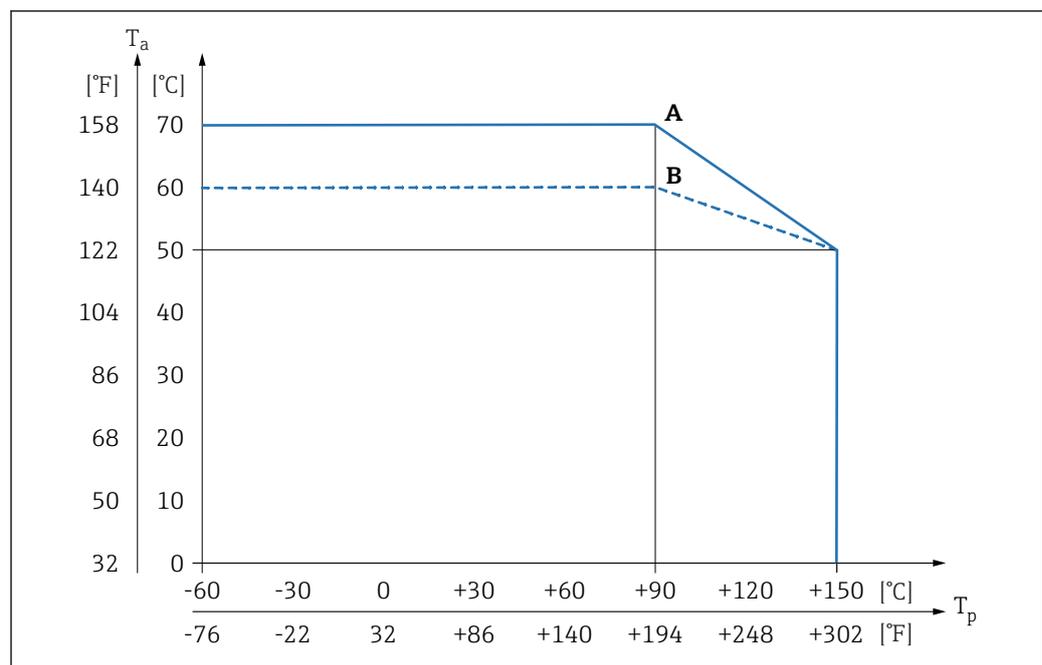
- ▶ For electrical safety reasons, the maximum connection voltage for all electronic inserts at ambient temperatures below -40 °C (-40 °F) is limited to a maximum of 35 V DC.

Optional

-60 °C (-76 °F) or -52 °C (-62 °F)

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).

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



28 Permitted ambient temperature T_a at the housing as a function of the process temperature T_p in the vessel:

- A Device without LED module; at process temperature $T_p > 90^\circ$, with FEL64 and max. load current 4 A
 B Device with LED module; at process temperature and FEL64 $T_p > 90^\circ$ max. load current 2 A

For devices with a temperature spacer, the following ambient temperatures apply across the entire process temperature range:

A: 70 °C

B: 60 °C

Ordering information:

- Product Configurator, order code for "output", option "1"
Ambient temperature -60 °C (-76 °F), optionally available for order
- Product Configurator, order code for "output", option "2"
Ambient temperature -52 °C (-62 °F), optionally available for order.

Low-temperature electronic inserts are marked LT.

- i** ■ Bluetooth module (non-Ex): -40 to +85 °C (-40 to +185 °F)
- Bluetooth module (Ex ia): -40 to +65 °C (-40 to +149 °F), T4
- LED module: -40 to +60 °C (-40 to +140 °F)

Outdoor operation in strong sunlight:

- Mount the device in the shade.
- Avoid direct sunlight, particularly in warmer climatic regions.
- Use a weather protection cover, which can be ordered as an accessory

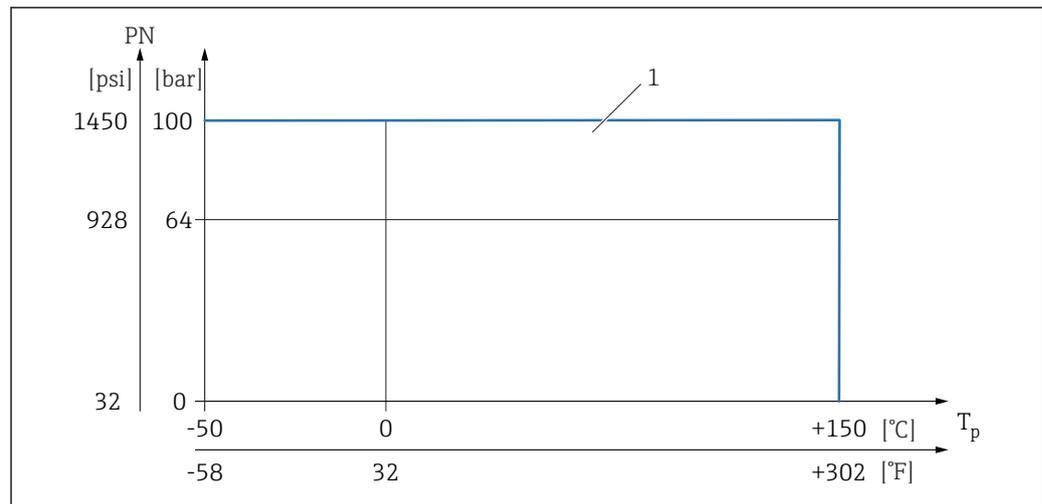
Storage temperature	-40 to +80 °C (-40 to +176 °F) optional: -52 °C (-62 °F), -60 °C (-76 °F)
Humidity	Operate up to 100 %. Do not open in a condensing atmosphere.
Operating altitude	As per IEC 61010-1 Ed.3: <ul style="list-style-type: none"> ■ Up to 2 000 m (6 600 ft) above sea level ■ Can be extended 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	For housing with electrical connection M20 coupling, plastic <ul style="list-style-type: none"> ■ Single-chamber, plastic: IP66/67 NEMA type 4X ■ Single-chamber and dual-chamber, aluminum: IP66/68 NEMA type 4X/6P ■ Single-chamber 316L, cast: IP66/68 NEMA type 4X/6P M20 coupling, nickel-plated brass Single-chamber and dual-chamber, aluminum: IP66/68 NEMA type 4X/6P M20 coupling, 316L <ul style="list-style-type: none"> ■ Single-chamber and dual-chamber, aluminum: IP66/68 NEMA type 4X/6P ■ Single-chamber 316L, cast: IP66/68 NEMA type 4X/6P Thread M20 <ul style="list-style-type: none"> ■ Single-chamber, plastic: IP66/67 NEMA type 4X ■ Single-chamber and dual-chamber, aluminum: IP66/68 NEMA type 4X/6P ■ Single-chamber 316L, cast: IP66/68 NEMA type 4X/6P Thread G ½ <ul style="list-style-type: none"> ■ Single-chamber, plastic: IP66/67 NEMA type 4X ■ Single-chamber and dual-chamber, aluminum: IP66/68 NEMA type 4X/6P ■ Single-chamber 316L, cast: IP66/68 NEMA type 4X/6P Thread NPT ½ <ul style="list-style-type: none"> ■ Single-chamber, plastic: IP66/67 NEMA type 4X ■ Single-chamber 316L, cast: IP66/68 NEMA type 4X/6P Thread NPT ¾ <ul style="list-style-type: none"> ■ Single-chamber and dual-chamber, aluminum: IP66/68 NEMA type 4X/6P ■ Single-chamber 316L, cast: IP66/68 NEMA type 4X/6P M12 plug <ul style="list-style-type: none"> ■ Single-chamber, plastic: IP66/67 NEMA type 4X ■ Single-chamber, aluminum: IP66/67 NEMA type 4X ■ Single-chamber 316L, cast: IP66/67 NEMA type 4X
Vibration resistance	As per IEC60068-2-64-2009 $a(\text{RMS}) = 50 \text{ m/s}^2$, $f = 5 \text{ to } 2\,000 \text{ Hz}$, $t = 3 \text{ planes} \times 2 \text{ h}$ For increased oscillations or vibrations, the additional option of order code "Application" option "B" 100 bar (1 450 psi) process pressure is recommended.
Shock resistance	As per IEC60068-2-27-2008: 300 m/s^2 [=30 gn] + 18ms
Mechanical load	Lateral loading capacity  Special mounting instructions
Electromagnetic compatibility	<ul style="list-style-type: none"> ■ 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. Details are available in the supplementary Functional Safety Manual.

