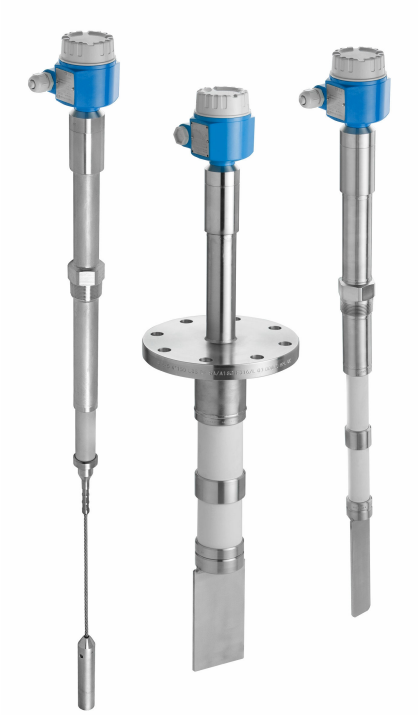
TI01561F/00/EN/02.24-00
71673389
2024-09-05

Technical Information
Solicap S
FTI77

Capacitance



Robust point level switch for applications with bulk solids and very high temperatures

Application

For applications with very high lateral loads (up to 800 Nm for sword version) and in applications with abrasive media.

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

Benefits

- Highest safety and reliability due to 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
- Cost-effective, reliable and universal application thanks to wide range of certificates and approvals
- Two-stage overvoltage protection against static discharges from the silo
- Active build-up compensation for bulk solids with caking tendency
- Use in safety systems requiring functional safety to SIL2/SIL3
- Reduction in storage costs thanks to easy-to-shorten sword model and rope model

Endress+Hauser
People for Process Automation

Table of contents

Document information

Symbols

Safety symbols

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

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

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

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

Electrical symbols


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

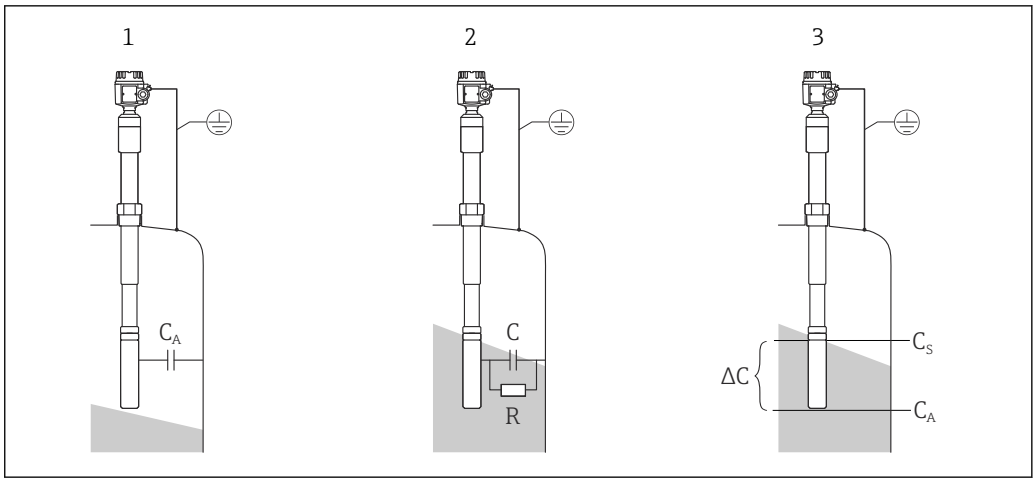
→ Safety instructions
Observe the safety instructions contained in the associated Operating Instructions

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.



