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Technical Information
Solicap M
FTI56

Capacitance

Point level switch for bulk solids

Application

For applications with very high tensile loads up to 60 kN (13 488 lbf). Fieldgate and Solicap represent a solution for material provisioning and logistical optimization (inventory control).

- Process connections: flanges and threads
- International explosion protection certificates, SIL

Benefits

- Extremely robust design for harsh process conditions
- Cost savings thanks to easy and fast commissioning as calibration is performed at the press of a button
- Universal application thanks to wide range of certificates and approvals
- Two-stage overvoltage protection against static discharges from the silo
- Increased safety due to permanent automatic monitoring of electronics
- Reduction in storage costs thanks to easy-to-shorten rope model (for partial and full insulation)

Endress+Hauser
People for Process Automation

Table of contents

Document information

Document conventions

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

Alternating current

Direct current and alternating current

Direct current

Ground connection

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

Protective earth (PE)

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

The ground terminals are located on the interior and exterior of the device:
- Interior ground terminal: protective earth is connected to the mains supply.
- Exterior ground terminal: device is connected to the plant grounding system.

Tool symbols

Phillips head screwdriver

Flat blade screwdriver

Torx screwdriver

Allen key

Open-ended wrench

Symbols for certain types of information and graphics

Permitted
Procedures, processes or actions that are permitted

Preferred
Procedures, processes or actions that are preferred

Forbidden
Procedures, processes or actions that are forbidden

Tip
Indicates additional information

Reference to documentation

Reference to page

Reference to graphic

▶
Notice or individual step to be observed

1., 2., 3.
Series of steps

Result of a step

Help in the event of a problem

Visual inspection

Operation via operating tool

Write-protected parameter

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

Hazardous area
Indicates the hazardous area

Safe area (non-hazardous area)
Indicates the non-hazardous area

Safety instructions
Observe the safety instructions contained in the associated Operating Instructions

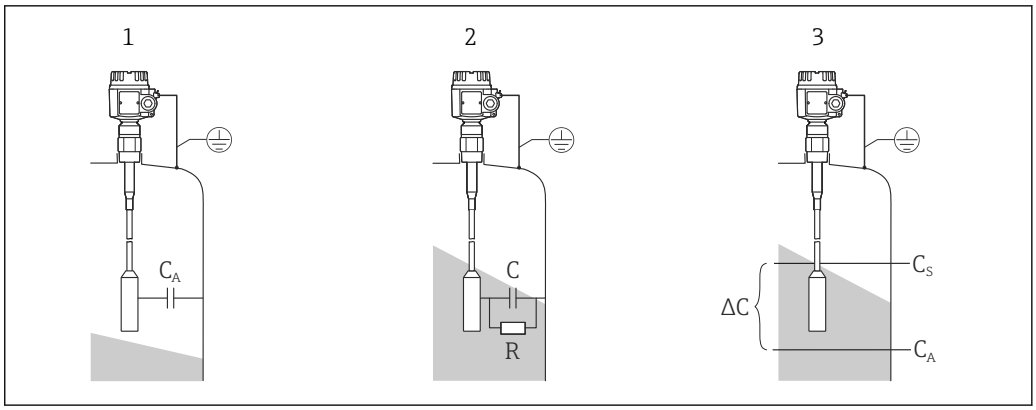
Temperature resistance of the connection cables
Specifies the minimum value of the temperature resistance of the connection cables

Function and system design

Measuring principle

The principle of capacitance point level detection is based on the change in capacitance of a capacitor as a result of the probe being covered by bulk solids. The probe and container wall (conductive material) form an electric capacitor. When the probe is in air (1), a certain low initial capacitance is measured. If the container is being filled, the capacitance of the capacitor increases as more of the probe is covered (2), (3). The point level switch switches when the capacitance C_S specified during calibration is reached. In addition, a probe with inactive length ensures that the effects of medium buildup or condensate near the process connection are avoided. A probe with active buildup compensation compensates for the effects of buildup on the probe in the area of the process connection.

A ground tube is used as a counter electrode for containers made of non-conductive materials.



1 Measuring principle of capacitance point level detection

1 The probe in the air
2 The probe covered by the solid
3 The probe covered by the solid (switching mode)
R Conductivity of the solid
C Capacitance of the solid
C_A Initial capacitance when the probe is not covered
C_S Switching capacitance
ΔC Change in capacitance

Function

The selected electronic insert of the probe determines the change in capacitance on how much the probe is covered and thereby allows precise switching at the calibrated point level.

Application examples

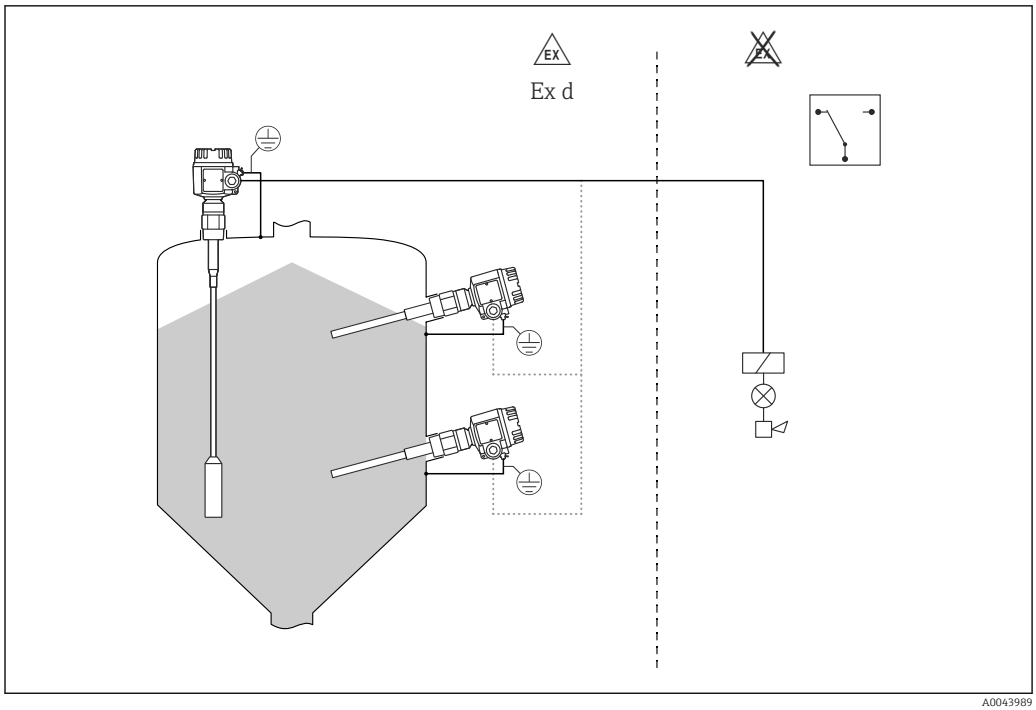
The probe is dedicated for all bulk solids with a relative dielectric constant $\varepsilon_r \geq 2.5$, like:
- sand
- glass aggregate
- gravel
- molding sand
- lime
- crushed ore
- plaster
- aluminium shravings
- cement
- grain
- pumice
- flour
- dolomite
- sugar beet
- kaolin
- fodder and similar bulk solids

Measuring system

The type of the measuring system depends to the selected electronic insert.

Point level switch

The complete measuring system consists of the point level switch Solicap M FTI56 and an electronic insert FEI51, FEI52 or FEI54.

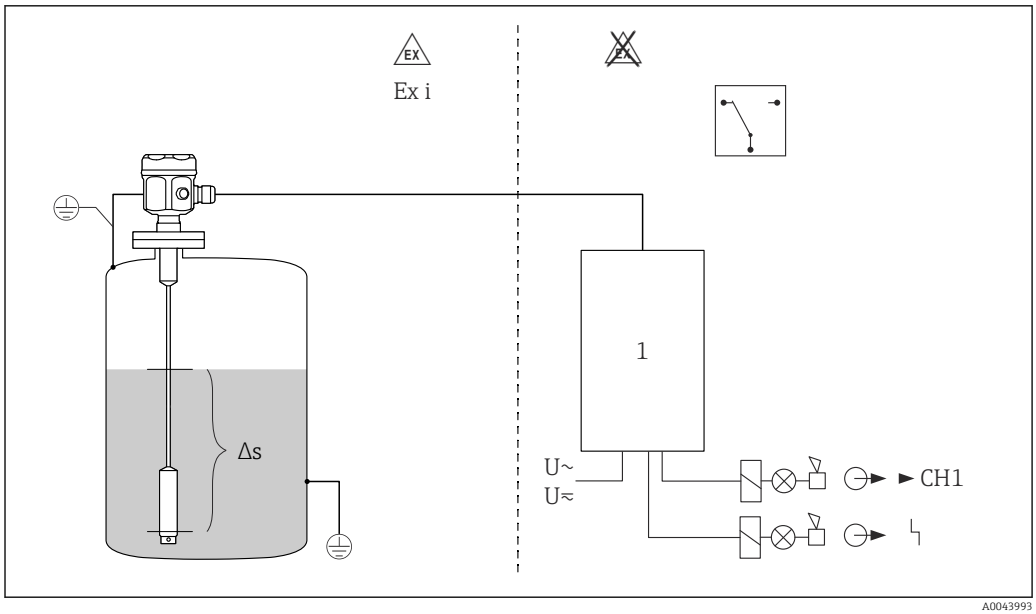


2 Probes as a point level switch

Point level switch and separate switching unit

The Solicap M FTI56 can be used as sensor for the separate switching unit.

The complete measuring system consists of:
- the point level switch Solicap M FTI56
- an electronic insert:
  - FEI53 - non Ex areas
  - FEI57S - Ex-i areas
  - FEI58 - Ex-i areas
- a transmitter power supply unit e.g. FTC325, FTL325N, FTL325P



3 Probe as the separate switching unit

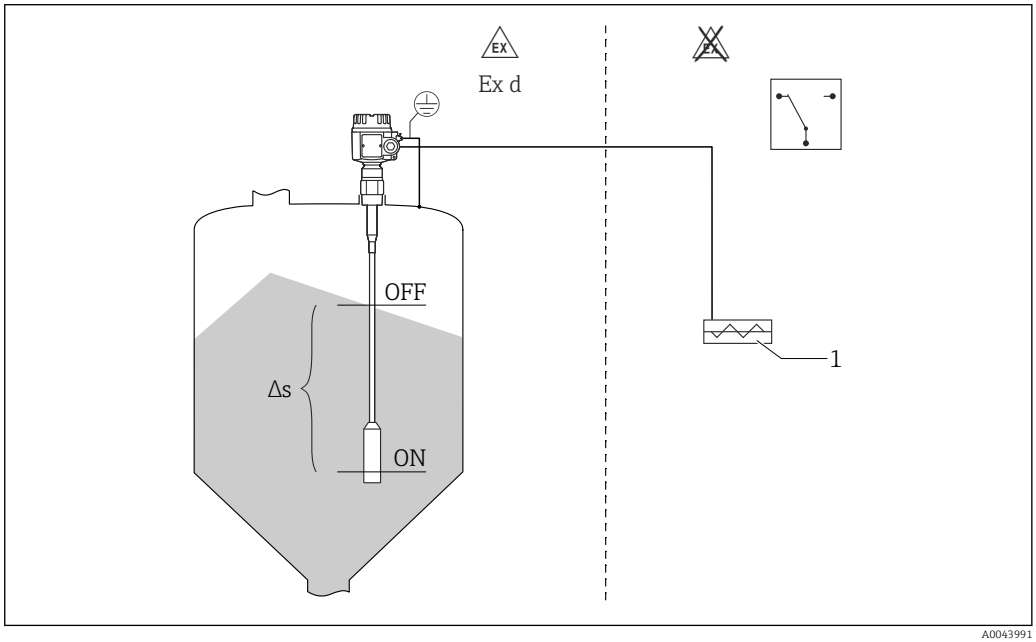
1 A transmitter power supply unit
Δs Two-point control

Two-point control (Δs function)

Use the partially insulated probes only in conjunction with non-conductive bulk solids.

The complete measuring system consists of: The device including electronic insert FE51, FEI52 oder FEI54.

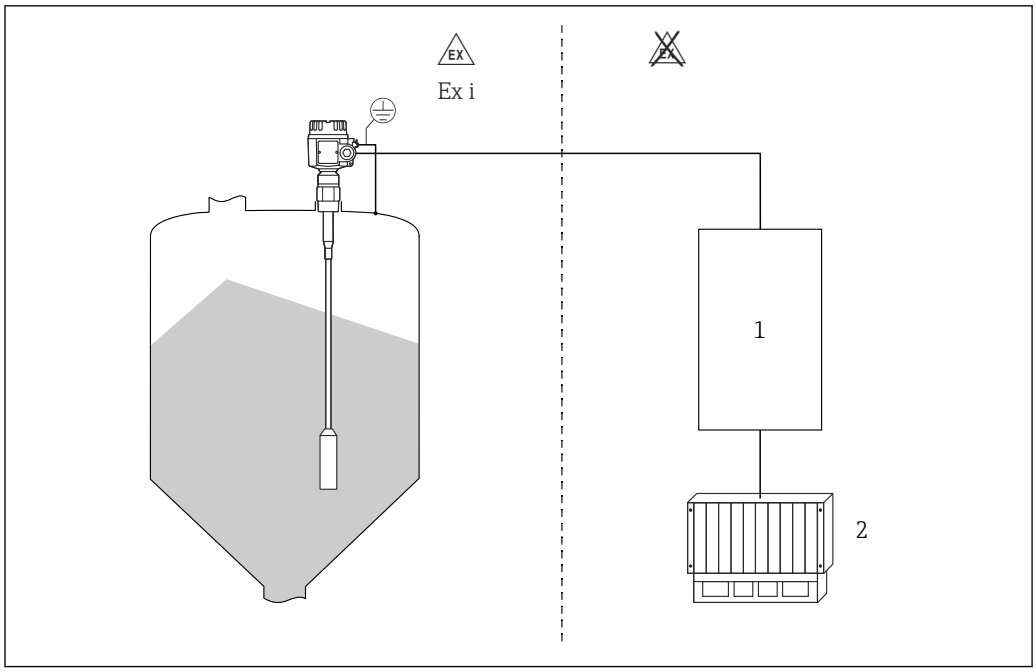
The point level switch can also be used to control a screw conveyor where the on and off values can be freely defined.