Process

Process temperature range -50 to +150 °C (-58 to +302 °F)
Pay attention to the pressure and temperature dependence (see the "Sensor process pressure range" section)

Thermal shock ≤ 120 K/s

Process pressure range



A0038268

29 Process temperature FTL51B

1 Permitted pressure rating if the "100 bar (1450 psi)" option is selected. For exceptions, see the "Process connections" section. Canadian CRN approval: more details on the maximum pressure values are available in the download area of the product page under "www.endress.com".

⚠ WARNING

The maximum pressure for the measuring device is dependent on the lowest-rated element, with regard to pressure, of the selected components. 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.
- ▶ The measuring device must be operated only 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 measuring device.

Permitted pressure values for flanges at higher temperatures can be found in the following standards:

- pR EN 1092-1: 2005 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

The lowest value from the derating curves of the device and of the selected flange applies in each case.

Process pressure range of the sensors

- PN: 64 bar (928 psi) at max. 150 °C (302 °F)
Ordering information: Product Configurator, order code for "Application" option "A"
- PN: 100 bar (1450 psi) at max. 150 °C (302 °F)
Ordering information: Product Configurator, order code for "Application" option "B"

Test pressure

Gauge pressure

- PN = 64 bar (928 psi): test pressure = 1.5 · PN maximum 100 bar (1450 psi) depending on process connection selected
- Membrane burst pressure at 200 bar (2900 psi)

- PN = 100 bar (1 450 psi): test pressure = $1.5 \cdot$ PN maximum 150 bar (2 175 psi) depending on process connection selected
- Membrane burst pressure at 400 bar (5 800 psi)

The instrument 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

- Switch position $> 0.7 \text{ g/cm}^3$ = order configuration
Standard setting for liquids with a density $> 0.7 \text{ g/cm}^3$
 - Switch position $> 0.5 \text{ g/cm}^3$ = can be configured via DIP switch
For liquids with a density $> 0.5 \text{ g/cm}^3$ to $< 0.8 \text{ g/cm}^3$
 - Order option: 0.4 g/cm^3 (not for devices with SIL)
For liquids with a density $> 0.4 \text{ g/cm}^3$ and density $< 0.6 \text{ g/cm}^3$
If this option has been selected, the density setting is always set to 0.4 g/cm^3 . This setting can no longer be altered.
-

Pressure tightness

Up to vacuum



In vacuum evaporation systems, the density of the liquids can drop to a very low value: select density setting 0.4.

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

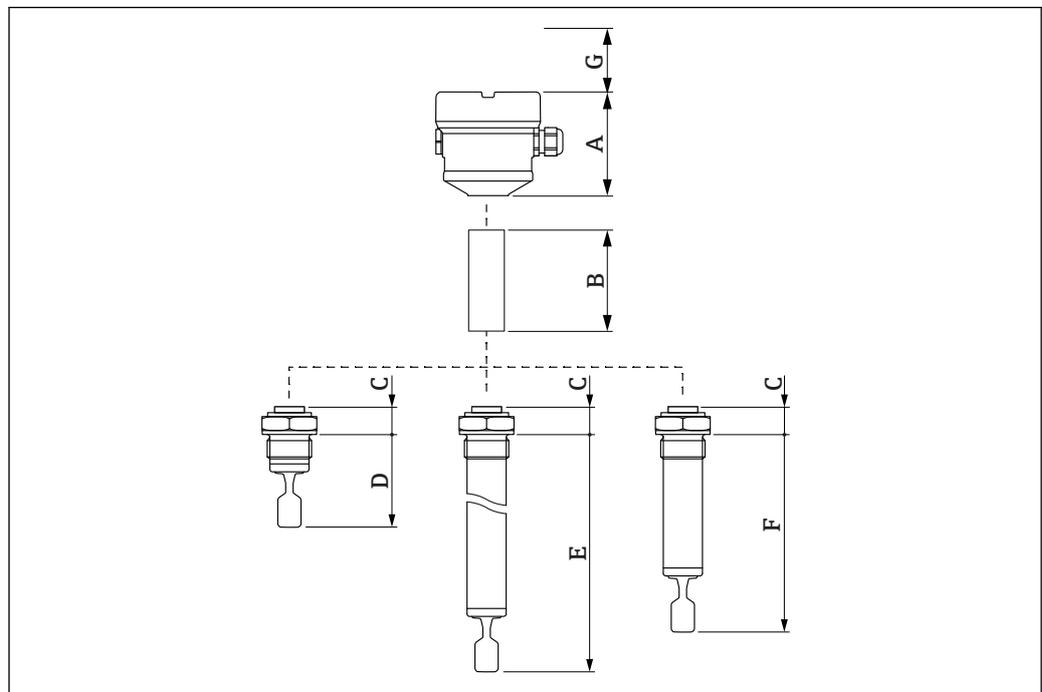
Device height

The device height is calculated from the following components:

- Housing including cover
- Optional spacer (temperature spacer or pressure-tight feedthrough (second line of defense))
- Pipe extension, short pipe or compact version
- Process connection

The individual heights of the components can be found in the following sections:

- Determine the height of the device and add the individual heights.
- Take into consideration the installation distance (space that is used to install the device).



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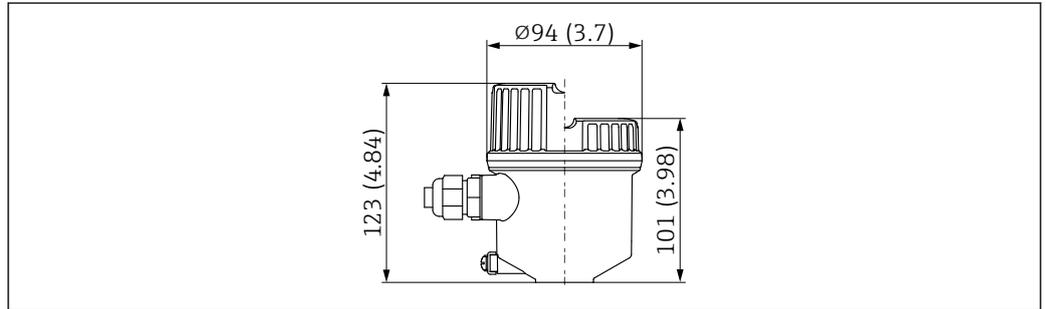
 30 Components for determining the height of the device

- A Housing
- B Depending on the process connection, up to 60 mm (2.36 in). For details, see Product Configurator.
- C Process connections
- D Process connections
- E Pipe extension
- F Short pipe
- G Installation clearance

Dimensions

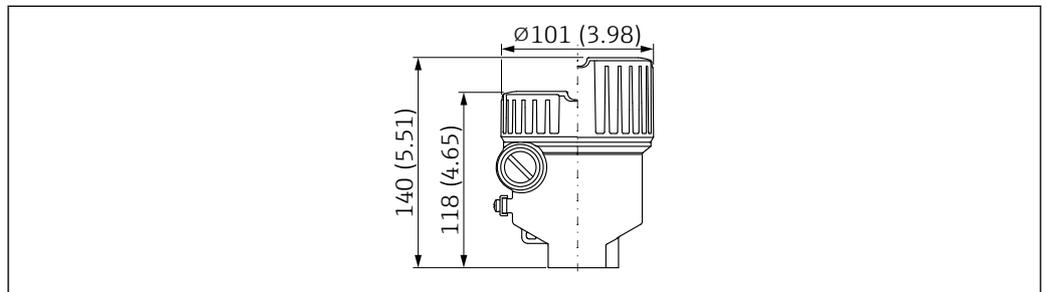
Housing

The housings can be aligned. On metal housings, the alignment of the housing can also be fixed by means of the locking screw. A tall cover with viewing window must be used for devices that are operated with the Bluetooth or LED module.