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

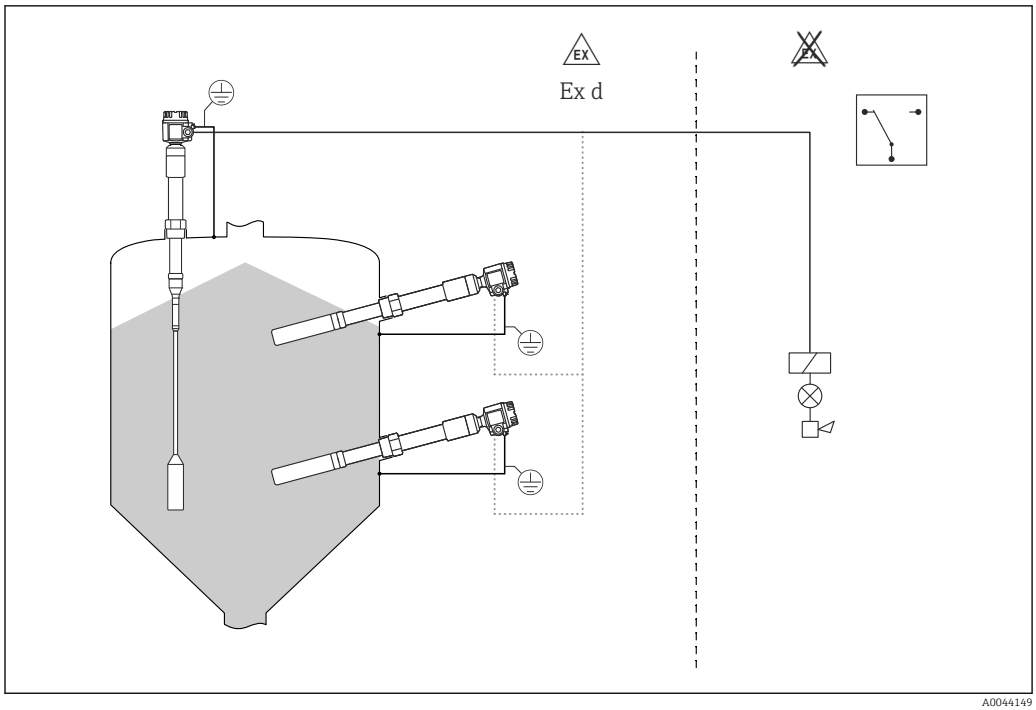
The probe is dedicated for all bulk solids with a relative dielectric constant $\varepsilon_r \geq 2.5$, like:
- fly ash
- sand
- glass aggregate
- gravel
- molding sand
- lime
- crushed ore
- plaster
- aluminium shravings
- cement
- grain
- pumice
- dolomite
- kaolin and similar bulk solids

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 S FTI77 and the electronic insert FEI51, FEI52 or FEI54.

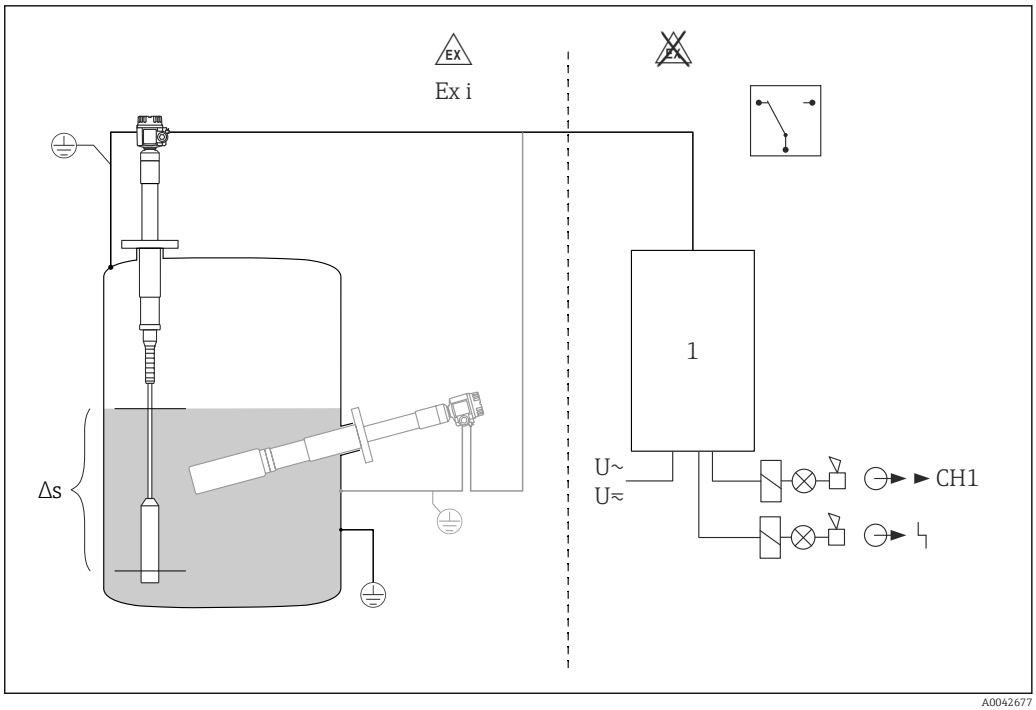


2 Probes as a point level switch

Point level switch and separate switching unit

The Solicap S FTI77 can be used as sensor for the separate switching unit.