Δs Two-point control
1 Screw conveyor

Point level switch 8 mA or 16 mA

The complete measuring system consists of:
- the point level switch Solicap M FTI56
- the FEI55 electronic insert
- a transmitter power supply unit, e.g. RMA42



4 The probe powered by external power supply unit

1 The transmitter power supply unit
2 PLC

Electronic inserts

FEI51
Two-wire AC connection
- Load switched directly into the power supply circuit via the thyristor
- Point level adjustment directly at the point level switch

FEI52
3-wire direct current version
- Switch the load via the transistor (PNP) and separate supply voltage connection
- Point level adjustment directly at the point level switch

FEI53
3-wire direct current version with 3 to 12 V signal output
- For separate switching unit, Nivotester FTC325 3–WIRE
- Point level adjustment directly at the switching unit

FEI54
Universal current version with relay output
- Switch the loads via 2 floating changeover contacts (DPDT)
- Point level adjustment directly at the point level switch

FEI55
Signal transmission 8 mA or 16 mA on two-wire cable
- SIL2 approval for the hardware
- SIL3 approval for the software
- For separate switching unit, e.g. RMA42
- Point level adjustment directly at the point level switch

FEI57S
PFM signal transmission (current pulses are superimposed on the supply current)
- For separate switching unit with PFM signal transmission e.g. Nivotester FTC325 PFM, FTL325P.
- Self-test from the switching unit without changing levels
- Point level adjustment directly at the point level switch
- Cyclical checking from the switching unit

FEI58 (NAMUR)
Signal transmission H-L edge 2.2 to 3.5 or 0.6 to 1.0 mA as per IEC 60947-5-6 on two-wire cable
- For a separate switching unit, e.g. Nivotester FTL325N
- Point level adjustment directly at the point level switch
- Test the connection cables and slaves by pressing the button on the electronic insert

System integration via Fieldgate

Vendor managed inventory

The remote interrogation of tank or silo levels via Fieldgate enables suppliers of raw materials to gather information about the current inventories of their regular customers at any time and, for example, to take this into account in their own production planning. The Fieldgate monitors the configured point levels and automatically triggers the next order as required. Here, the range of possibilities ranges from simple requisitioning by e-mail through to fully automatic order processing by incorporating XML data into the planning systems on both sides.

Remote maintenance of measuring systems

Not only does Fieldgate transmit the current measured values, it also alerts the standby personnel responsible by e-mail or SMS as required. Fieldgate forwards the information transparently. In this way, all options of the operating software in question are available remotely. By using remote diagnosis and remote configuration some onsite service operations can be avoided and all others can at least be planned and prepared better.

Input

Measured variable

Measurement of the change in capacitance between the probe and the tank wall, depending on the level of the bulk solids.

Measuring range

Measuring frequency
500 kHz

Span
- ΔC = 5 to 1 600 pF
- FEI58
  ΔC = 5 to 500 pF

Final capacitance
C_E = maximum 1 600 pF

Adjustable initial capacitance
- range 1 - factory setting
  C_A = 5 to 500 pF
- range 2 - not avaliable with FEI58
  C_A = 5 to 1 600 pF

Input signal

Probe covered -> high capacitance

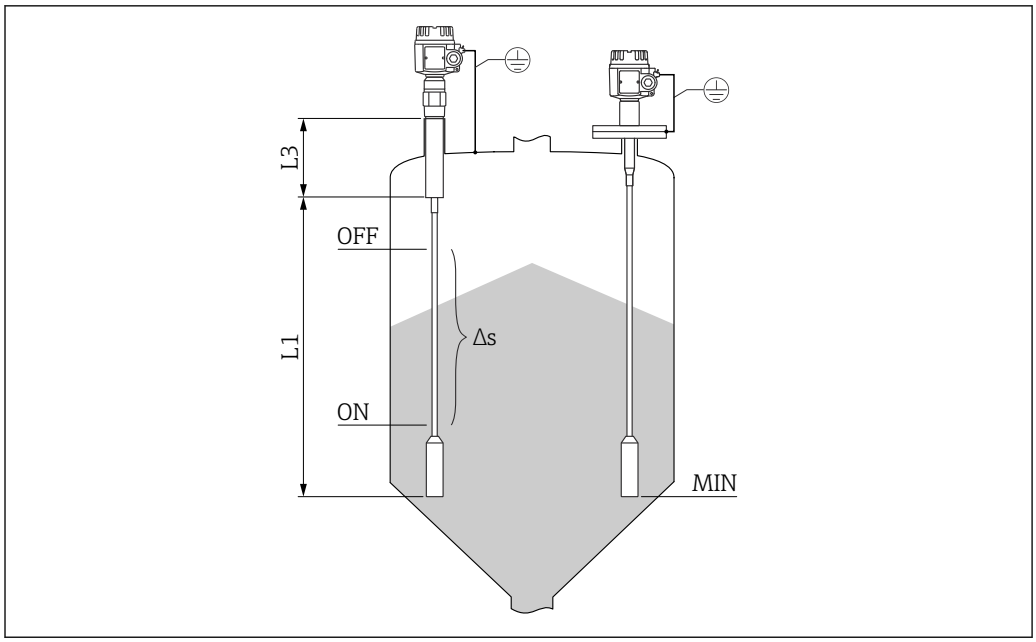
Probe not covered -> low capacitance

Measuring conditions

When installing in a nozzle, use inactive length (L3). probes can be used to control a screw conveyor (Δs mode). The on-value and off-value are determined by the empty and full calibration. Partially insulated probes are only suitable for nonconductive bulk solids.

- DK > 10: measuring range up to 4 m (13 ft)
- 5 < DK < 10: measuring range up to 12 m (39 ft)
- 2 < DK < 5: measuring range up to 20 m (66 ft)

The minimum capacitance change for point level detection must be ≥ 5 pF.



5 *Measuring conditions*

L1 Active length
L3 Inactive length
Δs Two-point control
MIN Minimum measuring level

Minimum probe length for nonconductive media < 1 µS/cm

The minimum probe length can be calculated using the formula:

$$l_{min} = \frac{\Delta C_{min}}{C_s \cdot (\varepsilon_r - 1)}$$

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l_{min}	minimum probe length
ΔC_{min}	5 pF
C_s	probe capacitance in air
ε_r	relative dielectric constant, e.g. for dried grain = 3.0

Output

Switch behavior

Binary or Δs operation.

The pump control is not possible with FEI58.

Switch-on behaviour

When the power supply is switched on, the switching status of the outputs corresponds to the signal on the alarm.

The correct switch condition is reached after a maximum of 3 s.

Fail-safe mode

Minimum and maximum quiescent current safety can be switched at the electronic insert [1].

1) For FEI53 and FEI57S only on the associated Nivotester: FTC325.

MIN
Minimum safety: the output switches safety-oriented when the probe is uncovered [2] (signal on alarm).

MAX
Maximum safety: the output switches safety-oriented when the probe is covered [3] (signal on alarm).

Switching delay

FEI51, FEI52, FEI54, FEI55
Can be adjusted incrementally at the electronic insert: 0.3 to 10 s.

FEI53, FEI57S
Depends on the connected Nivotester (transmitter): FTC325.

FEI58
Can be adjusted alternately at the electronic insert: 1 s or 5 s

Galvanic isolation

FEI51 and FEI52
between the probe and power supply

FEI54
between the probe, power supply and load

FEI53, FEI55, FEI57S and FEI58
see connected switching device [4]

Power supply

Electrical connection

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

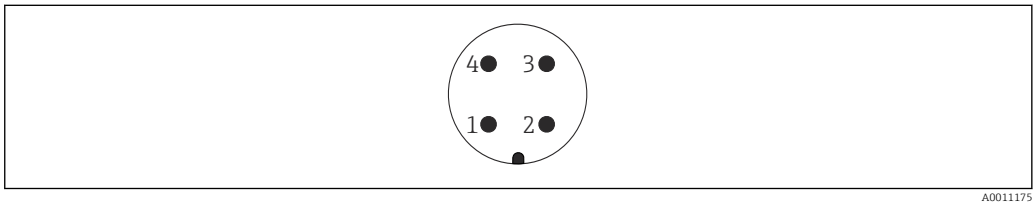
Standard protection, Ex ia protection
- polyester housing F16
- stainless steel housing F15
- aluminum housing F17
- aluminum housing F13 with gas-tight process seal
- stainless steel housing F27 with gas-tight process seal
- aluminum housing T13 with a separate connection compartment

Ex d protection, Gas-tight process seal
- aluminum housing F13 with gas-tight process seal
- stainless steel housing F27 with gas-tight process seal
- aluminum housing T13 with a separate connection compartment

Connector

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

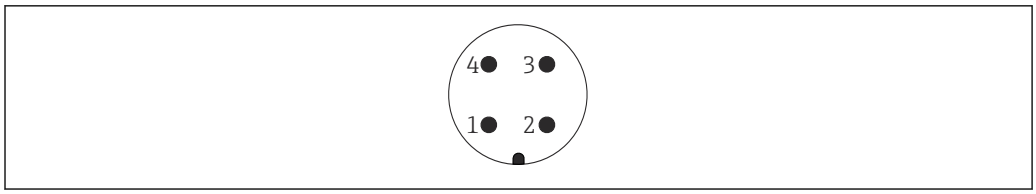
PIN assignment for M12 connector



6 M12 connector with 2-wire-electronic insert FEI55, FEI57, FEI58, FEI57C

1 Positive potential
2 Not used
3 Negative potential
4 Ground

2) E.g. for dry running protection and pump protection.
3) E.g. for use with overfill protection.
4) Functional galvanic isolation in the electronic insert.



7 *M12 connector with 3-wire-electronic insert FEI52, FEI53*

1 *Positive potential*
2 *Not used*
3 *Negative potential*
4 *External load / signal*

Cable entry

Cable gland
M20x1.5 for Ex d only cable entry M20
Two cable glands are included in scope of delivery.

Cable entry
- G½
- NPT½
- NPT¾
- M20 thread

Performance characteristics

Reference operating conditions

Temperature: 20 °C (68 °F) ±5 °C (±8 °F)

Pressure: 1013 mbar (407 inH_2O) abs. ±20 mbar (±8.03 inH_2O)

Humidity: 65 % ±20 %

Medium: water from mains (conductivity 180 µS/cm)

Switch point

Uncertainty as per DIN 61298-2: max. ±0.3 %

Non-repeatability (reproducibility) as per DIN 61298-2: max. ±0.1 %

Ambient temperature effect

Electronic insert
< 0.06 % per 10 K related to the full-scale value

Separate housing
capacitance change of connecting cable per meter 0.15 pF per 10 K

Installation

Mounting requirements

General notes and precautions

NOTICE

Filling the silo.
▶ The filling stream must not be directed onto the probe.

NOTICE

Angle of material flow.
▶ Take care to the expected angle of the material flow and the outlet funnel when determining the mounting location or probe length.

NOTICE

Distance between probes.
▶ The minimum distance of 500 mm (19.7 in) between the probes must be observed.

NOTICE

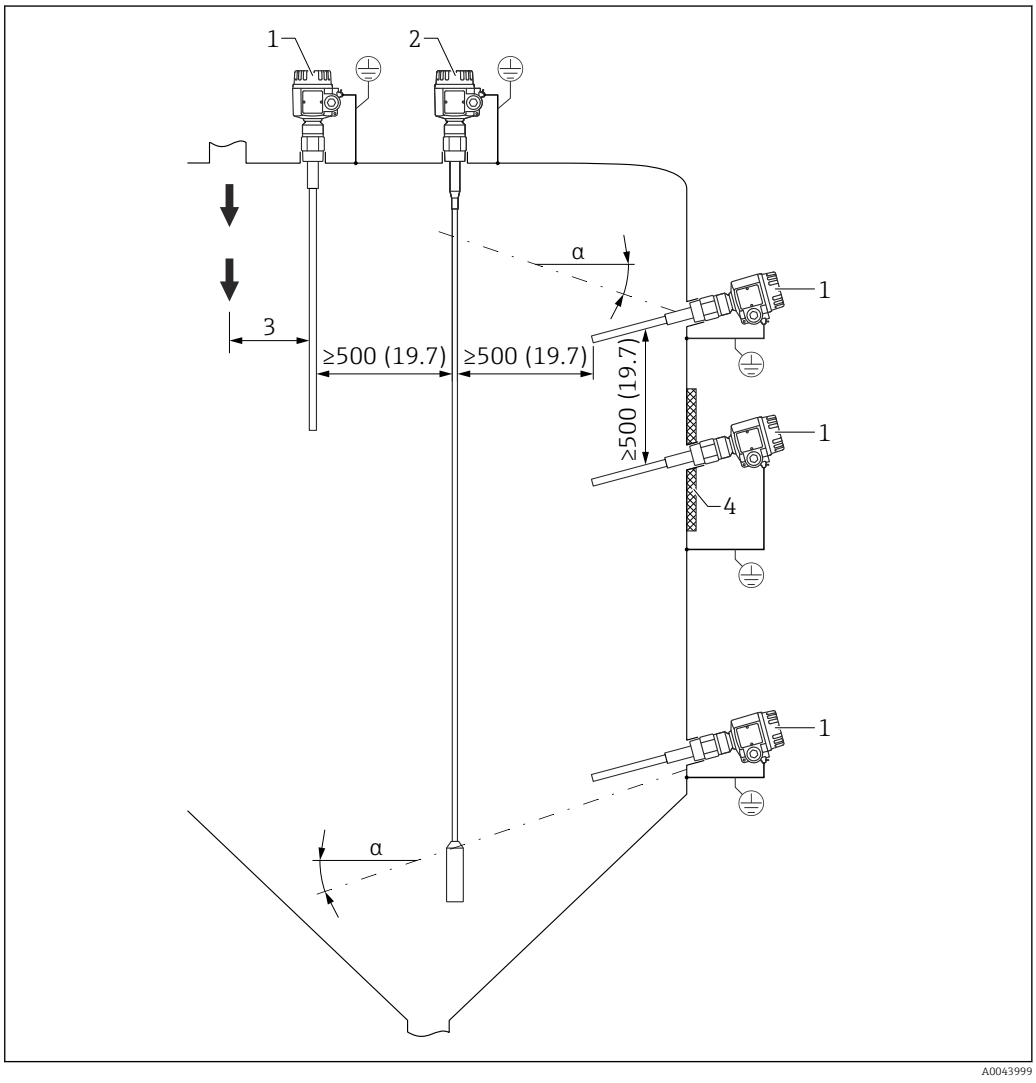
Threaded coupling for mounting.

- The threaded coupling must be as short as possible. Condensation or product residue can occur in a long threaded coupling and interfere with the correct operation of the probe.

NOTICE

Heat insulation

- Insulate the external silo wall to avoid exceeding the permitted temperature of the Solicap M housing.
- Insulate the silo wall to prevent the condensation and reduce buildup in the threaded coupling area.