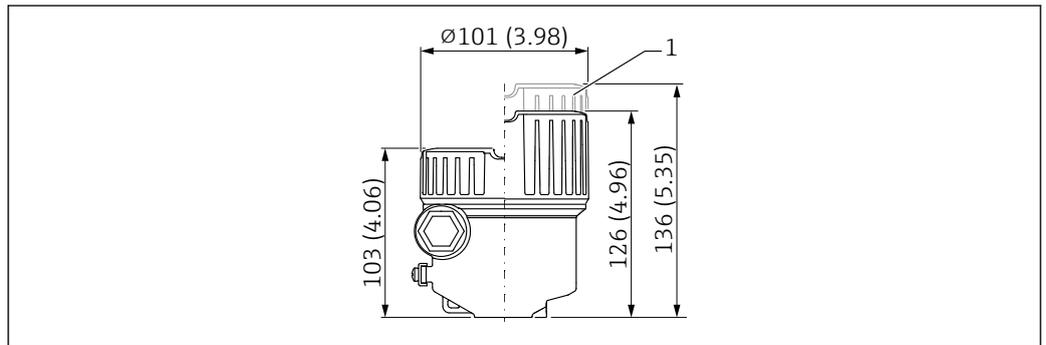
A0035911

31 Single-chamber housing, plastic; Product Configurator: order code for "Housing; material", option A. Unit of measurement mm (in)



A0039401

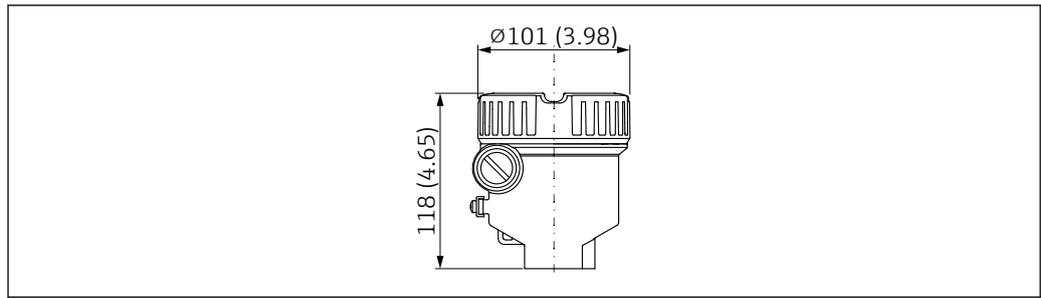
32 Single-chamber housing, aluminum for Ex d/XP approval; Product Configurator: order code for "Housing; material", option B. Unit of measurement mm (in)



A0039402

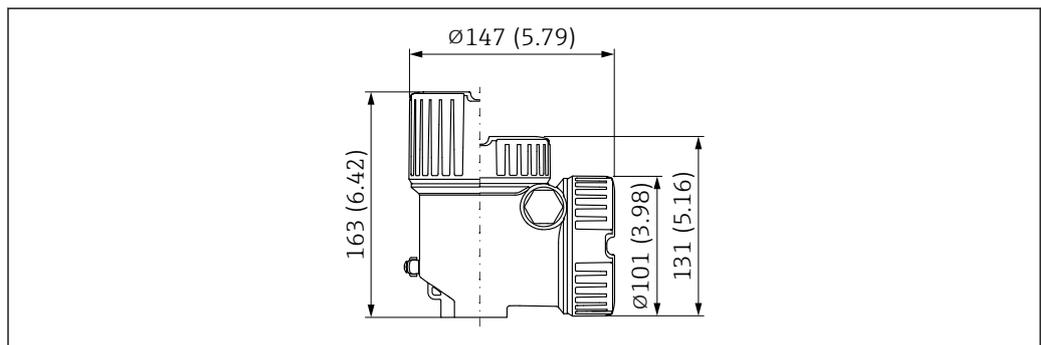
33 Single-chamber housing, aluminum; Product Configurator: order code for "Housing; material", option B. Unit of measurement mm (in)

1 Cover for dust ignition-proof approval



A0035590

- 34 Single-chamber housing, 316L, cast for Ex d/XP area; Product Configurator: order code for "Housing; material", option C. Unit of measurement mm (in)



A0035591

- 35 Dual-chamber housing, L-shaped, aluminum for Ex d/XP area; Product Configurator: order code for "Housing; material", option M. Unit of measurement mm (in)

Ground terminal

- Ground terminal inside the housing, max. conductor cross-section 2.5 mm² (14 AWG)
- Ground terminal outside the housing, max. conductor cross-section 4 mm² (12 AWG)
- Safety extra-low voltage 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)

When delivered:

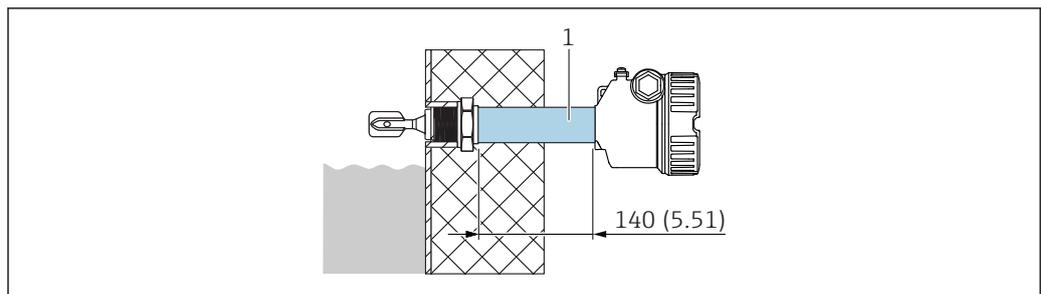
- 1 cable gland installed
- 1 cable gland sealed with dummy plug

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

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

With a Japanese Ex d approval, a special cable gland is enclosed.

Temperature spacer (optional)



A0036845

- 36 Temperature spacer, pressure-tight feedthrough (1). Unit of measurement mm (in)

Temperature spacer

Product Configurator, order code for "Sensor design", option MR

Provides sealed insulation for the vessel and a normal ambient temperature for the housing

Pressure-tight feedthrough (second line of defense)

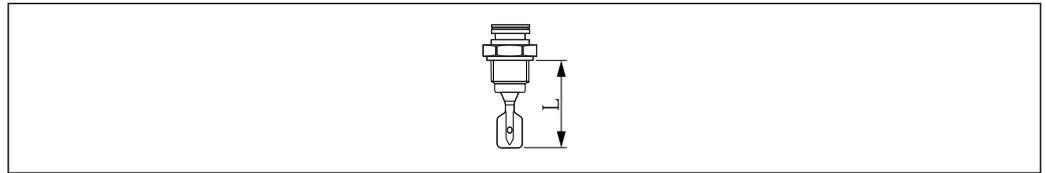
Product Configurator, order code for "Sensor design", option MS

In the event of damage to the sensor, protects the housing from exposure to vessel pressures up to 100 bar (1 450 psi).

Provides sealed insulation for the vessel and a normal ambient temperature for the housing

Probe design

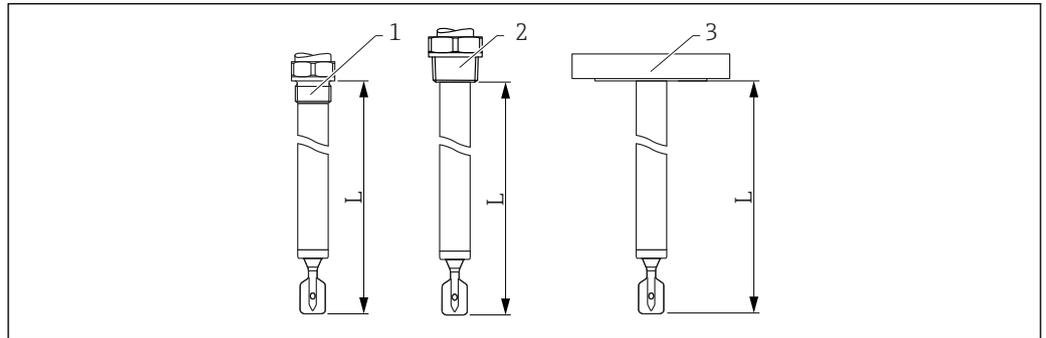
- Compact
- Material: 316L or Alloy C
- Sensor length L: depends on process connection
See "Process connections" section: thread G, ASME B1.20.3 MNPT, EN10226 R, Tri-Clamp



A0036848

37 Compact, sensor length L

- Pipe extension
- Material: 316L, sensor length L: 117 to 6 000 mm or 4.7 to 236 in
- Material: Alloy C, sensor lengths L: 148 to 3 000 mm or 5.9 to 118 in

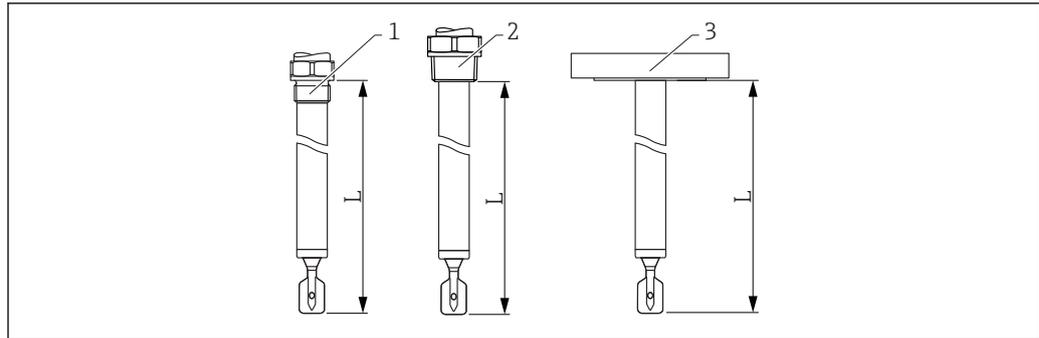


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38 Pipe extension, sensor length L