The complete measuring system consists of:
- the point level switch Solicap S FTI77
- the electronic insert: , FEI57S or FEI58
  - FEI53 - non Ex areas
  - FEI57S - Ex i areas
  - FEI58 - Ex i areas
- a transmitter power supply unit e.g. FTC325, FTL325N



3 Probe as two-point control switch

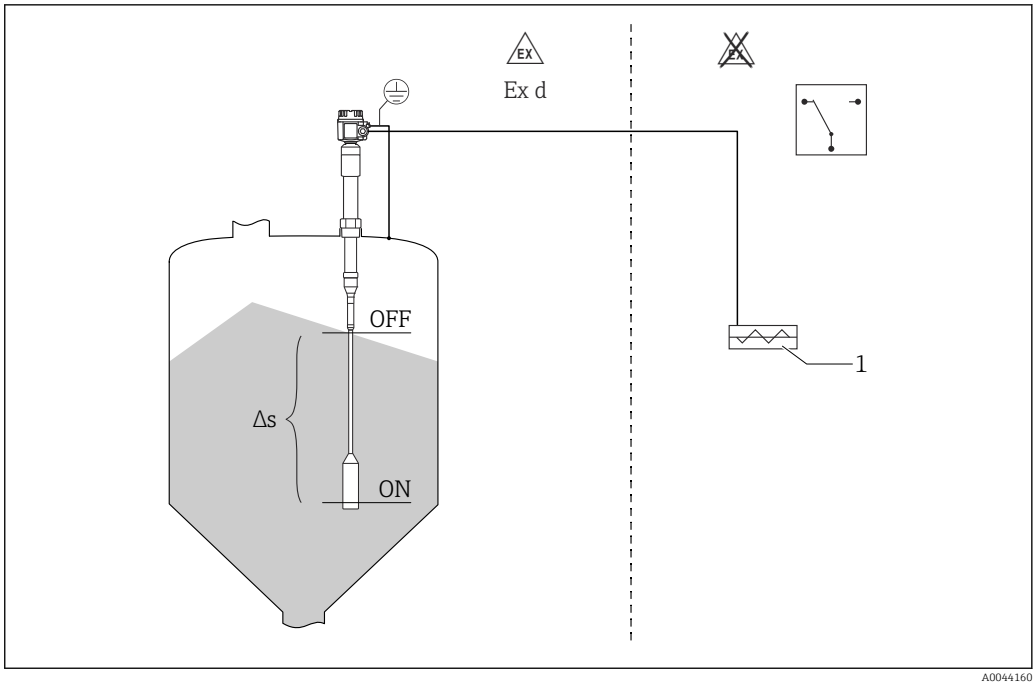
1 The transmitter power supply unit
Δs Two-point control

The electronic insert and transmitter power supply compatibility
FEI53, FEI57S, FEI58: FTC325

Two-point control - Δs function

Use only in conjunction with non-conductive bulk solids.