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8 Mounting examples. Unit of measurement mm (in)

α Angle of the slope
1 FTI55
2 FTI56
3 Distance from the loading point
4 Heat insulation

Mounting the sensor

NOTICE

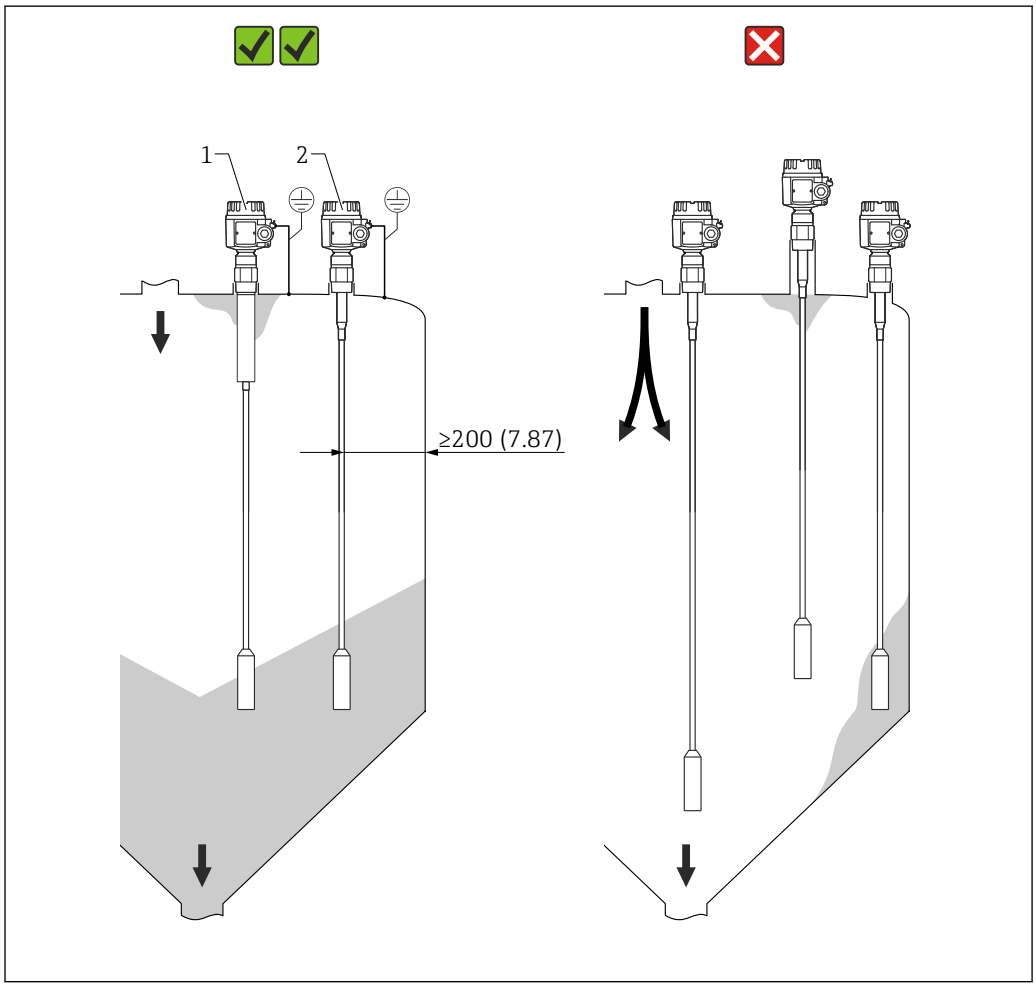
Mouting the probe rope in the loading curtain area can cause an incorrect device operation!

- Mount the probe away from the loading curtain.

NOTICE

The probe rope cannot touch the metal container wall!

► Make sure that the probe rope is insulated from the metal container wall.



9 *Mounting examples. Unit of measurement mm (in)*

1 *FTI56 with inactive length in the event of condensation and material buildup*
2 *The correct distance from the silo wall, the material inlet and the material outlet*

Silo roof

Ensure that the silo roof is of a sufficiently stable construction. High tensile forces can occur when material is being extracted, particularly in the case of heavy and powdery bulk solids which have a tendency to form buildup.

Coarse-grained bulk solids

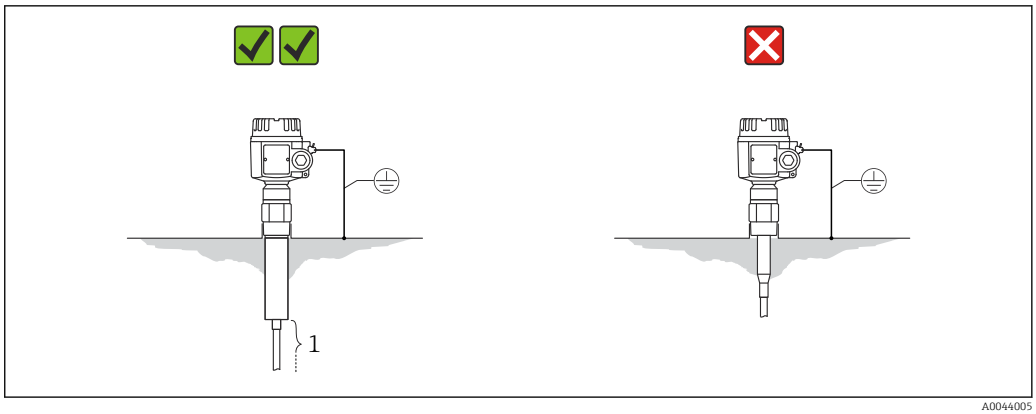
In silos with extremely coarse-grained or extremely abrasive bulk solids, the use of a Solicap M FTI56 is recommended only for maximum detection.

Distance between the rope probes

To rule out mutual probe interference, you must maintain a minimum distance of 0.5 m between the rope probes. This also applies if you are installing several Solicap M units in adjacent silos with nonconductive walls.

Installation in the case of condensation

Use the Solicap M with inactive length. The inactive length prevents moisture and buildup forming between the active part of the probe and the silo roof.

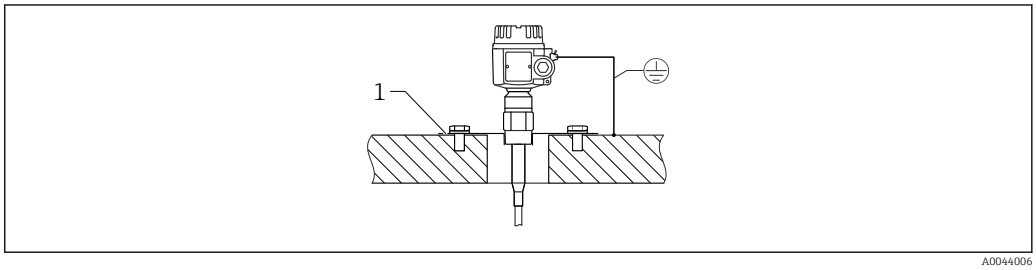


10 *Silo with walls that conduct electricity*

1 *Active part of the probe*

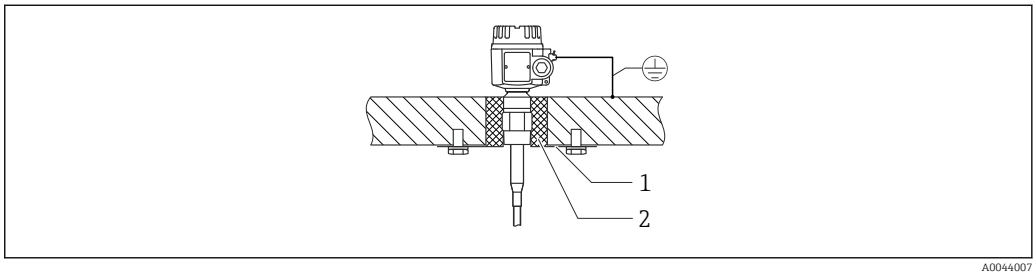
The threaded coupling must be projected into the silo to reduce the effects of condensation and buildup. The maximum thread length is 25 mm (0.98 in).

Heat insulation reduces condensation and therefore buildup on the steel plate.



11 *Mounting in the concrete silo wall*

1 *Steel plate connected to the reinforcing steel*

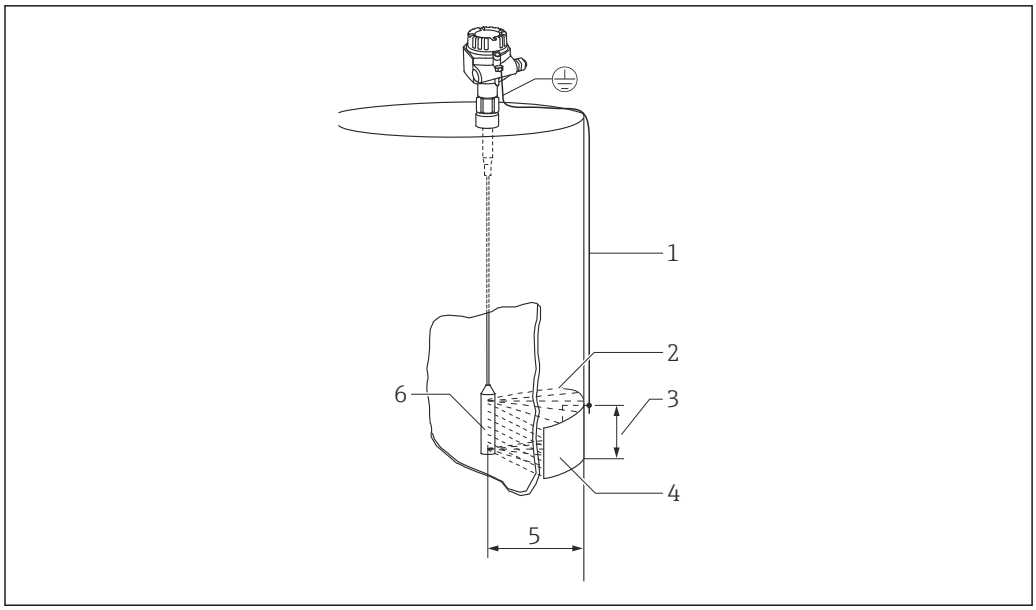


12 *Mounting in the concrete silo wall in case of condensation*

1 *Steel plate*
2 *Heat insulation*

Installation in plastic tanks

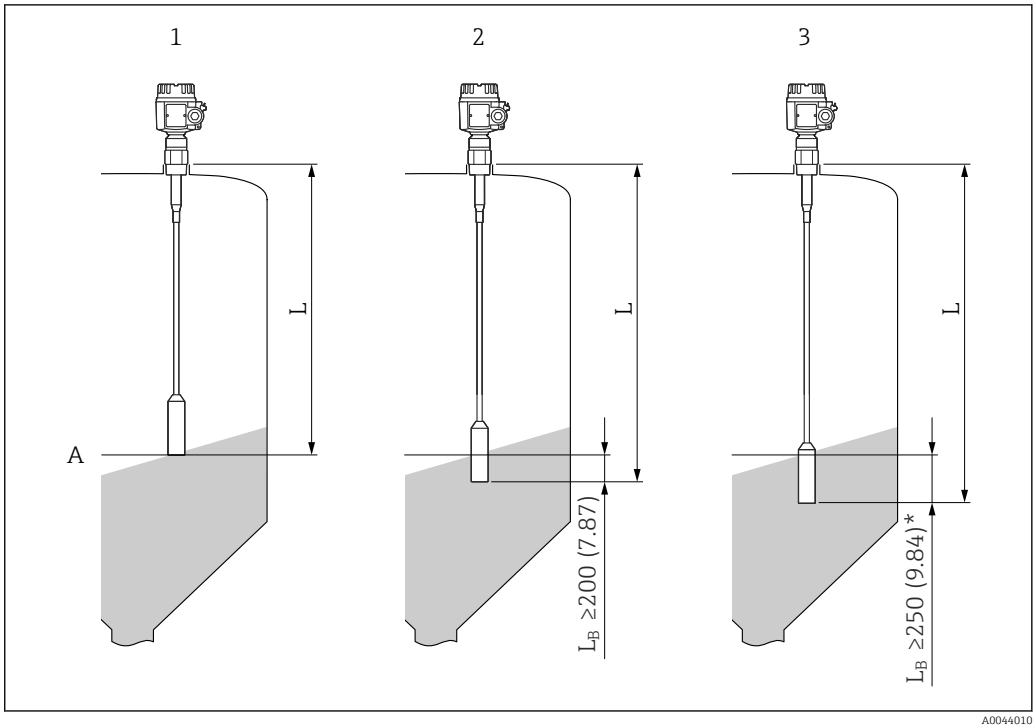
If installing in a silo made of plastic, a counter electrode must be mounted on the silo exterior at the same height as the tensioning weight. The length of the edge of the metal counter electrode should be approximately the same length as the distance between the tensioning weight and the silo wall.



13 Mounting the probe in plastic tanks

1 Ground connection
2 Electrical HF field
3 Surface area e.g. 1 m^2 (10.7 ft^2)
4 Metal counter electrode
5 Distance of 1 m (3.3 ft)
6 Tensioning weight

Range of sensor lengths



14 *Rope length in correlation with the material. Unit of measurement mm (in)*

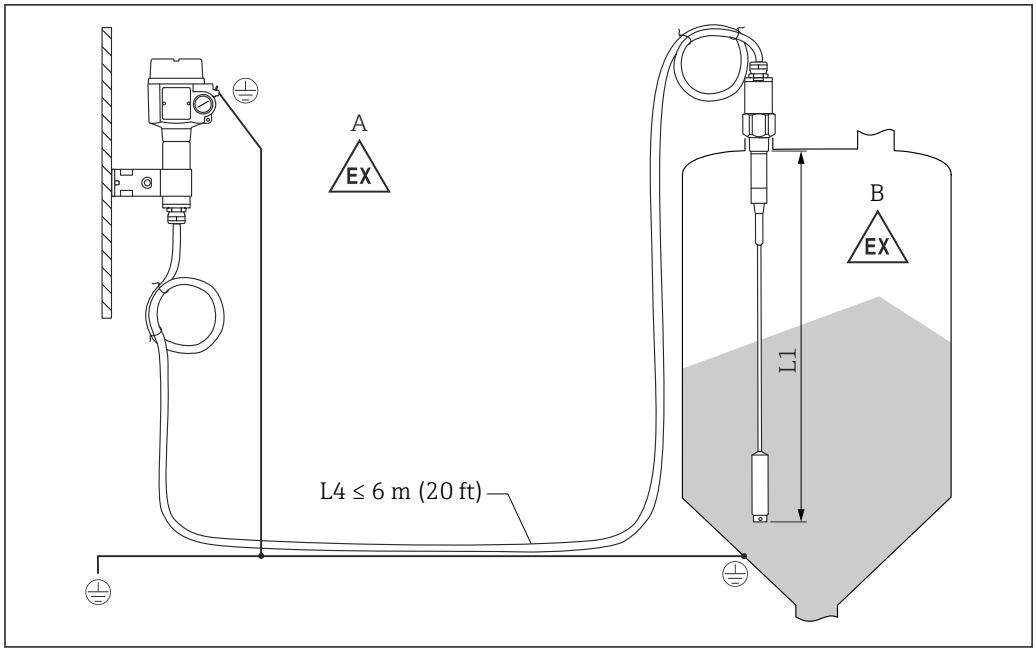
A *Level*
L_B *Covered length*
1 *Rope length (L) for electrically conductive bulk solids, e.g. coal*
2 *Rope length (L) for bulk solids with high dielectric constant, e.g. rock salt*
3 *Rope length (L) for bulk solids with low dielectric constant, e.g. dried grain*

The covered length (L_B) must be 5 % longer than the distance between the tank roof and the limit level, and no shorter than 250 mm (9.84 in) for non-conductive bulk solids with a low dielectric constant (ε_r).