- 1 G 3/4, G 1
- 2 NPT 3/4, NPT 1, R 3/4, R 1
- 3 Flange, Tri-Clamp

- Short pipe
- Material: 316L, sensor length L: depends on process connection
- Material: Alloy C, sensor length L: depends on process connection
 - Flange = 115 mm (4.53 in)
 - Thread G 3/4 = 115 mm (4.53 in)
 - Thread G 1 = 118 mm (4.65 in)
 - Thread NPT, R = 99 mm (3.9 in)
 - Tri-Clamp = 115 mm (4.53 in)

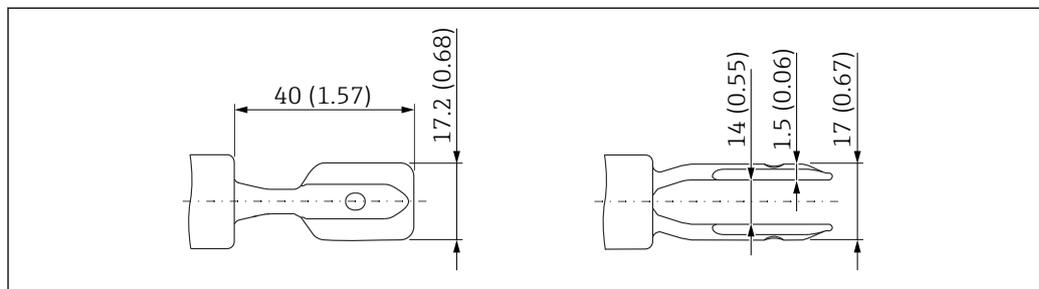


A0036861

39 Short pipe, sensor length L

- 1 $G \frac{3}{4}, G 1$
 2 $NPT \frac{3}{4}, NPT 1, R \frac{3}{4}, R 1$
 3 Flange, Tri-Clamp

Tuning fork



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40 Tuning fork. Unit of measurement mm (in)

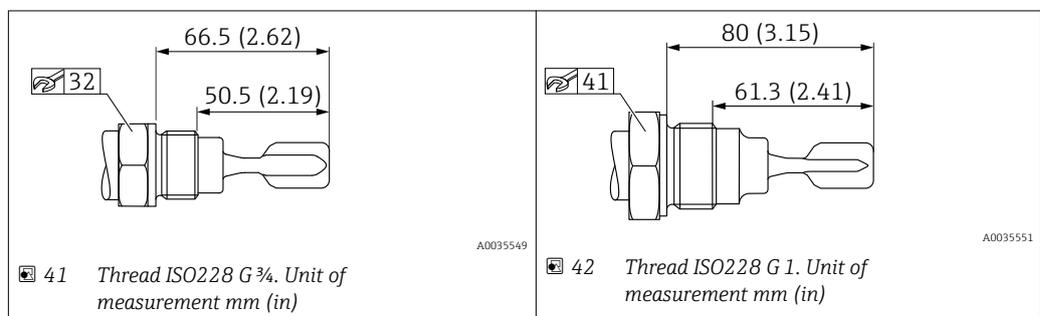
Process connections

Thread ISO228 G for installing in weld-in adapter

$G \frac{3}{4}, G 1$ suitable for installation in weld-in adapter

- Material: 316L
- Pressure rating, temperature: ≤ 40 bar (580 psi), ≤ 100 °C (212 °F)
- Pressure rating, temperature: ≤ 25 bar (363 psi), ≤ 150 °C (302 °F)
- Weight: 0.2 kg (0.44 lb)
- Accessory: weld-in adapter

 The weld-in adapter is not included in the scope of delivery.



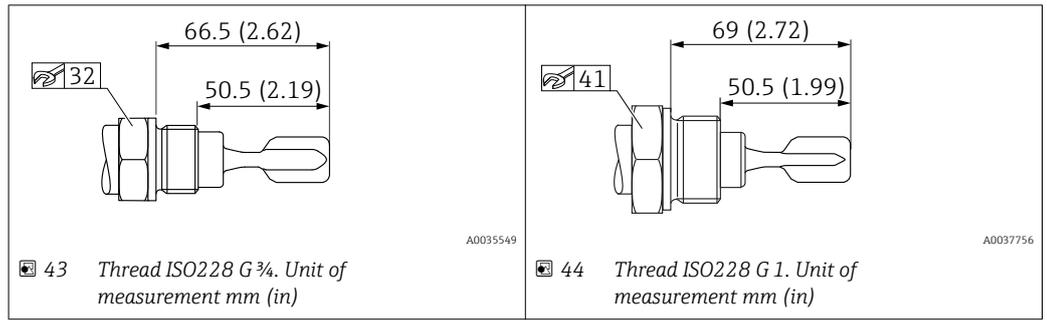
A0035549

41 Thread ISO228 $G \frac{3}{4}$. Unit of measurement mm (in)

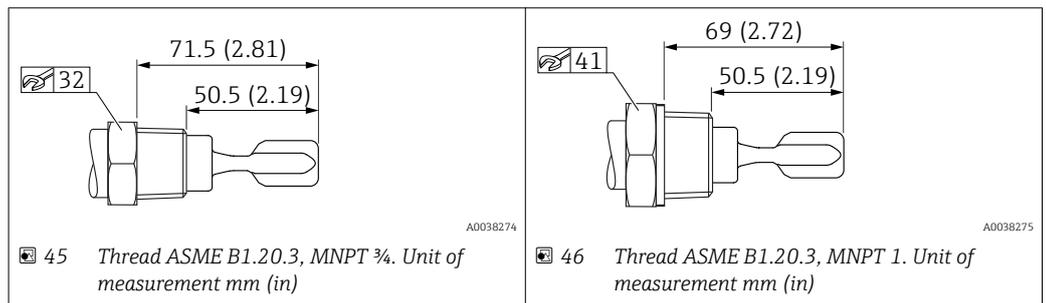
A0035551

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

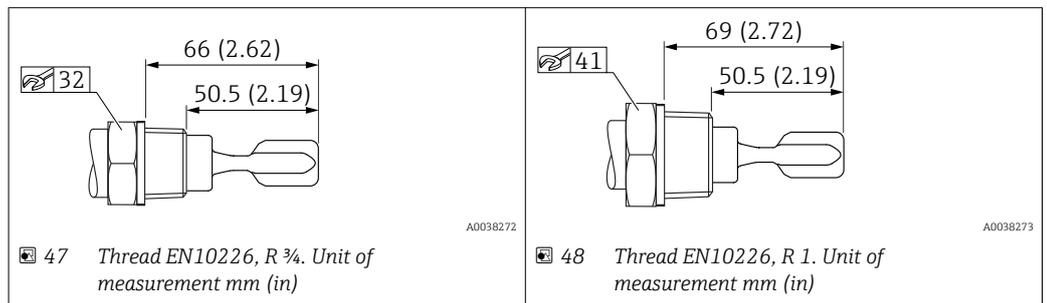
Thread ISO228 G with flat seal



Thread ASME B1.20.3, MNPT



Thread EN10226, R

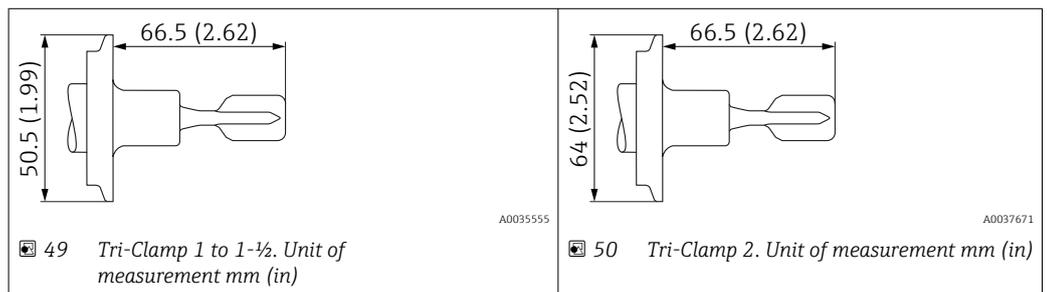


Tri-Clamp

Version ISO2852 DN25-38 (1 to 1-½), DIN32676 DN25-40

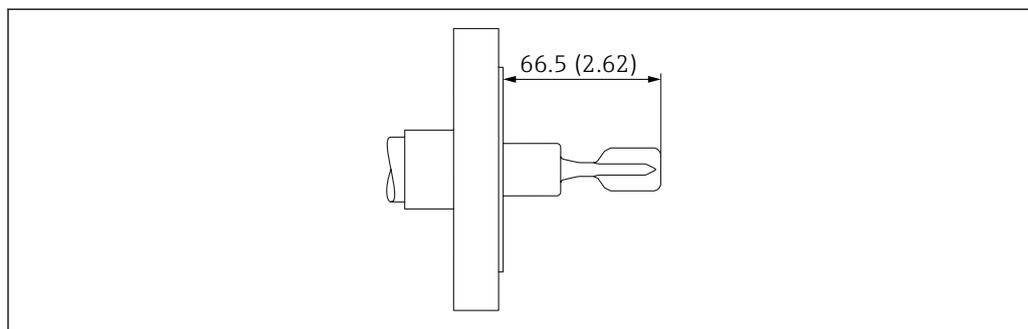
- Material: 316L
- Pressure rating: ≤ 25 bar (363 psi)
- Temperature: ≤ 150 °C (302 °F)
- Weight: 0.1 (0.22)

The maximum temperature and the maximum pressure are dependent on the clamping ring and the seal used. The lowest value applies in each case.