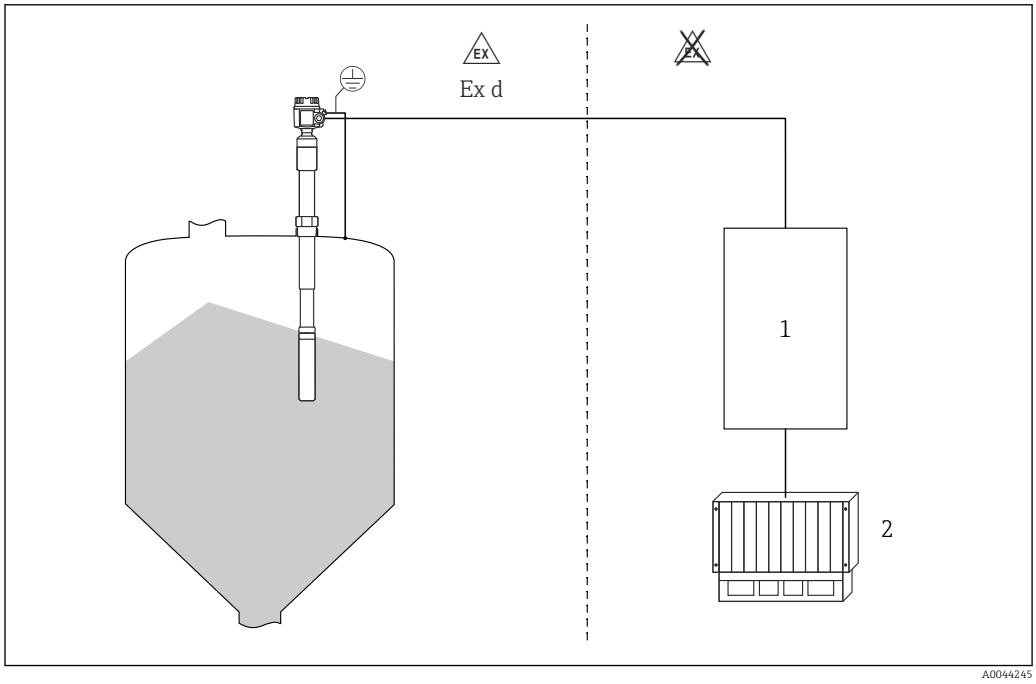
The point level switch can also be used to control a screw conveyor where the on and off values can be freely defined.



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 S FTI77
- the FEI55 electronic insert
- the transmitter power supply unit, e.g. RMA42



4 *Probe as point level swich*

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
- 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

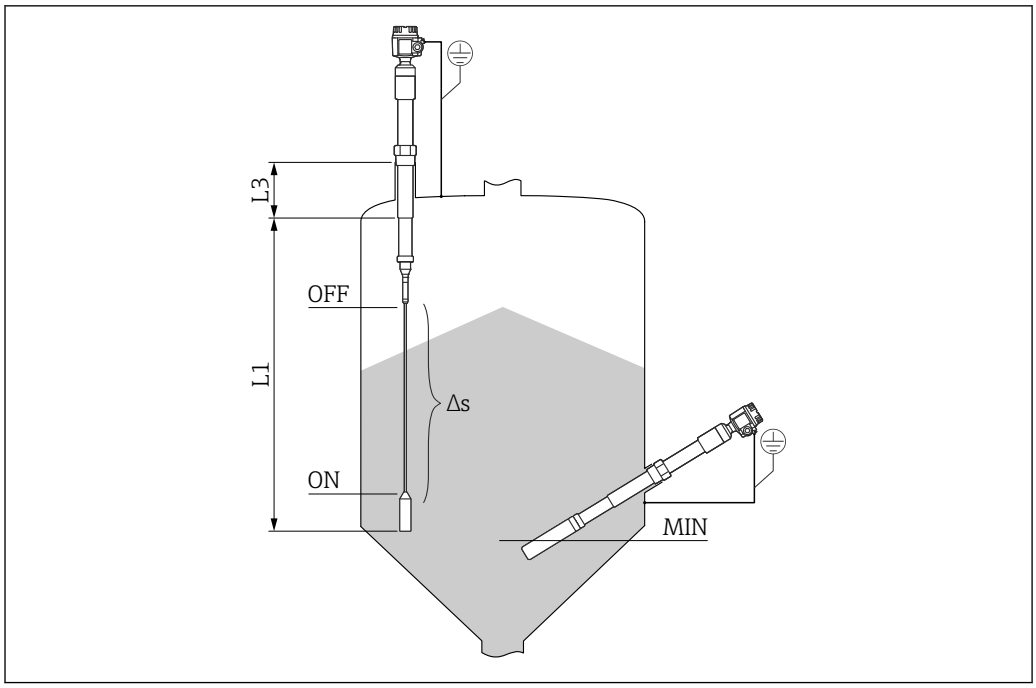
Probe not covered -> low capacitance

Measuring conditions

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



A0042687

5 Measuring conditions

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

Minimum probe length for nonconductive media < 1 µS/cm

The minimum probe length can be calculated using the formula:

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

A0040204

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].