Rope shortening

Both versions of the rope probes can be shortened. The weigth must be removed from the rope first. See Operating Instructions.

Probe with separate housing



15 *Connection of the probe and separate housing*

A Explosive zone 1
B Explosive zone 0
L1 Rope length: max. 19.7 m (65 ft)
L4 Cable length

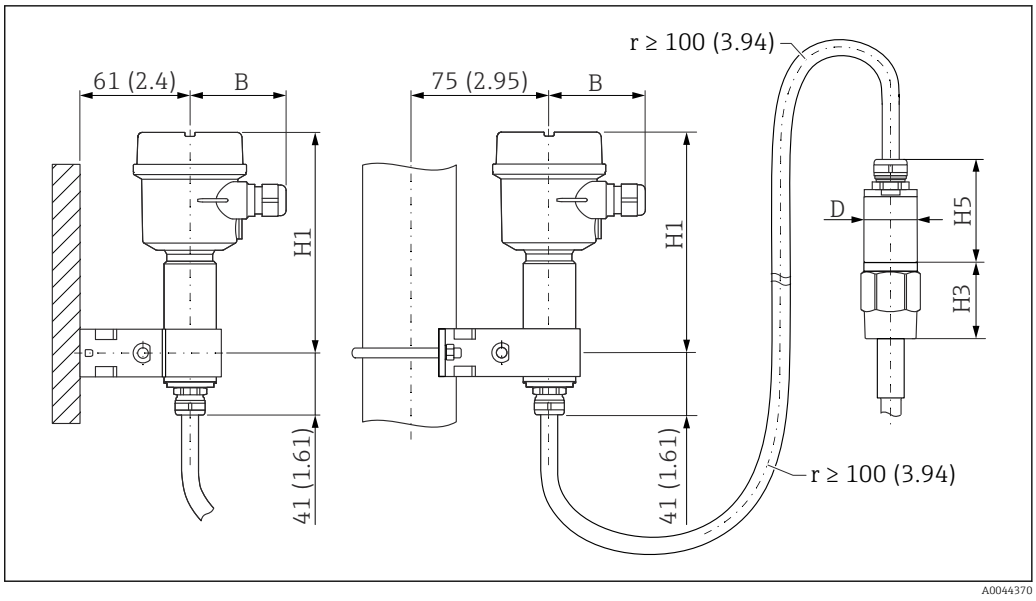
The maximum cable length L4 and rope length L1 cannot exceed 20 m (66 ft).

- The maximum cable length between the probe and separate housing is 19.7 m (65 ft).
- The required cable length must be indicated in the ordering process of a Liquicap M with separate housing.
- If the cable connection has to be shortened or led through a wall, then it must be separated from the process connection.

Extension heights: separate housing

The cable has:

- a minimum bending radius of r ≥ 100 mm (3.94 in)
- Ø 10.5 mm (0.14 in)
- outer jacket made of silicone, notch resistance



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

Values of parameters [5]:

B parameter
- polyester housing (F16): 76 mm (2.99 in)
- stainless steel housing (F15): 64 mm (2.52 in)
- aluminum housing (F17): 65 mm (2.56 in)

H1 parameter
- polyester housing (F16): 172 mm (6.77 in)
- stainless steel housing (F15): 166 mm (6.54 in)
- aluminum housing (F17): 177 mm (6.97 in)

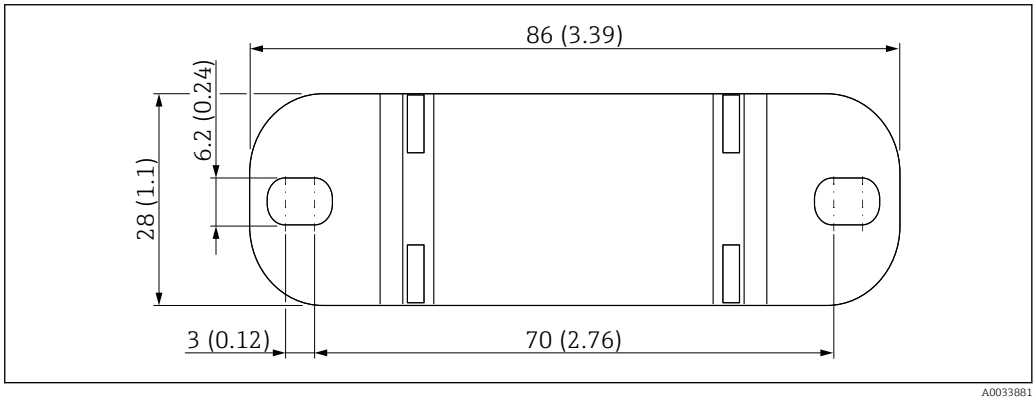
D parameter
Ø 50 mm (1.97 in)

H5 parameter
Ø62 mm (2.44 in)

H3 parameter value
The height H3 depends on the type of process connection.

Wall bracket

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



17 *Wall bracket overview. Unit of measurement mm (in)*

5) See parameters on the drawings.

Wall mounting

Wall mounting is possible, see Operating Instructions.

Pipe mounting

Pipe mounting is possible, see Operating Instructions.

Environment

Ambient temperature range

- F16 housing: −40 to +70 °C (−40 to +158 °F)
- remaining housing: −50 to +70 °C (−58 to +158 °F)
- observe derating
- use a protective cover, when operating outdoors

Storage temperature

−50 to +85 °C (−58 to +185 °F)

Climate class

DIN EN 60068-2-38/IEC 68-2-38: Z/AD check

Vibration resistance

DIN EN 60068-2-64/IEC 68-2-64: 20 to 2 000 Hz, 0.01 g^2/Hz

Cleaning

Housing

Make sure that the cleaning agent used does not corrode the housing surface or the seals.

Probe

Depending on the application, buildup (contamination and soiling) can form on the probe rope. A high degree of material buildup can affect the measurement result. If the medium tends to create a high degree of buildup, regular cleaning is recommended. When cleaning, it is important to make sure that the insulation of the probe rope is not damaged. Make sure the material is resistant to used cleaning agent.

Electromagnetic compatibility (EMC)

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

A usual commercial instrument cable can be used.

Shock resistance

DIN EN 60068-2-27/IEC 68-2-27: 30 g acceleration

Degree of protection

All protection degree regarding EN60529.

Type4X protection degree regarding NEMA250.

Polyester housing F16
Protection degree:
- IP66
- IP67
- Type4X

Stainless steel housing F15
Protection degree:
- IP66
- IP67
- Type4X

Aluminum housing F17
Protection degree:
- IP66
- IP67
- Type4X

Aluminum housing F13 with gas-tight process seal
Protection degree:
- IP66
- IP68 [6)]
- Type4X

Stainless steel housing F27 with gas-tight process seal
Protection degree:
- IP66
- IP67
- IP68 [6)]
- Type4X

Aluminum housing T13 with gas-tight process seal and separate connection compartment (Ex d)
Protection degree:
- IP66
- IP68 [6)]
- Type4X

Separate housing
Protection degree:
- IP66
- IP68 [6)]
- Type4X

Process

Process temperature range

The following process temperature ranges only apply for standard applications outside hazardous areas.

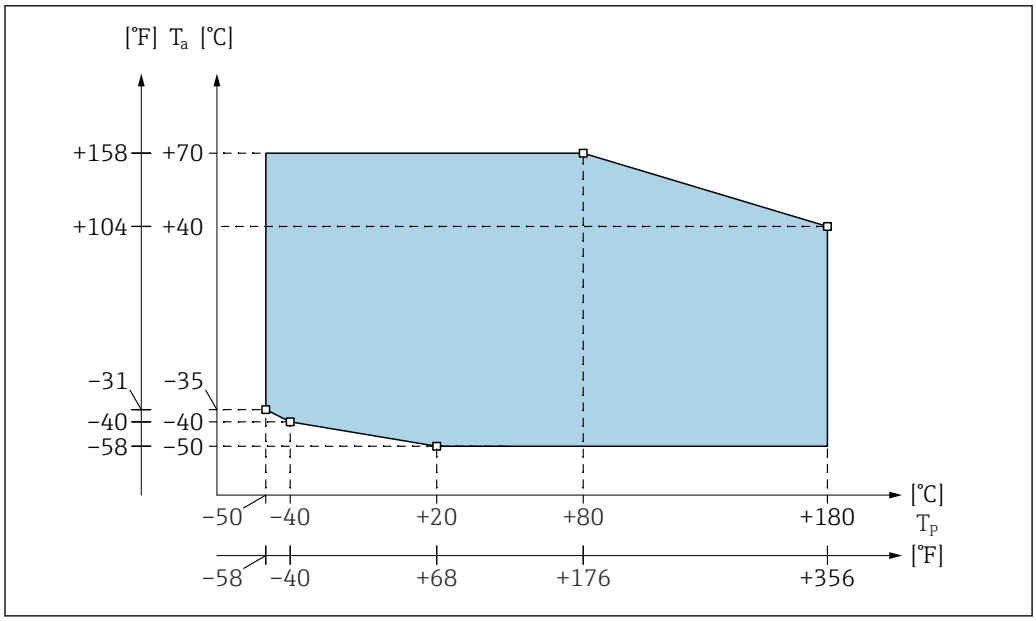
Regulations for use in hazardous areas are provided in the Supplementary Documentation that is available for the product and can be selected via the Product Configurator at www.endress.com.

Permitted ambient temperature T_a at the housing depending on the process temperature T_p in the tank.

Rope probe

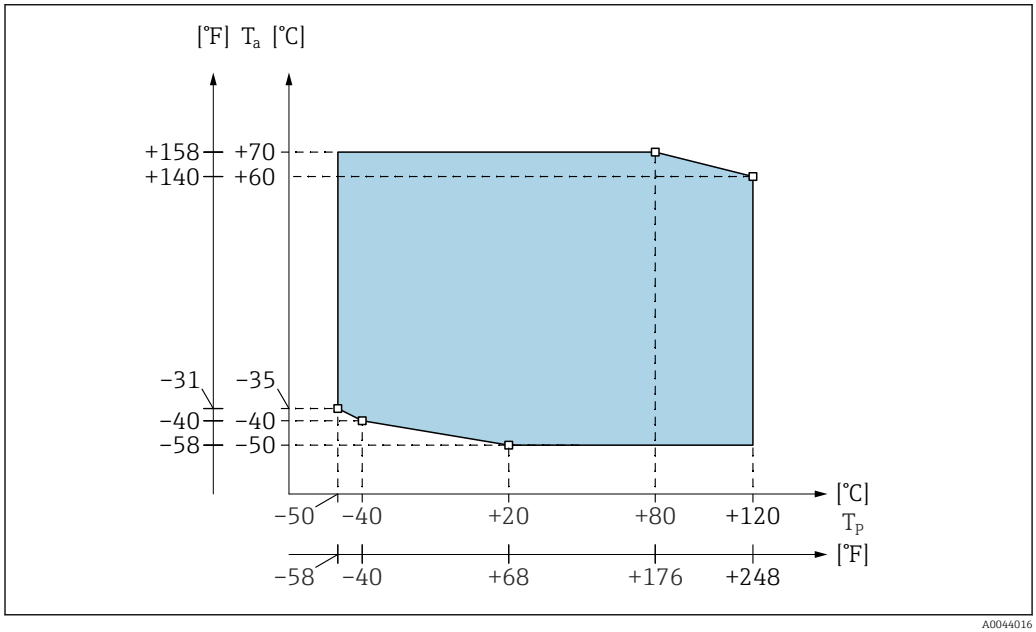
Partially insulated (PTFE)

6) Only with M20 cable entry or G½ thread.



18 *Process temperature range diagram: partially insulated probe*

Fully insulated (PA)



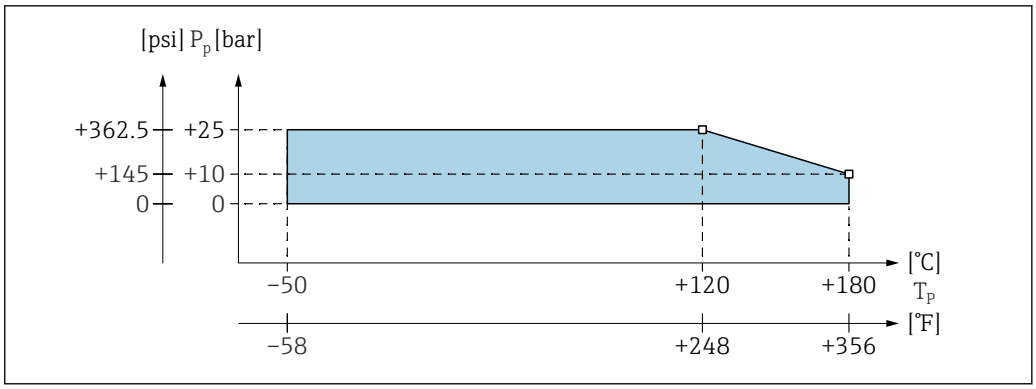
19 *Process temperature range diagram: fully insulated probe*

Process pressure and temperature derating

The lowest value from the derating curves of the device and the selected flange applies. In the case of flange process connections, the maximum pressure is limited by the nominal pressure of the flange.