Sensor dimensions in the case of flanges

AlloyC22-plated flanges are available for higher chemical resistance.
The flange carrier material is made of 316L and is welded to an AlloyC22 disk.



A0035554

51 Example with flange. Unit of measurement mm (in)

ASME B16.5 flanges, RF

Pressure rating	Type	Material	Weight kg (lb)
Cl.150	NPS 1"	316/316L	1 (2.21)
Cl.150	NPS 1-1/4"	316/316L	1.2 (2.65)
Cl.150	NPS 2"	316/316L	2.4 (5.29)
Cl.150	NPS 2"	AlloyC22>316/316L	2.4 (5.29)
Cl.150	NPS 1-1/2"	316/316L	1.5 (3.31)
Cl.150	NPS 3"	316/316L	4.9 (10.8)
Cl.150	NPS 4"	316/316L	7 (15.44)
Cl.300	NPS 1-1/4"	316/316L	2 (4.41)
Cl.300	NPS 1-1/2"	316/316L	2.7 (5.95)
Cl.300	NPS 2"	316/316L	3.2 (7.06)
Cl.300	NPS 3"	316/316L	6.8 (14.99)
Cl.300	NPS 3"	AlloyC22>316/316L	6.8 (14.99)
Cl.300	NPS 4"	316/316L	11.5 (25.6)
Cl.600	NPS 2"	316/316L	4.2 (9.26)
Cl.600	NPS 3"	316/316L	6.8 (14.99)

ASME B16.5 flanges, FF

Pressure rating	Type	Material	Weight kg (lb)
Cl.150	NPS 1"	316/316L	1 (2.21)
Cl.150	NPS 2"	316/316L	2.4
Cl.300	NPS 1-1/2"	316/316L	2.7
Cl.300	NPS 2"	316/316L	3.2

ASME B16.5 flanges, RJF

Pressure rating	Type	Material	Weight kg (lb)
Cl.300	NPS 2"	316/316L	3.2 (7.06)
Cl.300	NPS 4"	316/316L	11.5 (25.6)
Cl.600	NPS 2"	316/316L	4.2 (9.26)
Cl.600	NPS 3"	316/316L	6.2 (13.67)

EN flanges EN 1092-1, A

Pressure rating	Type	Material	Weight kg (lb)
PN6	DN32	316L (1.4404)	1.2 (2.65)
PN6	DN40	316L (1.4404)	1.4 (3.09)
PN6	DN50	316L (1.4404)	1.6 (3.53)
PN10/16	DN80	316L (1.4404)	4.8 (10.58)
PN10/16	DN100	316L (1.4404)	5.6 (12.35)
PN25/40	DN25	316L (1.4404)	1.3 (2.87)
PN25/40	DN32	316L (1.4404)	2.0 (4.41)
PN25/40	DN40	316L (1.4404)	2.4 (5.29)
PN25/40	DN50	316L (1.4404)	3.2 (7.06)
PN25/40	DN65	316L (1.4404)	4.3 (9.48)
PN25/40	DN80	316L (1.4404)	5.9 (13.01)
PN25/40	DN100	316L (1.4404)	7.5 (16.54)
PN40	DN50	316L (1.4404)	3.2 (7.06)
PN100	DN50	316L (1.4404)	5.5 (12.13)

EN flanges EN 1092-1, B1

Pressure rating	Type	Material	Weight kg (lb)
PN6	DN32	316L (1.4404)	1.2 (2.65)
PN6	DN50	316L (1.4404)	1.6 (3.53)
PN6	DN50	AlloyC22>316L	1.6 (3.53)
PN10/16	DN100	316L (1.4404)	5.6 (12.35)
PN10/16	DN100	AlloyC22>316L	5.6 (12.35)
PN25/40	DN25	316L (1.4404)	1.4 (3.09)
PN25/40	DN25	AlloyC22>316L	1.4 (3.09)
PN25/40	DN50	316L (1.4404)	3.2 (7.06)
PN25/40	DN50	AlloyC22>316L	3.2 (7.06)
PN25/40	DN80	316L (1.4404)	5.9 (13.01)
PN25/40	DN80	AlloyC22>316L	5.2 (11.47)
PN100	DN50	316L (1.4404)	5.5 (12.13)

EN flanges EN 1092-1, C

Type	Material	Pressure rating	Weight kg (lb)
DN32	316L (1.4404)	PN6	1.2 (2.65)
DN50	316L (1.4404)	PN25/40	3.2 (7.06)

EN flanges EN 1092-1, D

Type	Material	Pressure rating	Weight kg (lb)
DN32	316L (1.4404)	PN6	1.2 (2.65)
DN50	316L (1.4404)	PN25/40	3.2 (7.06)

EN flanges EN 1092-1, E

Type	Material	Pressure rating	Weight kg (lb)
DN32	316L (1.4404)	PN6	1.2 (2.65)
DN50	316L (1.4404)	PN25/40	3.2 (7.06)

JIS flanges B2220

Pressure rating	Type	Material	Weight kg (lb)
10K	10K 25A	316L (1.4404)	1.3 (2.87)
10K	10K 40A	316L (1.4404)	1.5 (3.31)
10K	10K 50A	316L (1.4404)	1.7 (3.75)
10K	10K 50A	AlloyC22>316L	1.7 (3.75)
10K	10K 80A	316L (1.4404)	2.2 (4.85)
10K	10K 100A	316L (1.4404)	2.8 (6.17)

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, RJF (Ring-Joint Face)
- Flange EN1092-1, Form A
- Flange EN1092-1, Form B1
- Flange EN1092-1, Form C
- Flange EN1092-1, Form D
- Flange EN1092-1, Form E
- Flange JIS B2220, RF (Raised Face)
- Flange HG/T20592, RF (raised face), under development
- Flange HG/T20615, RF (raised face), under development
- Flange HG/T20615, RJ (ring joint), under development

Other

Weight

See the specific section.

Materials**Materials in contact with process**

- Process connection: 316L (1.4404 or 1.4435)
- Pipe extension: 316L (1.4404 or 1.4435)
- Flat seal for process connection G ¾ or G 1: fiber-reinforced elastomer seal, asbestos-free as per DIN 7603
- For flanges,  "Mechanical construction" section
- Flange plating: Alloy C22 (2.4602)
- Tuning fork: 316L (1.4435), optional (Alloy C22)

Seals

Seal included in delivery:

Metrical threads G ¾, G 1 standard, flat seal as per DIN7603

Seal not included in delivery:

- Tri-Clamp
- Flanges
- R and NPT thread
- Metrical threads G ¾, G 1 for installation in weld-in adapter

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 substitute for cable glands: 316L
- TAG sign: plastic film, metal, or provided by customer

Aluminum housing

- Housing: EN AC 44300 aluminum
- Dummy cover: EN AC 44300 aluminum
- Cover with sight glass: EN AC 44300 aluminum, PC Lexan 943A synthetic glass
Cover with viewing window made of polycarbonate, optionally available to order. For Ex d applications, the sight glass is made from borosilicate.
- Cover seal materials: HNBR
- Cover seal materials: FVMQ (in low-temperature version only)
- TAG sign: plastic film, 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 (in low temperature version only)
- Cover seal materials: HNBR
- TAG sign: plastic film, stainless steel, or provided by customer
- M20 cable glands: Select material (stainless steel, nickel-plated brass, polyamide)