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

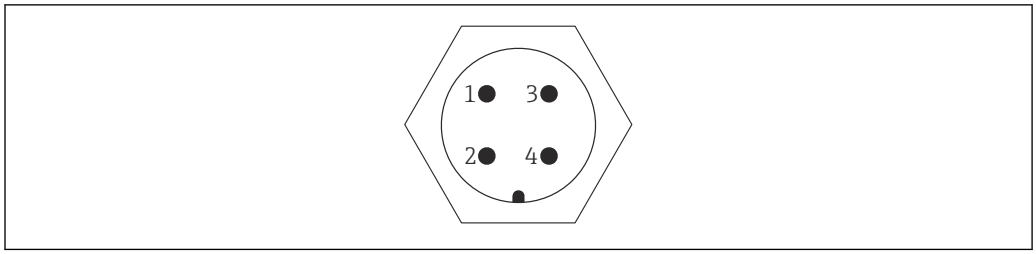
Ex d protection, Gas-tight process seal
- aluminum housing F13 with gas-tight process seal
- stainless steel housing F27 with gas-tight process seal
- aluminum housing T13 with a separate connection compartment

Connector

In the case of the versions with a connector (M12 or 7/8"), the housing does not have to be opened to connect the signal cable.

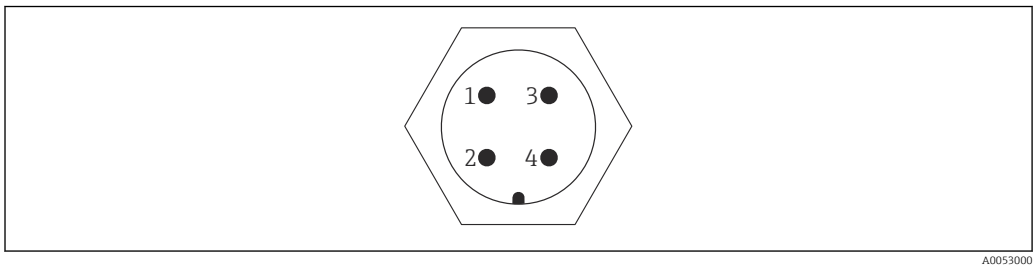
1) For FEI53 and FEI57S only on the associated Nivotester: FTC325.
2) E.g. for dry running protection and pump protection.
3) E.g. for use with overfill protection.
4) Functional galvanic isolation in the electronic insert.

PIN assignment for M12 connector (PROFIBUS PA standard, HART)



6 FEI52, FEI53

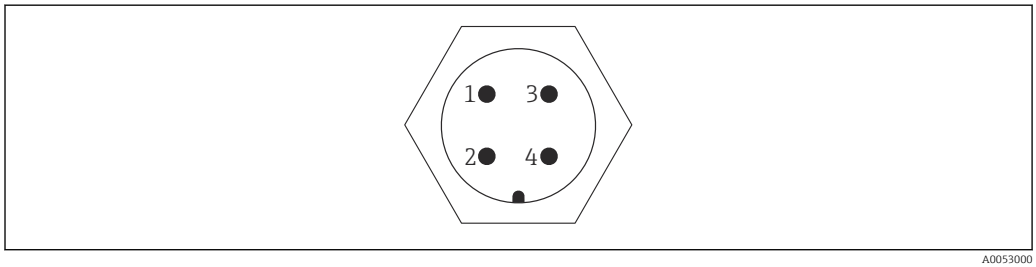
1 External load / voltage output
2 Not assigned
3 Signal –
4 Signal +



7 FEI55, FEI57S, FEI58

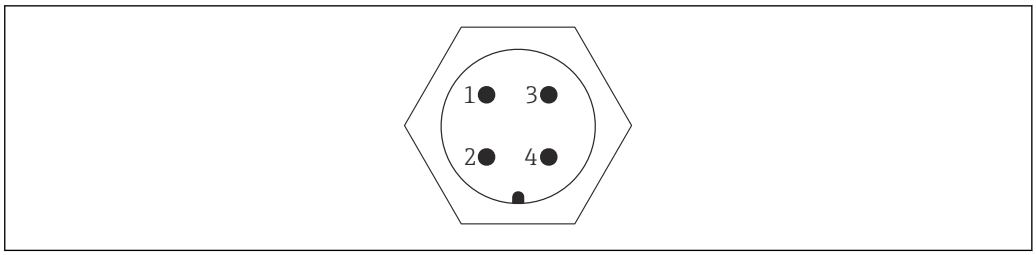
1 Not assigned
2 Not assigned
3 Signal –
4 Signal +