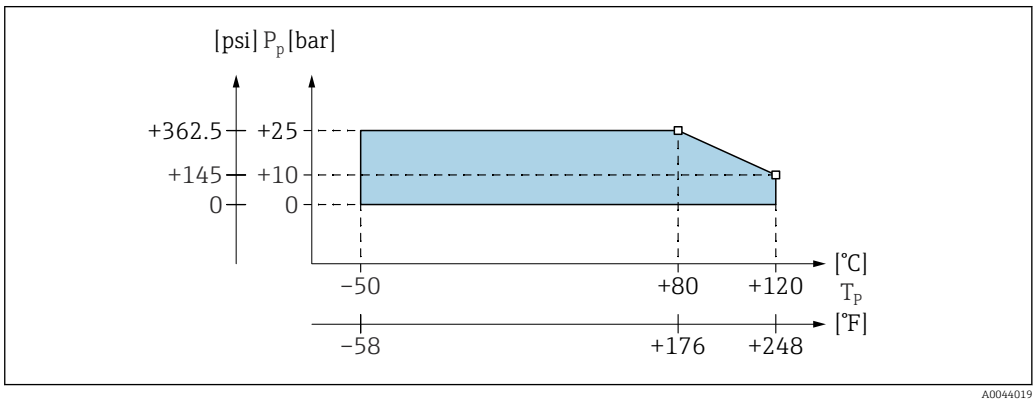
Rope probe

Partially insulated (PTFE)



20 *Process pressure and temperature derating diagram: partially insulated probe*

Fully insulated (PA)



21 *Process pressure and temperature derating diagram: Fully insulated probe*

Process pressure limits

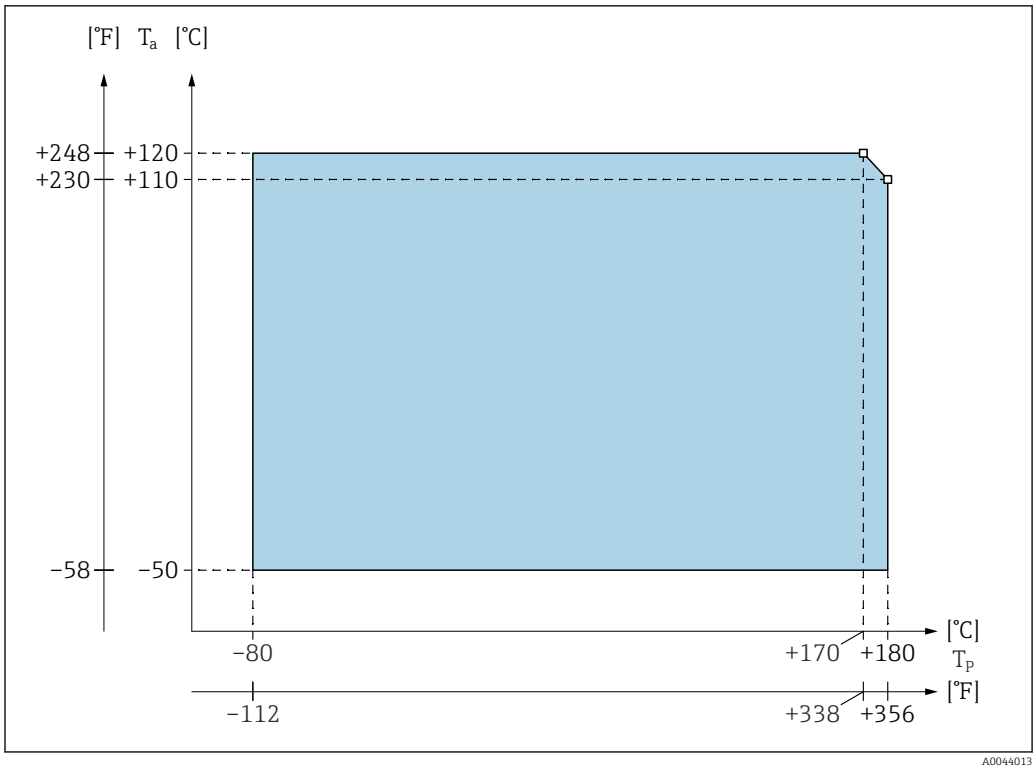
Process pressure limits: −1 to 25 bar (−14.5 to 362.5 psi).

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

Refer to the following standards for the pressure values permitted at higher temperatures:
- pR EN 1092-1: 2005 Table, Appendix G2
  With regard to its resistance and temperature property, the material 1.4435 is identical to 1.4404 (AISI 316L) which is grouped under 13E0 in EN 1092-1 Tab. 18. The chemical make-up of the two materials can be identical.
- ASME B 16.5a - 1998 Tab. 2-2.2 F316
- ASME B 16.5a - 1998 Tab. 2.3.8 N10276
- JIS B 2220

Temperature-derating separate housing

The temperature at the separate housing must not exceed 70 °C (158 °F).



22 *Process pressure range diagram*

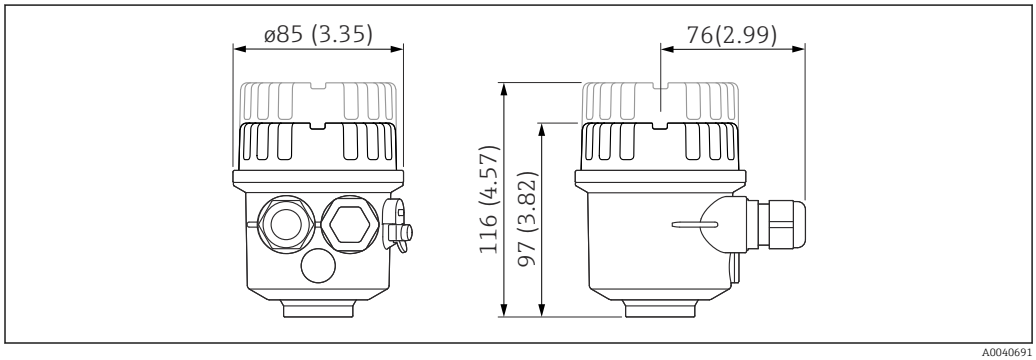
T_a *Ambient temperature*
T_p *Process temperature*

The maximum connection length between the probe and the separate housing is 6 m (L4). When ordering a device with a separate housing, the desired length must be specified. If the connecting cable is to be shortened or passed through a wall, it must be separated from the process connection, see operating instructions.

Mechanical construction

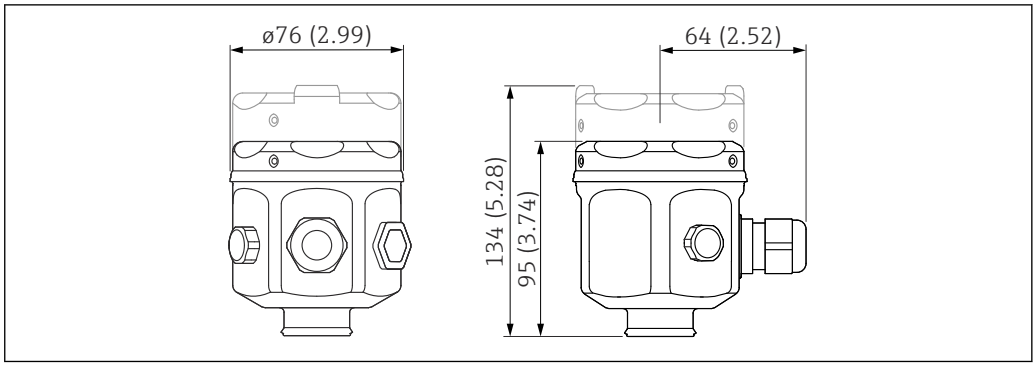
Housing

Polyester housing F16



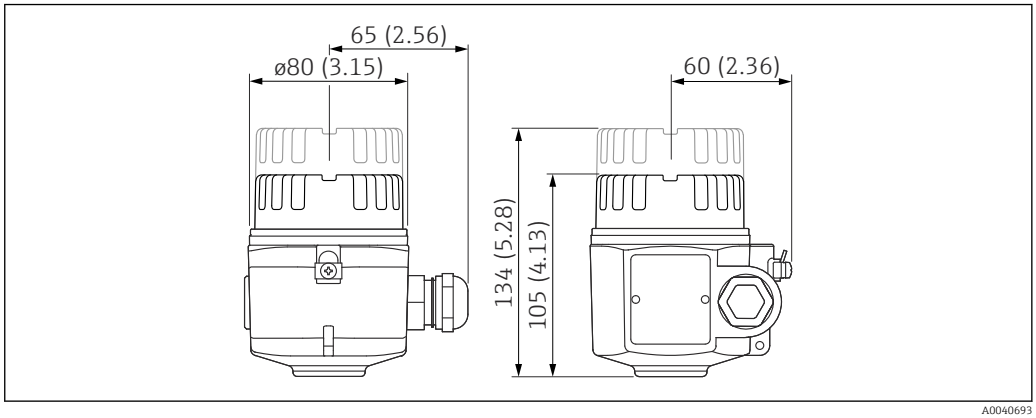
Unit of measurement mm (in)

Stainless steel housing F15



Unit of measurement mm (in)

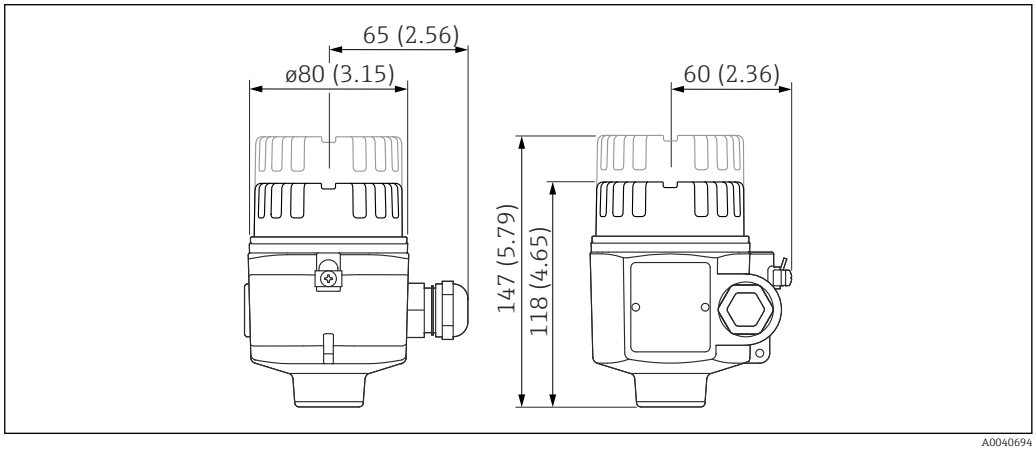
Stainless steel housing F17



Unit of measurement mm (in)

Aluminum housing F13

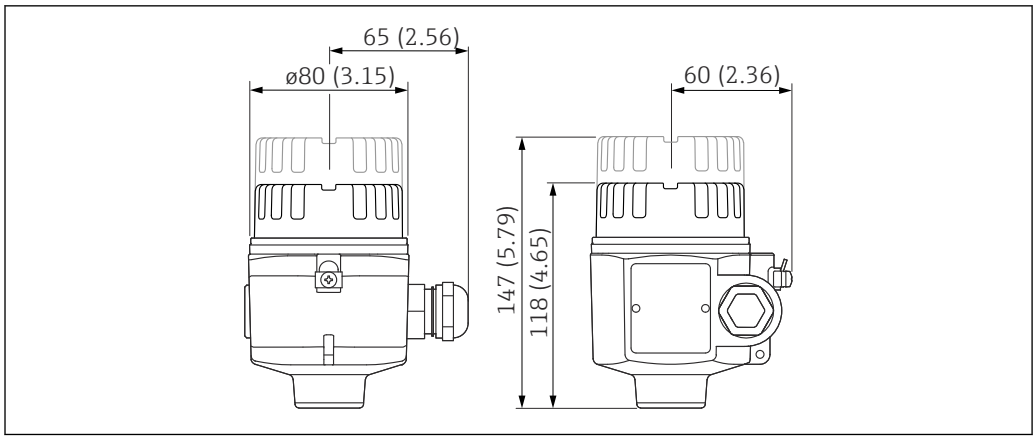
With the gas-tight process seal.



Unit of measurement mm (in)

Stainless steel housing F27

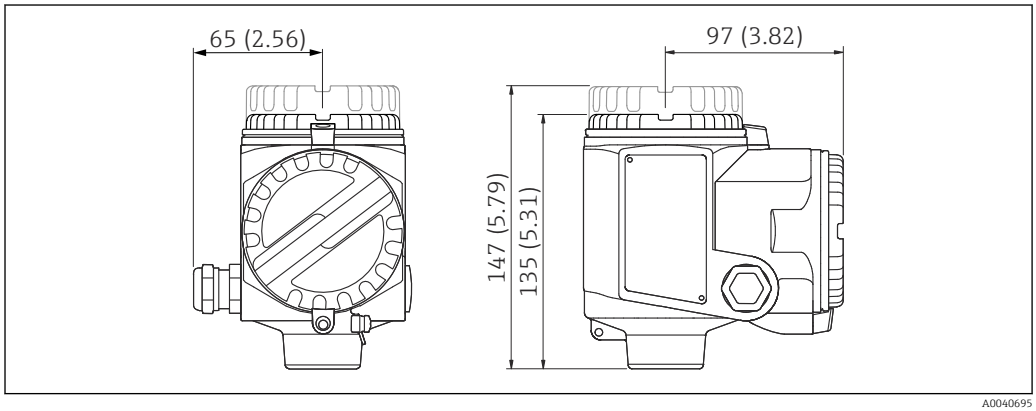
With the gas-tight process seal.



Unit of measurement mm (in)

Aluminum housing T13

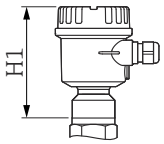
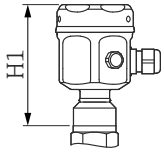
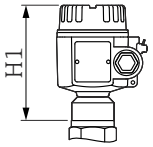
With separate connection compartment and gas-tight process seal.



Unit of measurement mm (in)

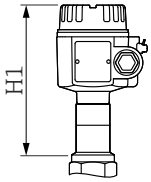
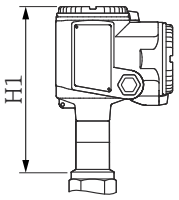
Housing heights with adapter

List of abbreviations:
- G - order code
- H1 - height

A [1]	B [2]	C [3]
 A0044020	 A0044021	 A0044022
G: 2	G: 1	G: 3
125 mm (4.92 in)	121 mm (4.76 in)	131 mm (5.16 in)

1) Polyester housing F16
2) Stainless steel housing F15
3) Aluminum housing F17

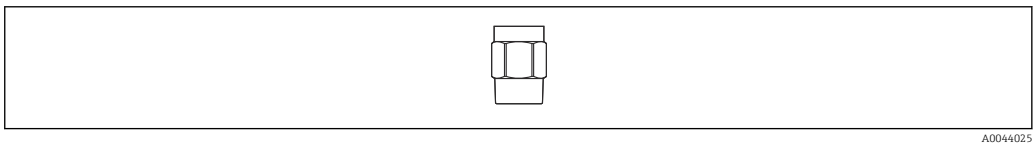
List of abbreviations:
- G - order code
- H1 - height

D [1]	F [2]
 A0044023	 A0044024
G: 4	G: 5
177 mm (6.97 in)	194 mm (7.64 in)

1) Aluminum housing F13 with gas-tight process seal
2) Aluminum housing with separate connection compartment T13 and gas-tight process seal

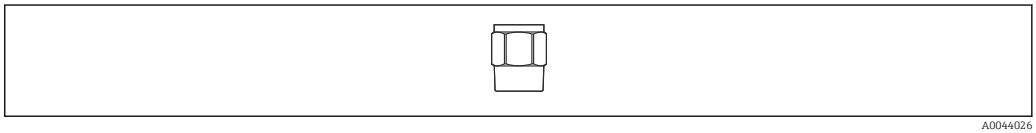
Process connections and flanges

Thread: R 1½ - DIN EN 10226-1


A0044025

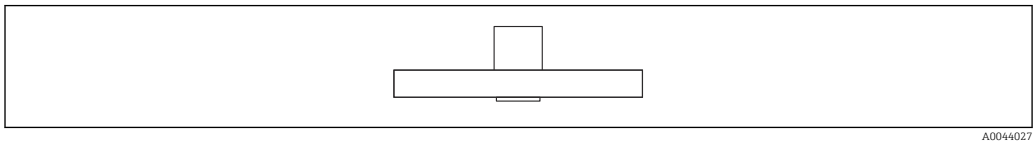
- p_{max}: 25 bar (362.5 psi)
- Order code
  - 316L: **RVJ**
  - steel: **RV1**