Surface roughness

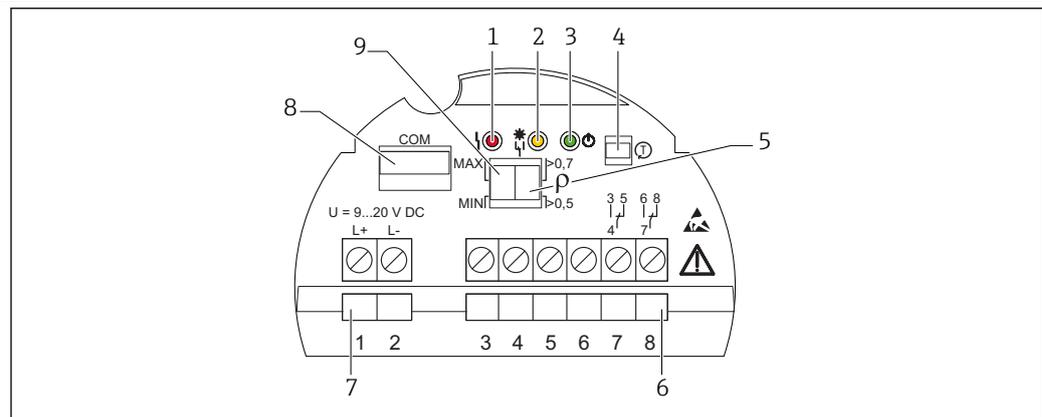
The roughness of the surface in contact with the process is $R_a < 3.2 \mu\text{m}$ (126 μin).

Operability

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 switching status and operational status with optional LED module (lights visible from the outside)
 - For plastic housing and aluminum housing (standard and Ex d) in conjunction with the DC-PNP and relay electronics
- Ordering information: Product Configurator, order code for "Display; operation" option "B"

Elements on the electronic insert



A0037705

52 Example of electronic insert FEL64DC

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

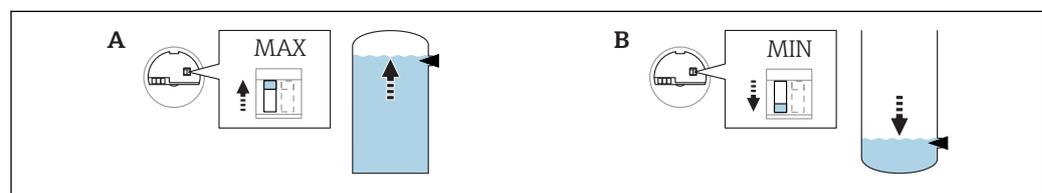
Terminals

Terminals for cable cross-section up to 2.5 mm² (14 AWG). Use ferrules for the wires.

Local operation

Operation at electronic insert

MAX/MIN safety mode



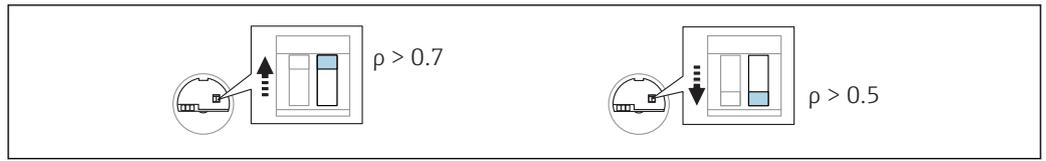
A0033470

53 Switch position on the electronic insert for MAX/MIN safety mode

- A MAX (maximum safety mode)
- B MIN (minimum safety mode)

- Toggle switch on electronic insert for minimum/maximum quiescent current safety
- MAX = Maximum safety: When tuning fork is covered, the output switches in the direction of demand. Use this for overflow protection, 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



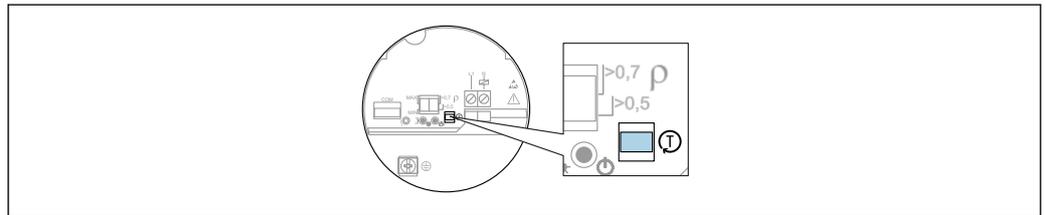
A0033471

54 Switch position on electronic insert for density

Factory setting for density: 0.7

- Switch position $> 0.7 \text{ g/cm}^3$ = order configuration
Standard setting for liquids with density $> 0.7 \text{ g/cm}^3$
- Switch position $> 0.5 \text{ g/cm}^3$ = can be configured via DIP switch
For liquids with density $> 0.5 \text{ g/cm}^3$ to $< 0.8 \text{ g/cm}^3$
- Order option: 0.4 g/cm^3 (not for devices with SIL)
For liquids with density $> 0.4 \text{ g/cm}^3$ and density $< 0.6 \text{ g/cm}^3$
If this option has been selected, the density setting is always set to 0.4 g/cm^3 . This setting can no longer be altered.

Functional test using the button on the electronic insert



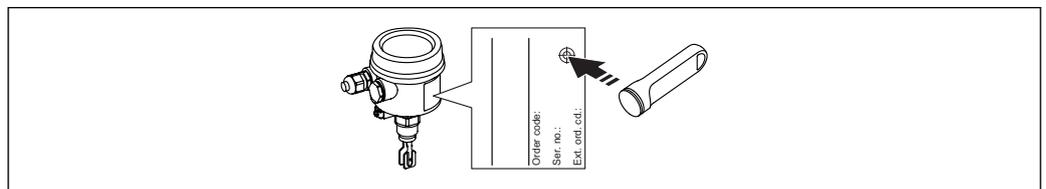
A0037132

55 Position button for functional test

- The functional test must be performed when the status is OK.
OK status: MAX safety and sensor uncovered or MIN safety and sensor covered.
- For proof testing in safety systems in accordance with SIL or WHG, pay attention to the information in the safety manual.

Functional test of the electronic switch with a test magnet

Without opening the device, hold the test magnet against the marking on the nameplate. It is possible to simulate the function test for the following versions: FEL62, FEL64, FEL64DC, FEL68



A0033419

56 Function test with test magnet

Local display

LED module VU120 (optional)

The LED module lights up very brightly, can be easily seen from a distance and can be connected to the following electronic inserts: FEL62, FEL64, FEL64 DC

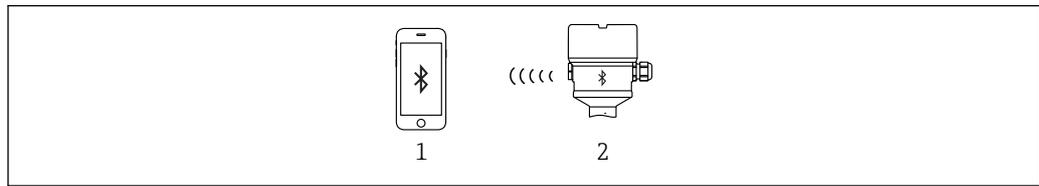
For each MAX/MIN setting, the sensor status can be identified by means of the LEDs, which light up green, yellow and red.

During the functional test, all three LED colors flash one after the other in the form of a chaser light.

Remote interrogation

Heartbeat diagnostics and verification with Bluetooth® wireless technology

Access via Bluetooth® wireless technology



A0033411

 57 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 seconds after the Bluetooth search commences
- Data can be read from the Bluetooth module 60 seconds 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. mobile phone.

Heartbeat Technology

Heartbeat Technology module

Heartbeat Diagnostics

Continuously monitors and evaluates the device status 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 status upon request and generates a Heartbeat Technology verification report showing the result of the verification.

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.

Technical data

- Approval: intrinsically safe Ex ia, IS or ec/ic
- NAMUR electronics (electronic insert FEL68):
For energy-related reasons, the Bluetooth module VU121 requires a special battery when operated with the 2-wire NAMUR electronics. 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 (at ambient temperatures between 10 to 40 °C (50 to 104 °F)).
- Maximum free-field range 50 m (165 ft)
- Operation radius with intervisibility 10 m (33 ft) around the device



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

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

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

CE mark

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

RCM-Tick 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 are labelled with the RCM- Tick marking on the name plate.



A0029561

Ex approval

All explosion protection data is listed in separate documentation which is available from the download area. The Ex documentation is supplied as standard with all Ex-systems.

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.

 Ordering information: Product Configurator, order code for "Additional approval", option "LD"

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). For a detailed description of the safety functions with the Liquiphant, settings and functional safety data, see the "Functional Safety Manual" on the Endress+Hauser website: www.endress.com → Downloads.