PIN assignment for the 7/8" connector (Fieldbus FOUNDATION standard, HART)



8 FEI52, FEI53

1 Signal –
2 Signal +
3 External load / voltage output
4 Ground



9 *FEI55, FEI57S, FEI58*

1 *Signal –*
2 *Signal +*
3 *Not assigned*
4 *Ground*

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

Room temperature: 20 °C (68 °F), ±5 °C (±8 °F)

Span
- Standard measuring range: 5 to 500 pF
- Extended measuring range: 5 to 1 600 pF
- Span for reference: 5 to 250 pF

Accordance to DIN 61298-2
- Uncertainty: maximum ±0.3 %
- Non-repeatability: maximum ±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

Input signal

Probe covered => high capacitance

Probe not covered => low capacitance

Installation

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

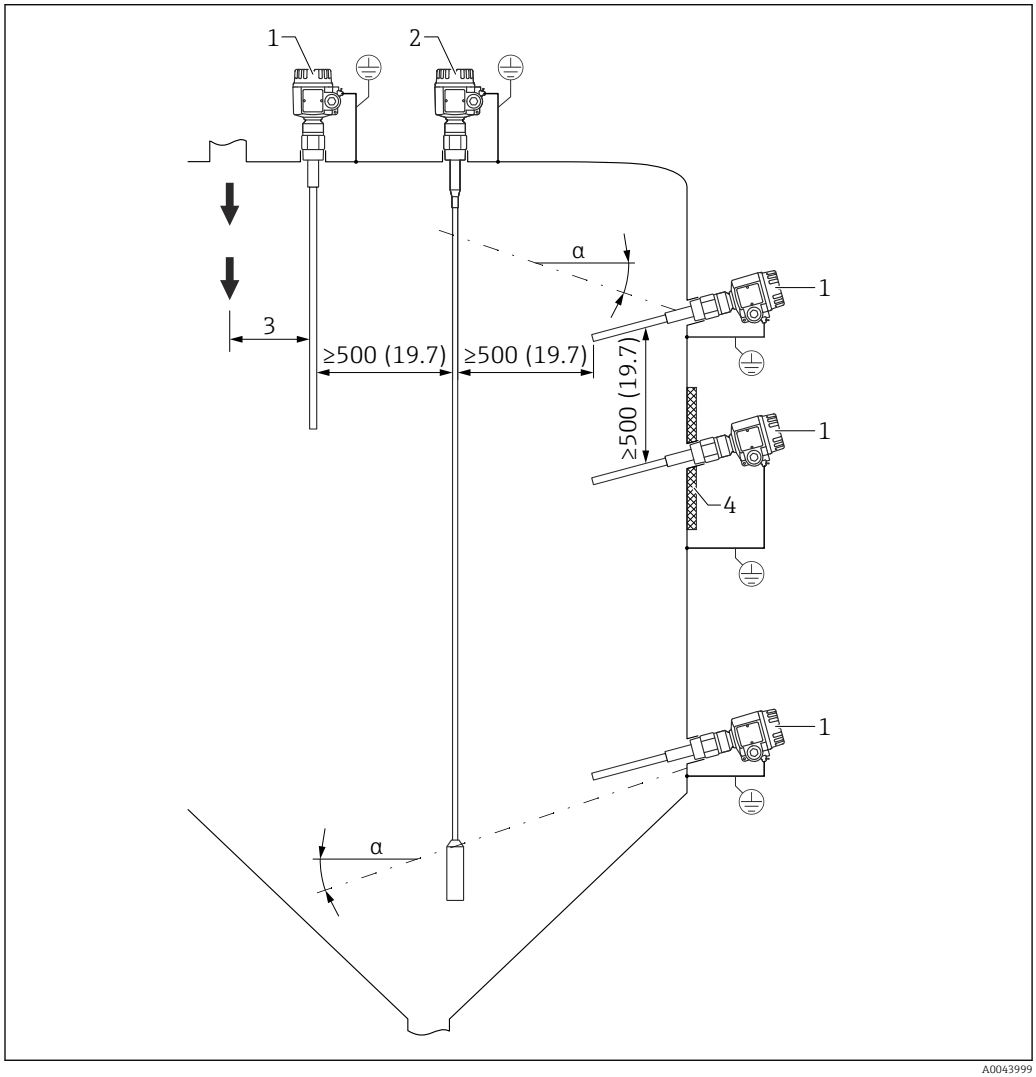
Threaded coupling for mounting.