Thread: NPT 1½ - ANSI B 1.20.1


A0044026

- p_{max}: 25 bar (362.5 psi)
- Order code
  - 316L: **RGJ**
  - steel: **RG1**

Flanges



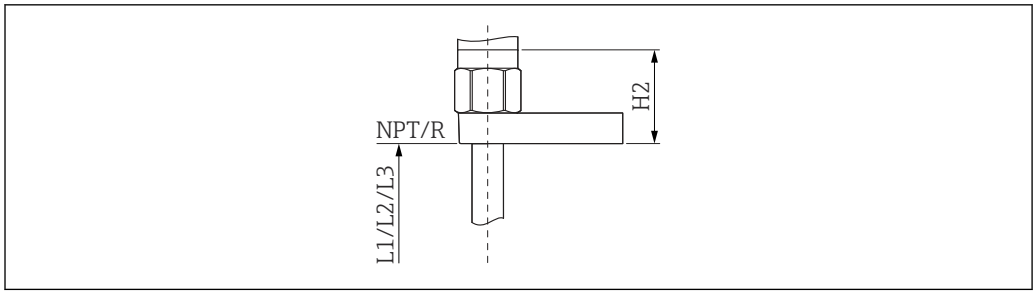
A0044027

- p_{max}: 25 bar (362.5 psi) [7]
- Order code
  - ASME B16.5, NPS 2" Cl.150 RF, 316/316L: **AFJ**
  - ASME B16.5, NPS 3" Cl.150 RF, 316/316L: **AGJ**
  - ASME B16.5, NPS 4" Cl.150 RF, 316/316L: **AHJ**
  - EN1092-1, DN80 PN10/16 A, 316L: **BSJ**
  - EN1092-1, DN100 PN10/16 A, 316L: **BTJ**
  - EN1092-1, DN50 PN25/40 A, 316L: **B3J**
  - JIS B2220, 10K 50A RF, 316L: **KFJ**
  - JIS B2220, 10K 80A RF, 316L: **KGJ**
  - JIS B2220, 10K 100A RF, 316L: **KHJ**

Rope probes FTI56

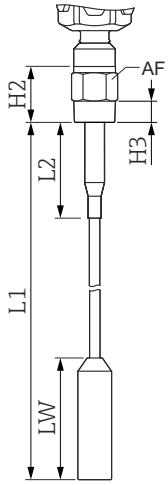
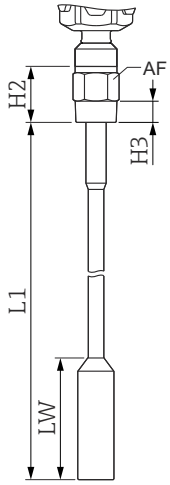
Total length of the probe measured from the start of the thread:
without active buildup compensation: L = L1 + L3

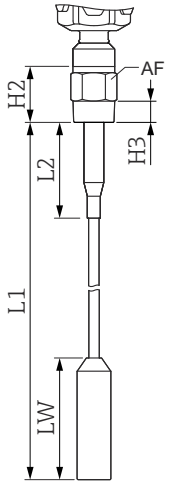
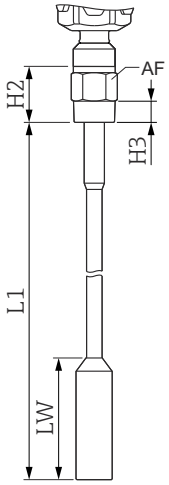
Length tolerance:
- up to 1 m (3.3 ft): 0 to −10 mm (0 to −0.39 in)
- > 1 to 3 m (3.3 to 9.8 ft): 0 to −20 mm (0 to −0.79 in)
- > 3 to 6 m (9.8 to 20 ft): 0 to −30 mm (0 to −1.18 in)
- > 6 m (20 ft): 0 to −40 mm (0 to −1.57 in)



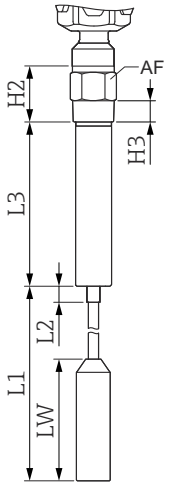
A0044028

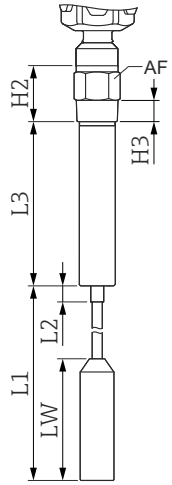
7) Depends on flange

A [1]		B [2]	
 A0044033		 A0044034	
H2			
66 mm (2.60 in)		66 mm (2.60 in)	
H3			
25 mm (0.98 in)		25 mm (0.98 in)	
AF			
50		50	
Total length (L)			
500 to 20 000 mm (19.7 to 787 in)		500 to 20 000 mm (19.7 to 787 in)	
Active rope length (L1)			
500 to 20 000 mm (19.7 to 787 in)		500 to 20 000 mm (19.7 to 787 in)	
Length of partial insulation (L2) [3]			
500 mm (19.7 in)		-	
Inactive length (L3)			
-		-	
Inactive length diameter			
-		-	
Probe rope diameter			
6 mm (0.24 in)	12 mm (0.47 in)	6 mm (0.24 in)	12 mm (0.47 in)
Probe rope diameter with insulation			
8 mm (0.31 in)	14 mm (0.55 in)	8 mm (0.31 in)	14 mm (0.55 in)
Tensioning weight diameter [4]			
30 mm (1.18 in)	40 mm (1.57 in)	30 mm (1.18 in)	40 mm (1.57 in)
Length of tensioning weight (LW)			
150 mm (5.91 in)	250 mm (9.84 in)	150 mm (5.91 in)	250 mm (9.84 in)
Tensile loading capacity of the probe rope at 20 °C (68 °F)			
30 kN (6744 lbs)	60 kN (13488 lbs)	300 Nm (221 lbf ft)	
Maximum process temperature			
180 °C (356 °F)		120 °C (248 °F)	
Probe can be used in mounting nozzles			
-		-	

A [1]	B [2]
	
Probe can be used in the event of condensate on tank ceiling	
-	-

1) Rope probe with partially insulated rope
2) Rope probe with fully insulated rope.
3) The length of the partial insulation extends, at maximum, to the tensioning weight.
4) The tension weight is always uninsulated.

C [1]	C [2]
	
H2	
66 mm (2.60 in)	
H3	
25 mm (0.98 in)	
AF	
50	
Total length (L)	
700 to 20 000 mm (27.6 to 787 in)	
Active rope length (L1)	
500 to 19 800 mm (19.7 to 780 in)	
Length of partial insulation (L2) [3]	

C [1]	C [2]
 A0044035	
500 mm (19.7 in)	-
Inactive length (L3)	
200 to 2 000 mm (7.87 to 78.7 in)	
Inactive length diameter	
43 mm (1.69 in)	
Probe rope diameter	
6 mm (0.24 in)	12 mm (0.47 in)
Probe rope diameter with insulation	
8 mm (0.31 in)	14 mm (0.55 in)
Tensioning weight diameter [4]	
30 mm (1.18 in)	40 mm (1.57 in)
Length of tensioning weight (LW)	
150 mm (5.91 in)	250 mm (9.84 in)
Tensile loading capacity of the probe rope at 20 °C (68 °F)	
300 Nm (221 lbf ft)	
Maximum process temperature	
180 °C (356 °F)	120 °C (248 °F)
Probe can be used in mounting nozzles	
✔	
Probe can be used in the event of condensate on tank ceiling	
✔	

1) Rope probe with inactive length and partially insulated rope
2) Rope probe with inactive length and fully insulated rope
3) The length of the partial insulation extends, at maximum, to the tensioning weight.
4) The tension weight is always uninsulated.

Materials

Housing

- Aluminum housing F17, F13, T13: GD–Al Si 10 Mg, DIN 1725, with plastic coating (blue and gray)
- Polyester housing F16: PBT–FR fiberglass reinforced polyester (blue and gray)
- Stainless steel housing F15: corrosion-resistant steel 316L (1.4404 or 1.4405), uninsulated

Housing cover and seals
- Aluminum housing F17, F13, T13: EN-AC-AlSi10Mg, plastic-coated, cover seal: EPDM
- Polyester housing F16: cover made of PBT-FR or cover with sight glass made of PA12, cover seal: EPDM
- Stainless steel housing F15: AISI 316L, cover seal: silicone

Probe material
- Process connection, tensioning weight for rope probe: 1.4404, 316L or steel
- Inactive length: 1.4404 or 316L
- Probe rope partially insulated: PTFE, 1.4401 (AISI 316)
- Probe rope fully insulated: PA, galvanized steel

Weight

Housing with process connection:
- F15, F16, F17, F13 approximately 4.00 kg (8.82 lb)
  - + flange weight or process connection
  - probe rope 0.180 kg/m (0.12 lb/ft) (for ø6 mm (0.24 in) probe rope)
  - probe rope 0.550 kg/m (0.37 lb/ft) (for ø12 mm (0.48 in) probe rope)
- T13 approximately 4.50 kg (9.92 lb)
  - + flange weight or process connection
  - probe rope 0.180 kg/m (0.12 lb/ft) (for ø6 mm (0.24 in) probe rope)
  - probe rope 0.550 kg/m (0.37 lb/ft) (for ø12 mm (0.48 in) probe rope)

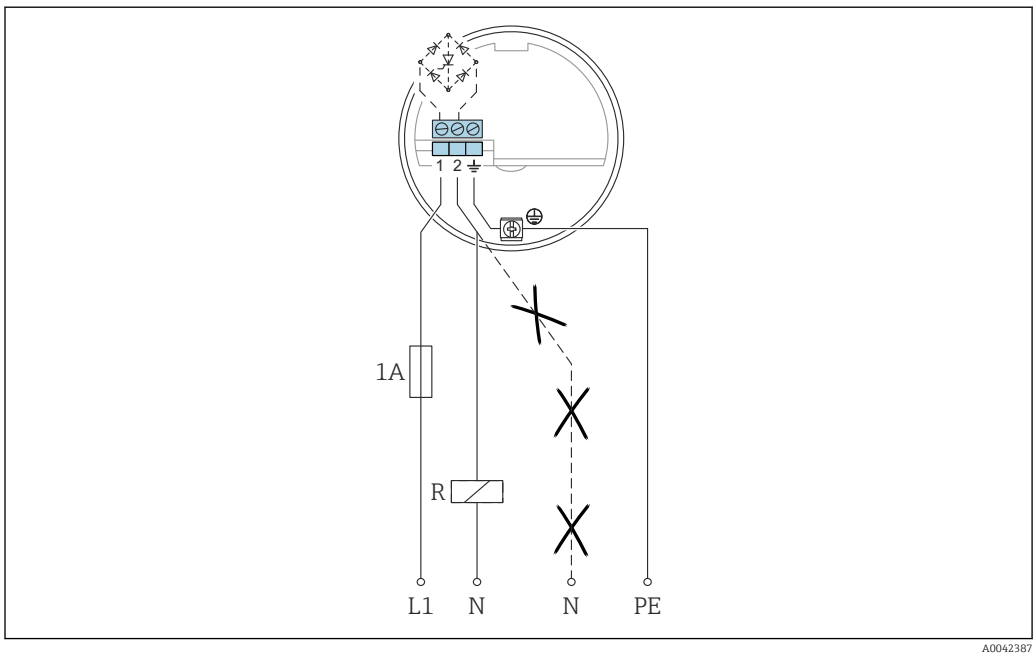
Operability

2-wire AC electronic insert FEI51

Power supply
- Supply voltage: 19 to 253 V_{AC}
- Power consumption: < 1.5 W
- Residual current consumption: < 3.8 mA
- Short-circuit protection
- Overvoltage category: II

Electrical connection

Connect the electronic insert in series with an external load.



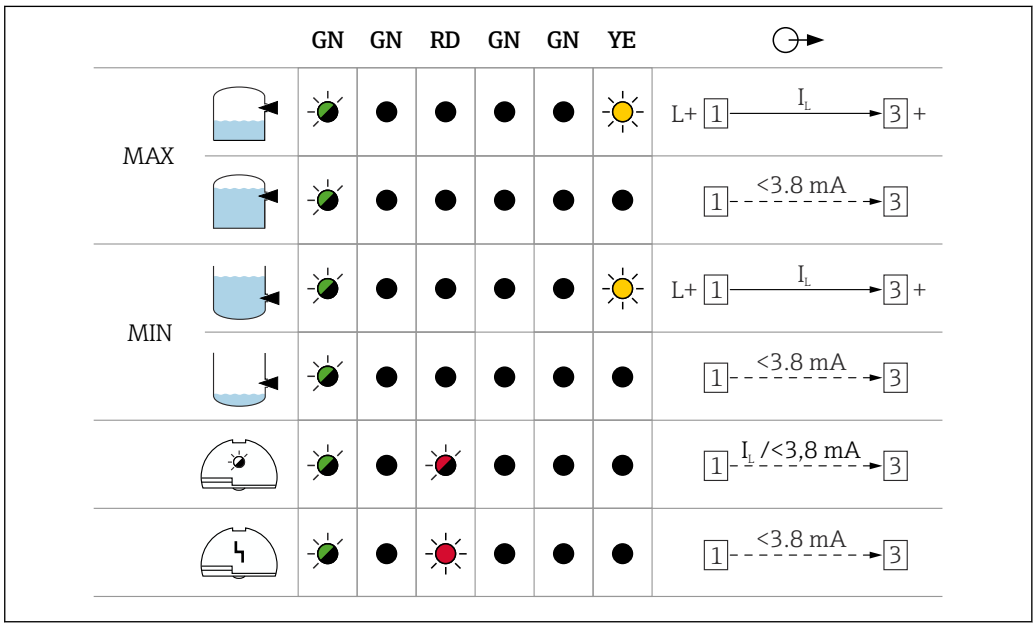
A0042387

L1 L1 phase cable
N Neutral cable
PE Grounding cable
R External load

Make sure that:
- the residual current consumption is in blocked state.
- for low voltage:
  - voltage drop across the load is such that the minimum terminal voltage at the electronic insert 19 V when blocked is not undershot
  - voltage drop across the electronics when switched through is observed (up to 12 V)
- a relay cannot de-energize with holding power below 1 mA [8)]

When selecting the relay, pay attention to the holding power and rated power.

Signal on alarm



Output signal

Output signal on power failure or in the event of damage to the sensor: < 3.8 mA

Connectable load

- For relays with a minimum holding power or rated power:
  - > 2.5 VA at 253 V_{AC} (10 mA)
  - > 0.5 VA at 24 V_{AC} (20 mA)
- Relays with a lower holding power or rated power can be operated by means of an RC module connected in parallel.
- For relays with a maximum holding power or rated power:
  - < 89 VA at 253 V_{AC}
  - < 8.4 VA at 24 V_{AC}
- Voltage drop across FEI51:
  maximum 12 V
- Residual current with blocked thyristor:
  3.8 mA
- Load switched directly into the power supply circuit via the thyristor.