 Ordering information: Product Configurator, order code for "Additional approval", option "LA"

Marine approvals

- ABS (American Bureau of Shipping), option "LF"
- GL (Germanischer Lloyd)/DNV (Det Norske Veritas), option "LJ"
- LR (Lloyd's Register) marine approval, option "LG"
- BV (Bureau Veritas) marine approval, option "LH"



Ordering information: Product Configurator, order code for "Additional approval", for option see items listed

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.



Ordering information: Product Configurator, order code for "Service", option "17"

Inspection certificates**Test, certificate, declaration**

The following documents can be ordered:

- Inspection certificate 3.1, EN10204 (material certificate, wetted parts)
- NACE MRO175 / ISO 15156 (wetted parts), declaration
- NACE MRO103 / 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
- Material identification check (PMI), internal procedure (wetted parts), test report
- Penetrant testing AD2000-HP5-3(PT), wetted/pressurized metal parts, inspection certificate
- Penetrant testing ISO23277-1 (PT), wetted/pressurized metal parts, inspection certificate
- Penetrant testing ASME VIII-1 (PT), wetted/pressurized metal parts, inspection certificate
- Welding documentation, wetted/pressurized seams



Ordering information: Product Configurator, order code for "Additional approval", option "LS"



The documentation currently available can be found on the Endress+Hauser- website: www.endress.com → Downloads or using the serial number of the device under Online Tools in the Device Viewer.

Service

- Cleaned of oil+grease (wetted)
- PWIS-free (paint-wetting impairment substances)
- Switching delay setting to be spec.
- Setting for MIN safety mode
- Default density setting > 0.4 g/cm³
- Default density setting > 0.5 g/cm³
- Product documentation on paper (test, certificate, declaration available for selection)

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, regulation SJ/T 11363-2006: The measuring system complies with the substance restrictions of the Restriction on Hazardous Substances Directive .
RoHS	The measuring system complies with the substance restrictions of the Restriction on Hazardous Substances Directive 2011/65/EU (RoHS 2).
Additional certification	<p>EAC conformity</p> <p>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.</p> <p>Endress+Hauser confirms successful testing of the device by affixing to it the EAC mark.</p>
ASME B 31.3	Design and materials in accordance with ASME B31.3. The welds are through-penetration welded and meet the requirements of the ASME Boiler and Pressure Vessel Code, Section IX and EN ISO 15614-1.

Ordering information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser website: www.endress.com → Click "Corporate" → Select country → Click "Products" → Select product using the filters and search field → Open product page → The "Configuration" button to the right of the product image opens the Product Configurator.
- Endress+Hauser Sales Center: www.addresses.endress.com



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	<p>Measuring point (TAG)</p> <p>The device can be ordered with a tag name.</p> <p>Position of the tag marking</p> <p>Choose from the following in the additional specification:</p> <ul style="list-style-type: none"> ■ Tag plate, stainless steel ■ Plastic film ■ Supplied label/plate ■ RFID TAG ■ RFID TAG + tag plate stainless steel ■ RFID TAG + plastic film ■ RFID TAG + supplied label/plate <p>Definition of the tag name</p> <p>Specify in the additional specification: 3 lines containing up to 18 characters each The specified tag name appears on the selected label and/or on the RFID TAG.</p> <p>Presentation in the SmartBlue app</p> <p>The first 32 characters of the tag name The tag name can always be changed specifically for the measuring point via Bluetooth.</p>
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Application packages



Ordering information

- Product Configurator, order code for "Application package", option EH "Heartbeat Verification + Monitoring"
For this, use of the optional Bluetooth module is required.
- For NAMUR: order code for "Accessory mounted", option NG "Prepared for Heartbeat Verification + Monitoring + Bluetooth"
The Bluetooth module must be ordered separately in this case.

Heartbeat Technology

Heartbeat Technology module

Heartbeat Diagnostics

Continuously monitors and evaluates the device status 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 status upon request and generates a Heartbeat Technology verification report showing the result of the verification.

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 ¹⁾

The "SIL Prooftest", "WHG Prooftest" or "SIL/WHG Prooftest" module includes a wizard for the proof testing that is required at appropriate intervals for the following applications: SIL (IEC61508/IEC61511), WHG (German Federal Water Act):

- The wizard can be used via the SmartBlue app.
- The wizard guides the user through the entire process of generating the verification report.
- The verification report can be saved as a PDF file.



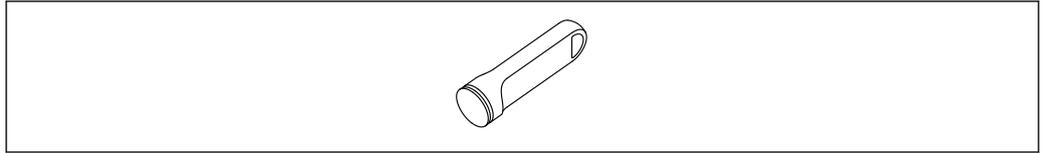
Accessories

Device-specific accessories

Test magnet

Order number: 71437508

1) Available only for devices with SIL or WHG approval

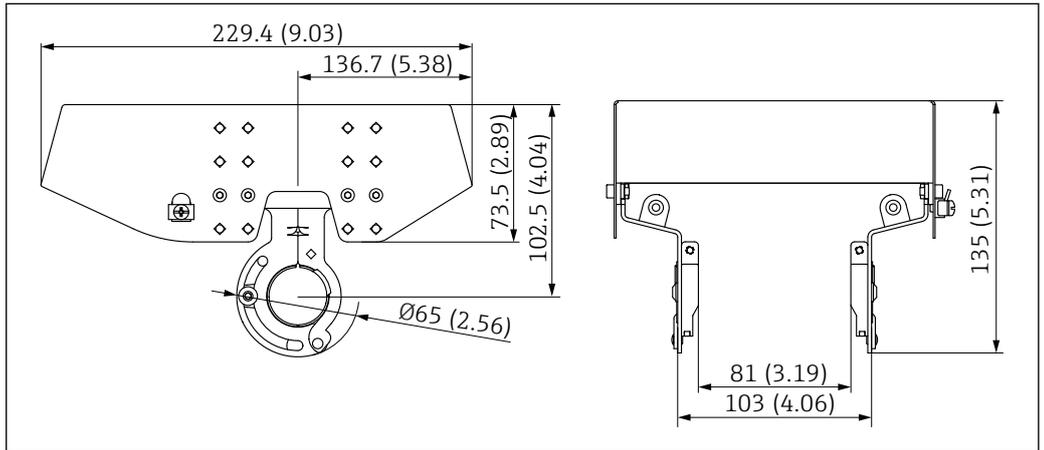


A0039209

58 Test magnet

Weather protection cover for dual-compartment housing, aluminum

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

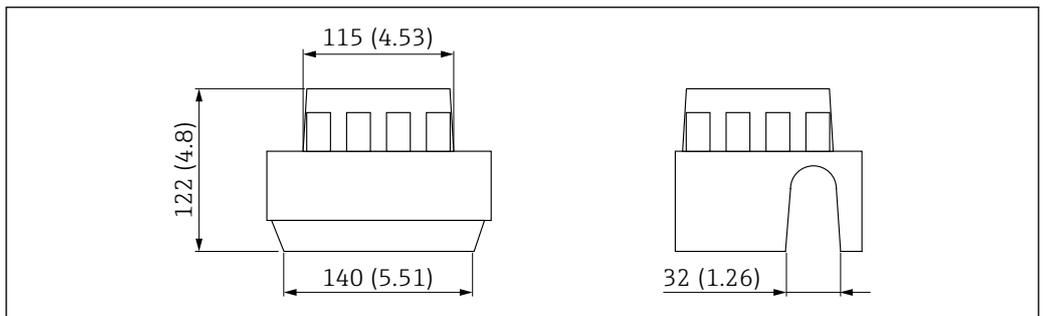


A0039231

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

Weather protection cover for single-compartment housing, metal

- Material: plastic
- Order number: 71438291



A0038280

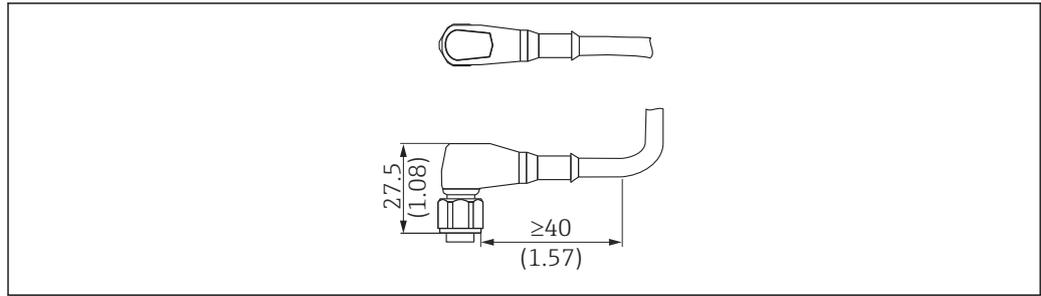
60 Weather protection cover for single-compartment housing, metal. Unit of measurement mm (in)

Plug-in jack

i 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

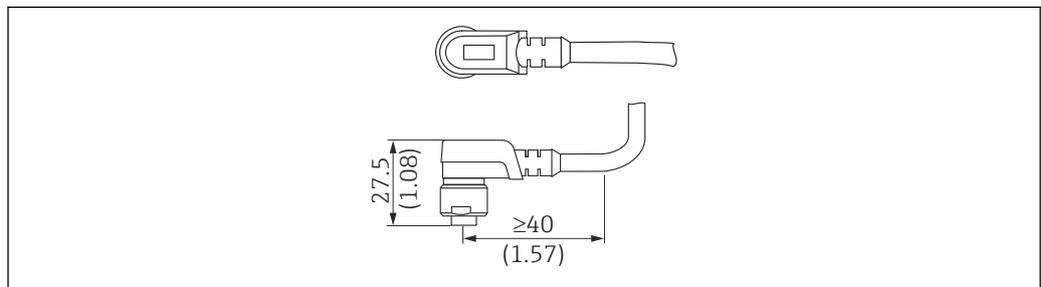


A0023713

61 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 (blue)
- Order number: 52010285



A0022292

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

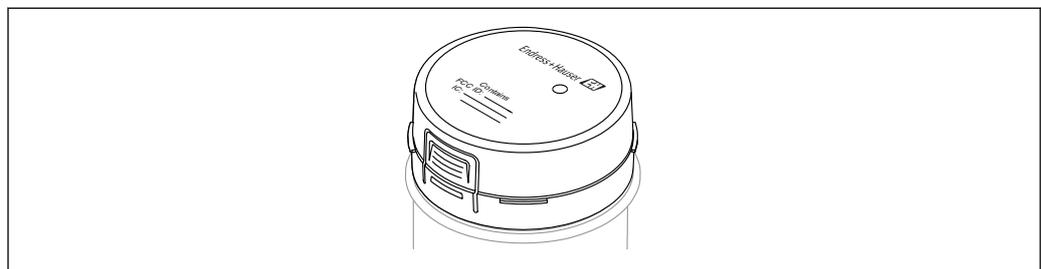
Additional modules

i If the Liquiphant is retrofitted with the Bluetooth module or the LED module, it is also necessary to order a tall housing cover with sight glass. The cover depends on the housing and approval of the device.

More detailed information is available:

- Product Configurator on the Endress+Hauser webpage: www.endress.com
- Endress+Hauser Sales Center www.addresses.endress.com

Bluetooth module VU121 (optional)



A0039257

63 Bluetooth module VU121

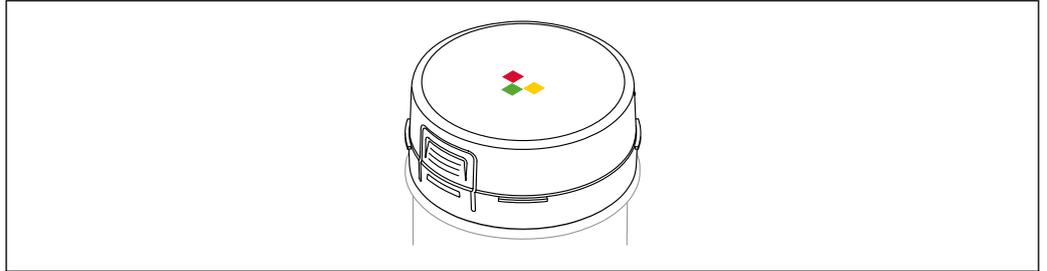
The Bluetooth module can be connected to the following electronic inserts via the COM interface: FEL61, FEL62, FEL64, FEL64DC, FEL67, FEL68 (NAMUR 2-wire).

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

i When using the device with the electronic insert FEL68 (2-wire NAMUR), the Bluetooth module must be ordered separately, including the required battery.

Product Configurator, order code for "Accessory mounted", option NG "Prepared for Heartbeat Verification + Monitoring + Bluetooth".

LED module VU120 (optional)



A0039258

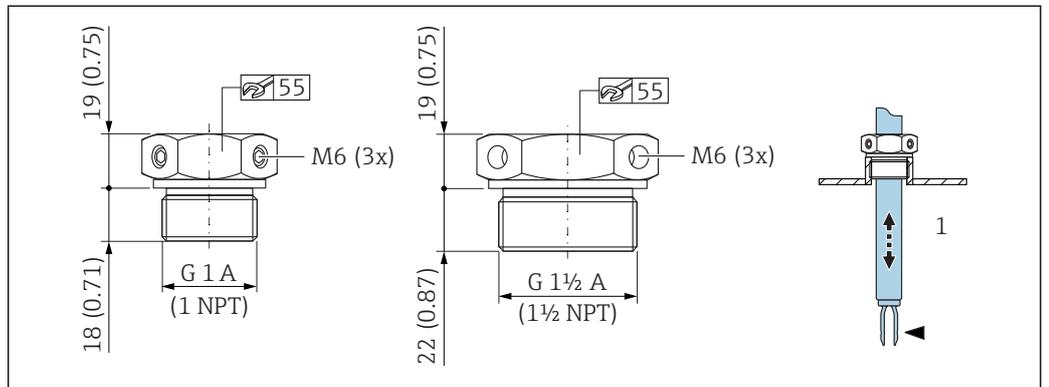
64 LED module

The bright LED display indicates the switch status or the alarm condition and can be connected to the following electronic inserts: FEL62, FEL64, FEL64DC

Order number: 71437382

Sliding sleeves for unpressurized operation

Switch point, infinitely adjustable.



A0037666

65 Sliding sleeves for unpressurized operation. Unit of measurement mm (in)

1 $p_e = 0 \text{ bar (0 psi)}$

G 1, DIN ISO 228/1

- 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 228/1

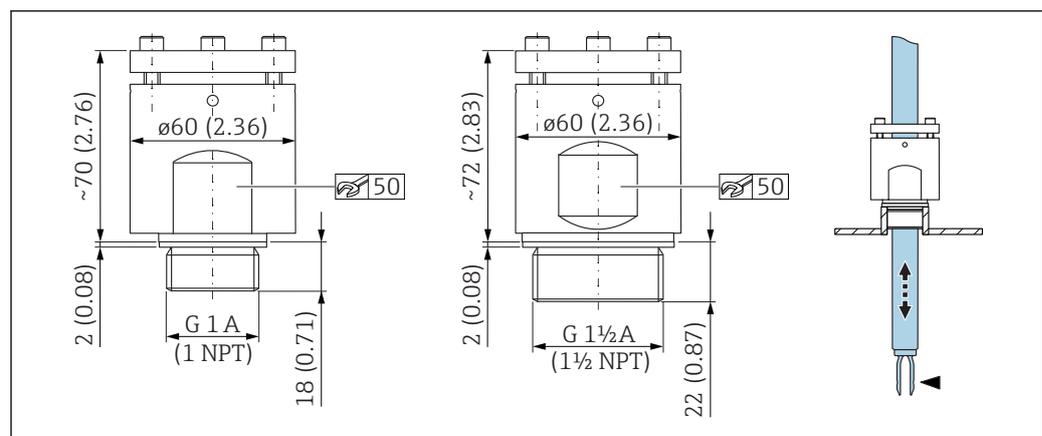
- Material: 1.4435 (AISI 316L)
- Weight: 0.54 kg (1.19 lb)
- Order number: 52003980
- Order number: 52011890, approval: with inspection certificate EN 10204 - 3.1 material

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

High pressure sliding sleeves

- Switch point, infinitely adjustable
- For use in hazardous areas,
- Seal package made of graphite
- For G 1, G 1½: seal included in delivery



A0037667

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

G 1, DIN ISO 228/1

- 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 228/1

- 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

Supplementary documentation



The certificates, approvals and other documentation currently available can be accessed as follows:

Endress+Hauser website: www.endress.com → Downloads.

Special documentation

- TI00426F: Weld-in adapter and flanges (overview)
- SD01622F: Weld-in adapter (installation instructions)
- SD02389F: Bluetooth module VU121

Supplementary device-dependent 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.
BA01894F

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.
KA01429F

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.

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