DC PNP electronic insert FEI52

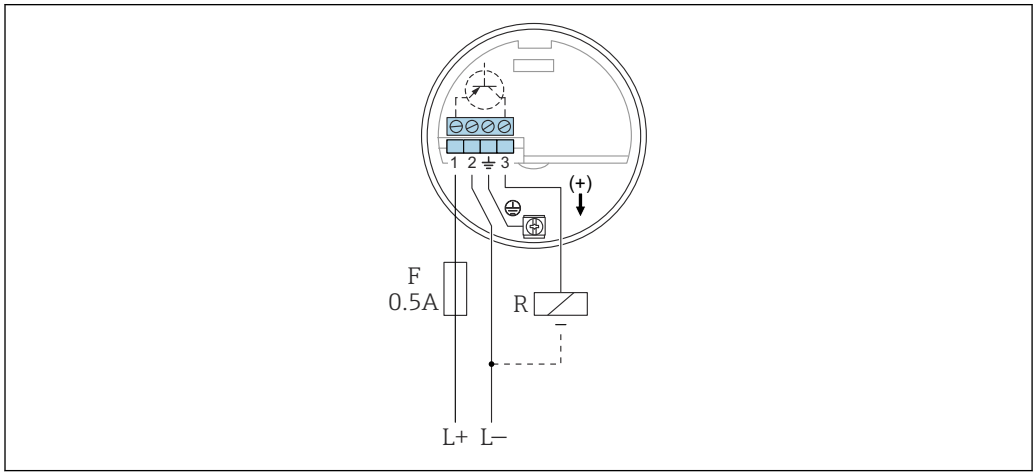
Power supply

- Supply voltage: 10 to 55 V_{DC}
- Ripple:
  - maximum 1.7 V
  - 0 to 400 Hz
- Current consumption: < 20 mA
- Power consumption without load: maximum 0.9 W
- Power consumption with full load (350 mA): 1.6 W

8) If not: A resistor should be connected parallel to the relay (RC module available on request).

- Reverse polarity protection: yes
- Separation voltage: 3.7 kV
- Overvoltage category: II

Electrical connection



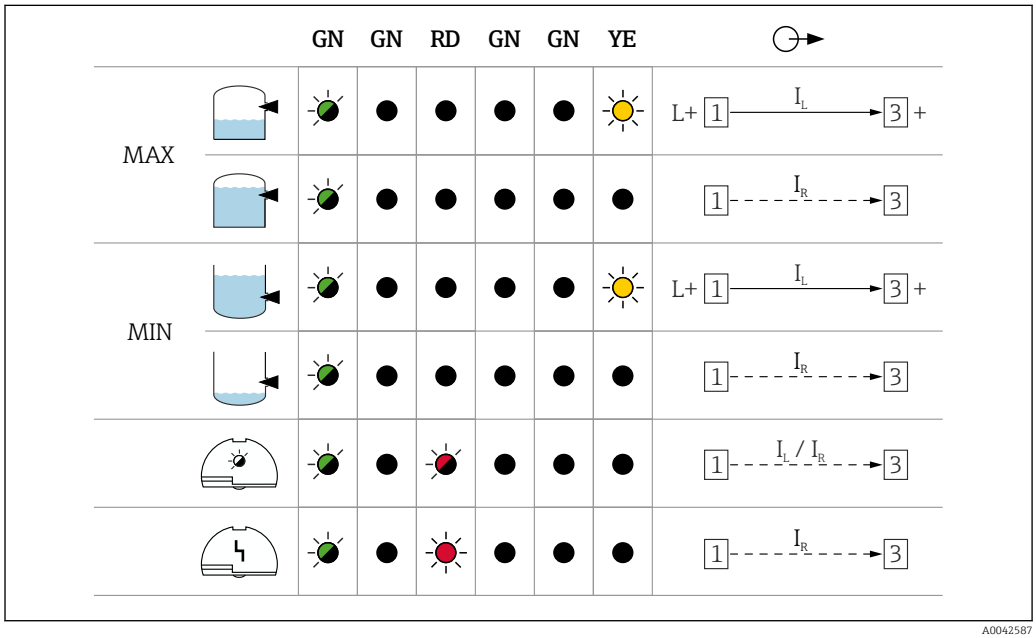
A0042388

L+ Power input +
L- Power input -
F Fuse 0.5 A
R External load: I_{max} =350 mA U_{max} = 55 V_{DC}

Preferably in conjunction with programmable logic controllers (PLC), DI modules in accordance with EN 61131-2.

Positive signal present at the switch output of the electronic system (PNP).

Output signal



A0042587

Signal on alarm

Output signal on power failure or in the event of device failure:
I_R < 100 µA

Connectable load

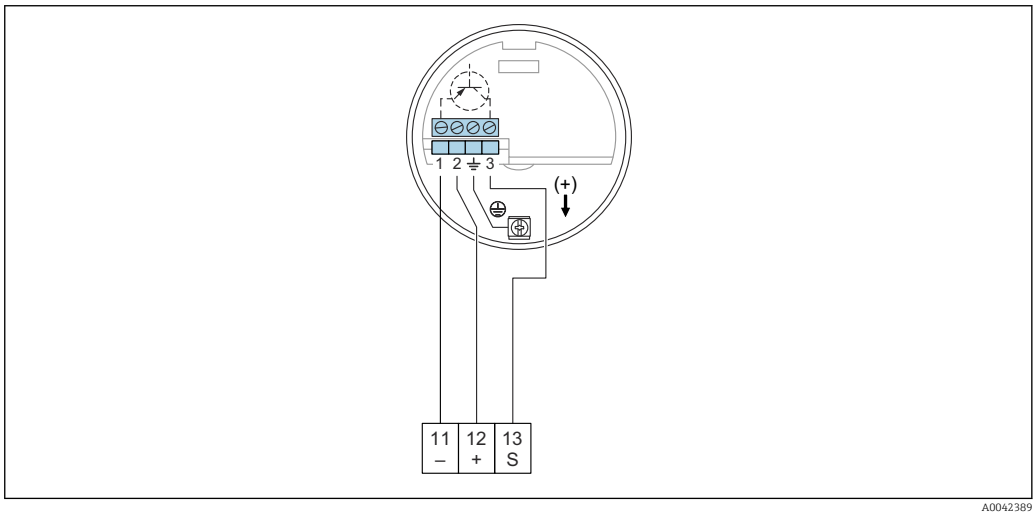
- Load switched via transistor and separate PNP connection: maximum 55 V
- Load current: maximum 350 mA cyclical overload and short-circuit protection
- Residual current: < 100 µA with transistor blocked
- Capacitance load:
  - maximum 0.5 µF at 55 V
  - maximum 1 µF at 24 V
- Residual voltage: < 3 V for transistor switched through

3-wire electronic insert FEI53

Power supply

- Supply voltage: 14.5 V_{DC}
- Current consumption: < 15 mA
- Power consumption: maximum 230 mW
- Reverse polarity protection: yes
- Separation voltage: 0.5 kV

Electrical connection



A0042389

11 The negative terminal in Nivotester FTC325
12 The positive terminal in Nivotester FTC325
S Signal terminal in Nivotester FTC325

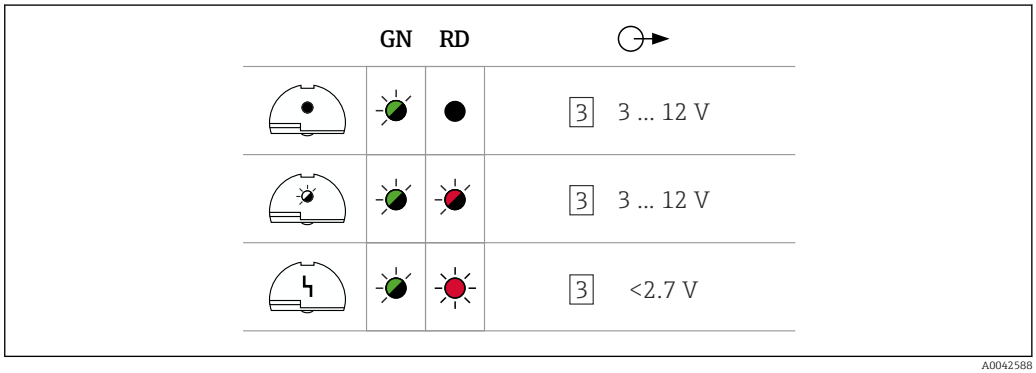
3 to 12 V signal.

For connecting to the switching unit, Nivotester FTC325 3–WIRE from Endress+Hauser.

Switching between minimum and maximum Safety in the Nivotester FTC325 3-WIRE.

Point level adjustment directly at the Nivotester.

Output signal



A0042588

Signal on alarm

Voltage at terminal 3 opposite terminal 1: < 2.7 V

Connectable load

- Floating relay contacts in the connected switching unit Nivotester FTC325 3-WIRE
- For the contact load capacity, refer to the technical data of the switching device

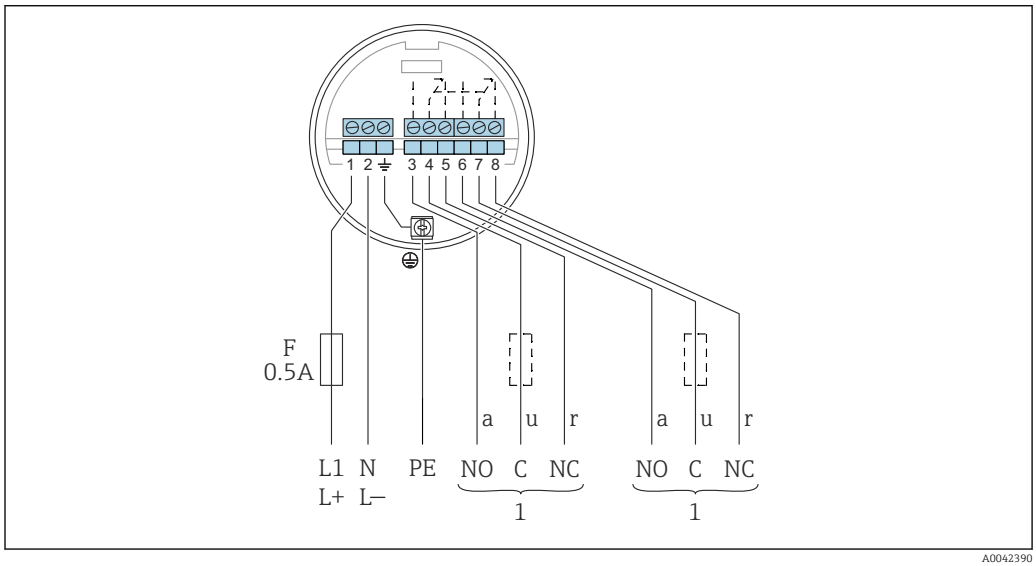
AC and DC with relay output electronic insert FEI54

Power supply

- Supply voltage:
  - 19 to 253 V_{AC} 50 to 60 Hz
  - 19 to 55 V_{DC}
- Power consumption: 1.6 W
- Reverse polarity protection: yes
- Separation voltage: 3.7 kV
- Overvoltage category: II

Electrical connection

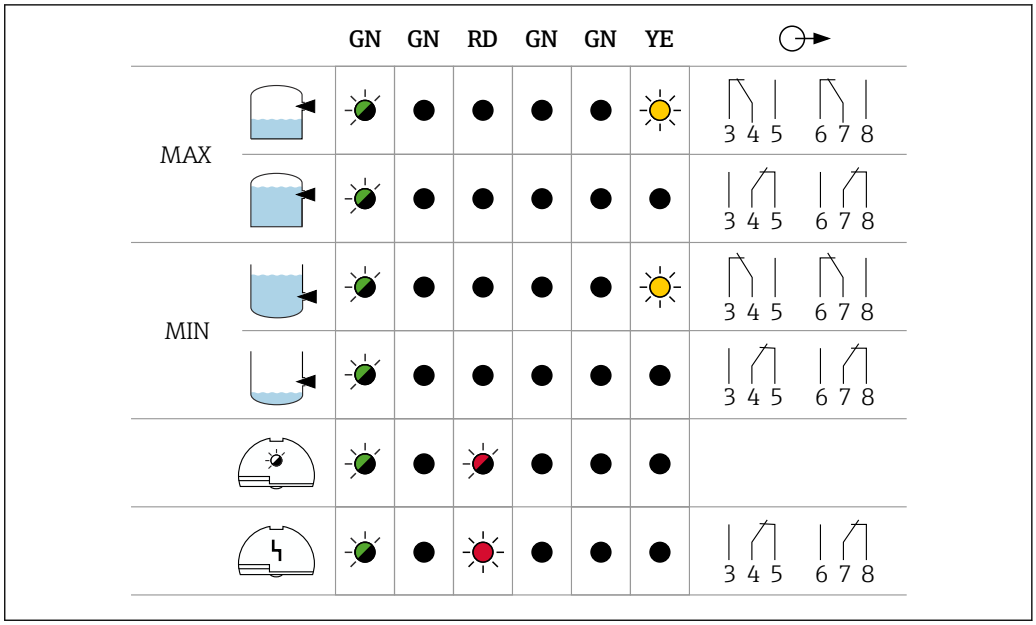
Please note the different voltage ranges for AC and DC.



F Fuse 0.5 A
L1 Phase (AC) terminal
L+ The positive (DC) terminal
N Neutral (AC) terminal
L- The negative (DC) terminal
PE Grounding cable
1 Refer also to connectable load

When connecting an instrument with high inductance, provide a spark arrester to protect the relay contact. A fine-wire fuse (depending on the load connected) protects the relay contact on short-circuiting. Both relay contacts switch simultaneously.

Output signal



Signal on alarm

Output signal on power failure or in the event of device failure: relay de-energized

Connectable load

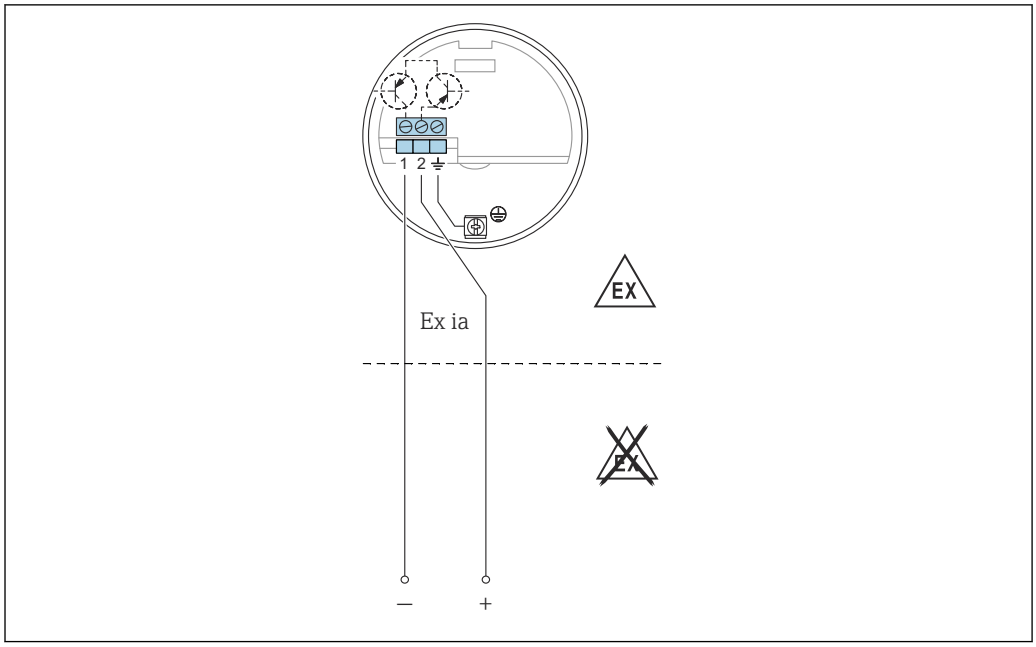
- Loads switched via 2 floating changeover contacts (DPDT)
- maximum values (AC):
  - I_{max} = 6 A
  - U_{max} = 253 V_{AC}
  - P_{max} = 1 500 VA at cosφ = 1
  - P_{max} = 750 VA at cosφ > 0.7
- maximum values (DC):
  - I_{max} = 6 A at 30 V_{DC}
  - I_{max} = 0.2 A at 125 V_{DC}
- The following applies when connecting a functional low-voltage circuit with double isolation as per IEC 1010:
  sum of voltages of relay output and power supply maximum 300 V

SIL2 / SIL3 electronic insert FEI55

Power supply

- Supply voltage: 11 to 36 V_{DC}
- Power consumption: < 600 mW
- Reverse polarity protection: yes
- Separation voltage: 0.5 kV

Electrical connection

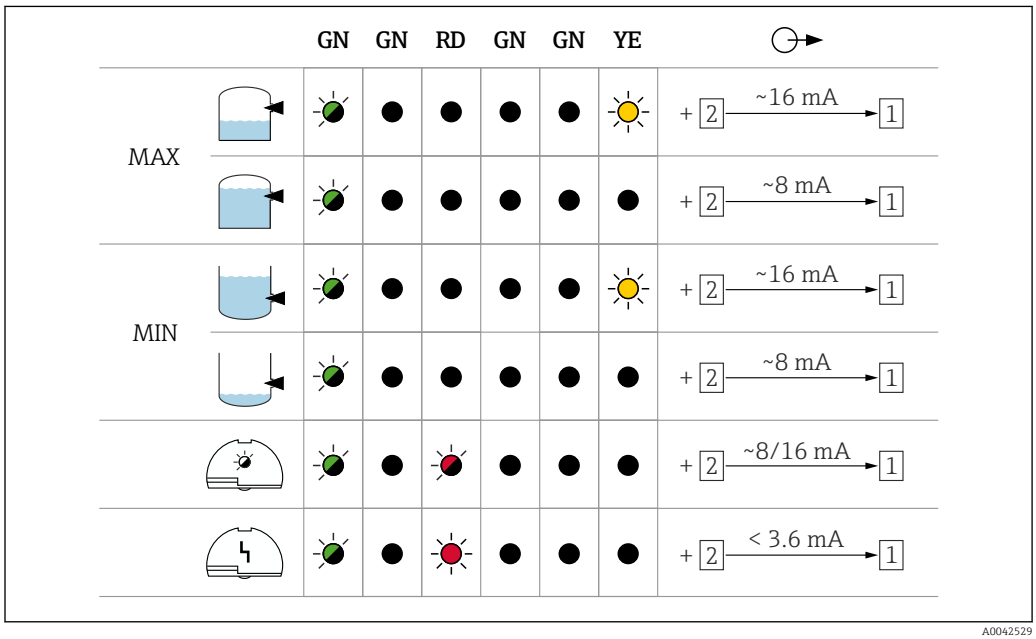


A0042391

Connect the insert to programmable logic controllers (PLC), AI modules 4 to 20 mA in accordance with EN 61131-2.

The point level signal is sent via an output signal jump from 8 to 16 mA.

Output signal



A0042529

Signal on alarm

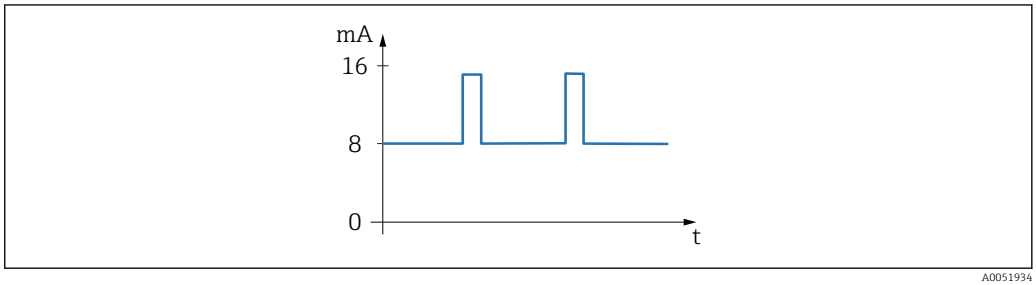
Output signal on power failure or in the event of device failure: < 3.6 mA

Connectable load

- U:
  - 11 to 36 V_{DC} for non-hazardous area and Ex ia
  - 14.4 to 30 V_{DC} for Ex d
- I_{max} = 16 mA

PFM electronic insert FEI57S

Power supply

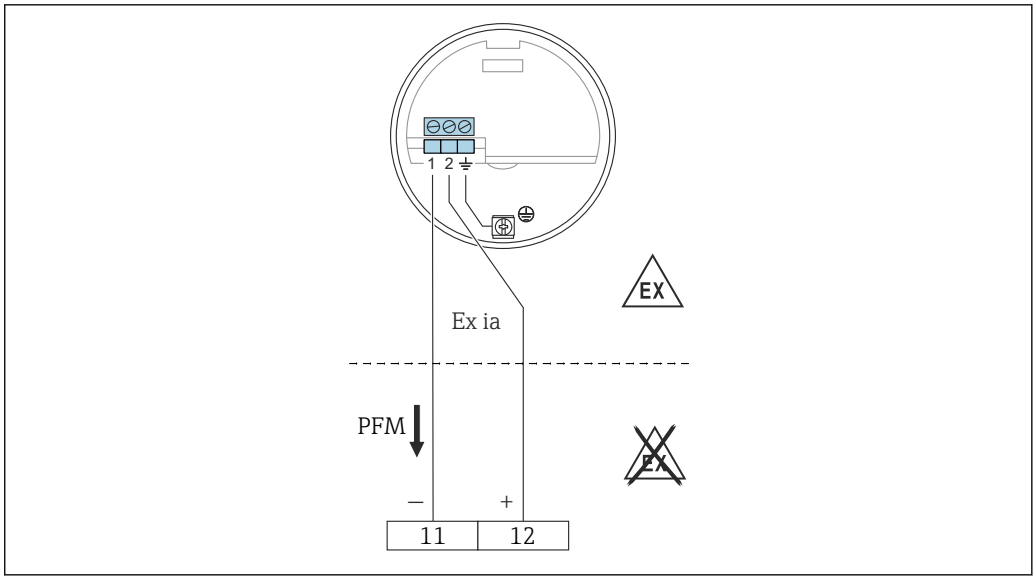


A0051934

23 *PFM signal with frequency 17 to 185 Hz*

- Supply voltage: 9.5 to 12.5 V_{DC}
- Power consumption: < 150 mW
- Reverse polarity protection: yes
- Separation voltage: 0.5 kV

Electrical connection



A0050141

11 *The negative terminal in Nivotester FTC325*
12 *The positive terminal in Nivotester FTC325*

For connecting to switching units Nivotester FTC325 and FTL325P from Endress+Hauser.

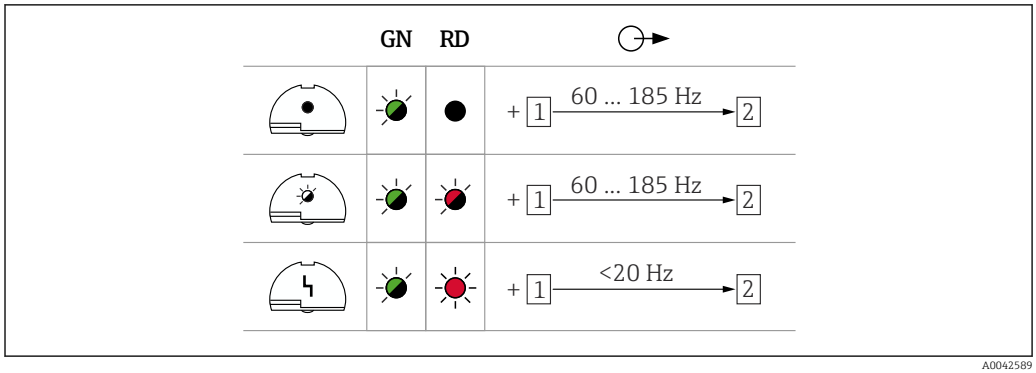
PFM signal 17 to 185 Hz.

Switching between minimum and maximum safety in the Nivotester.

Output signal

PFM 60 to 185 Hz.

Signal on alarm



A0042589

Connectable load

- Floating relay contacts in the connected switching unit Nivotester: FTC325 PFM
- For the contact load capacity, refer to the technical data of the switching device.

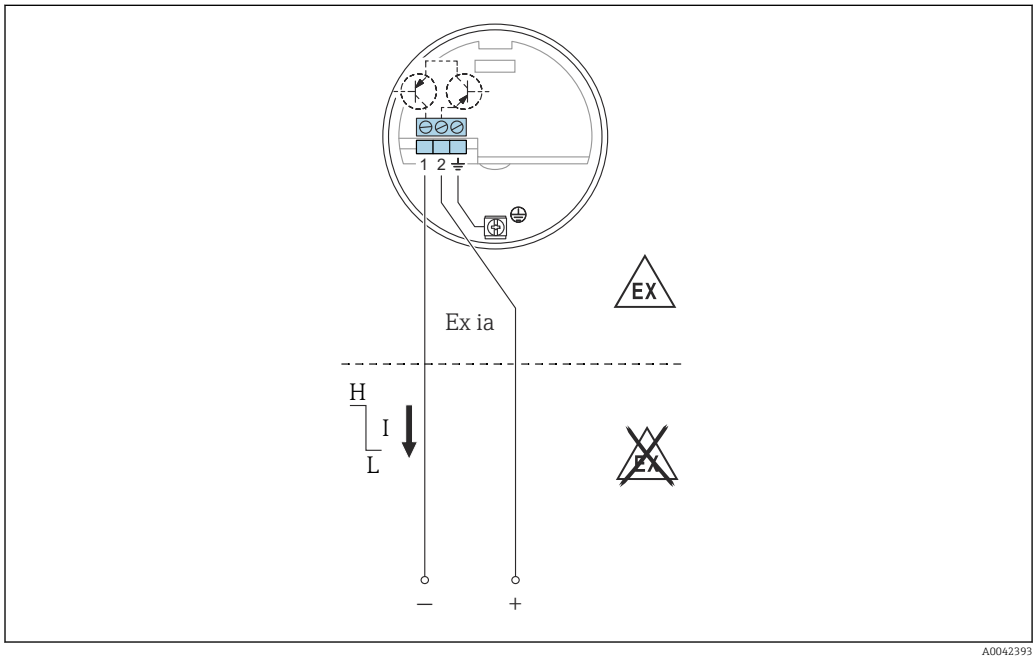
NAMUR electronic insert FEI58

Power supply

- Power consumption:
  - < 6 mW at I < 1 mA
  - < 38 mW at I = 2.2 to 4 mA
- Interface connection data: IEC 60947-5-6

Electrical connection

In the case of Ex-d operation, the additional function can only be used if the housing is not exposed to an explosive atmosphere.



A0042393

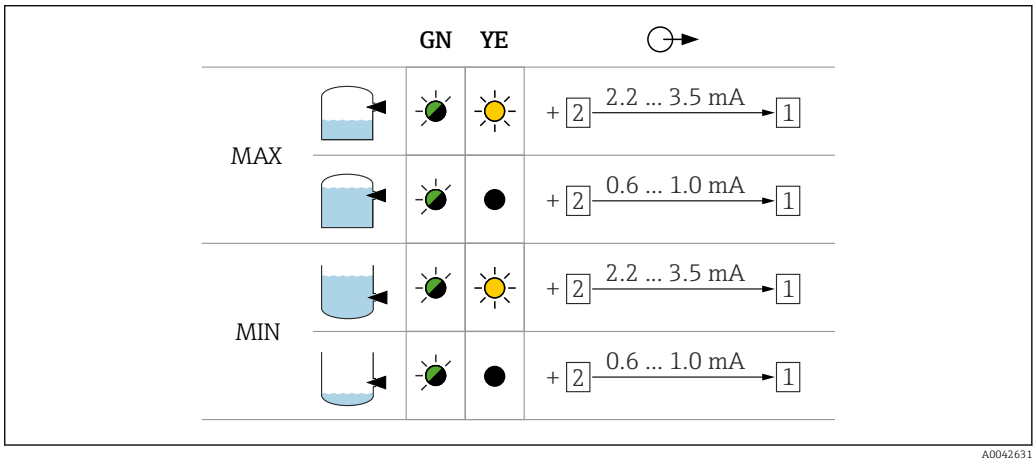
24 Terminals must be connected to isolating amplifier (NAMUR) IEC 60947-5-6

For connecting to isolating amplifiers as per NAMUR (IEC 60947-5-6), e.g. Nivotester FTL325N from Endress+Hauser. Change in output signal from high to low current in event of point level detection.

Additional function:
Test key on the electronic insert. Pressing the key interrupts the connection to the isolating amplifier.

Connection to Multiplexer:
Set 3 s as the cycle time at least.

Output signal



Signal on alarm

Output signal in the event of damage to the sensor: < 1.0 mA

Connectable load

- The technical data of the connected isolating amplifier as per IEC 60947-5-6 (NAMUR).
- Connection also to isolating amplifiers which have special safety circuits I > 3.0 mA.

Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

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

Other certificates and approvals for the product are available under https://www.endress.com-> Downloads.

Ordering information

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

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

The **Configuration** button opens the Product Configurator.

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.

Accessories

Protective cover

Protective cover for F13, F17 and F27 housing (without display)
order number: 71040497

Protective cover for F16 housing
order number: 71127760

Seal set for stainless steel housing

Seal set for stainless steel housing F15 with 5 sealing rings
Part number: 52028179

Surge arresters

HAW562

- For supply lines: BA00302K.
- For signal lines: BA00303K.

HAW569

- For signal lines in field housing: BA00304K.
- For signal or supply lines in field housing: BA00305K.

Technical information

Nivotester FTC325

TI00380F

Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

Document function

The following documentation may be available depending on the version ordered:

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid for your device** The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	**Guide that takes you quickly to the 1st measured value** The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	**Your reference document** The Operating Instructions contain all the information that is required in the various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	**Reference for your parameters** The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Safety Instructions (XA)	Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. The Safety Instructions are an integral part of the Operating Instructions. Information on the Safety Instructions (XA) relevant to the device is provided on the nameplate.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the device documentation.

www.addresses.endress.com

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