- 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.



10 *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 location

Mounting the sensor

The Solicap S FTI77 with the sword probe can be installed in vertical or horizontal position.

The Solicap S FTI77 with rope probe can be installed only in vertical position.

NOTICE

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

▶ Mount the probe away from the loading curtain.

NOTICE

Mouting the sword probe in pararel position can cause a incorrect device operation!

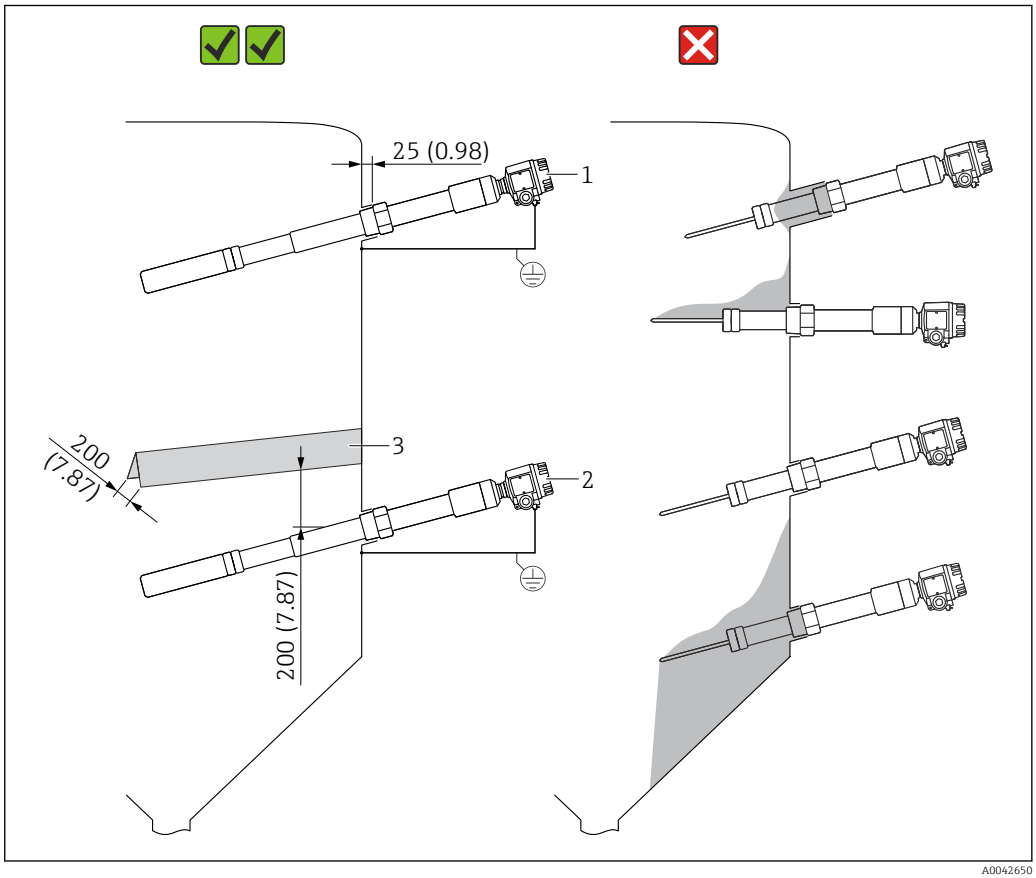
▶ Mount the sword probe with the narrow edge position upwards.

NOTICE

The probe cannot touch the metal container wall!

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

- To determine the mounting location and the probe lenght, observe the expected angle of the material flow or of the outlet funnel.
- The threaded coupling should be as short as possible. Condensation or product residue may occur in a long threaded coupling and interfere with the correct operation of the probe.
- In the case of high temperatures in the silo, insulate the silo wall to avoid exceeding the temperature the probe housing. The heat insulation also prevents condensation and reduces buildup from forming near the threaded boss in the silo.



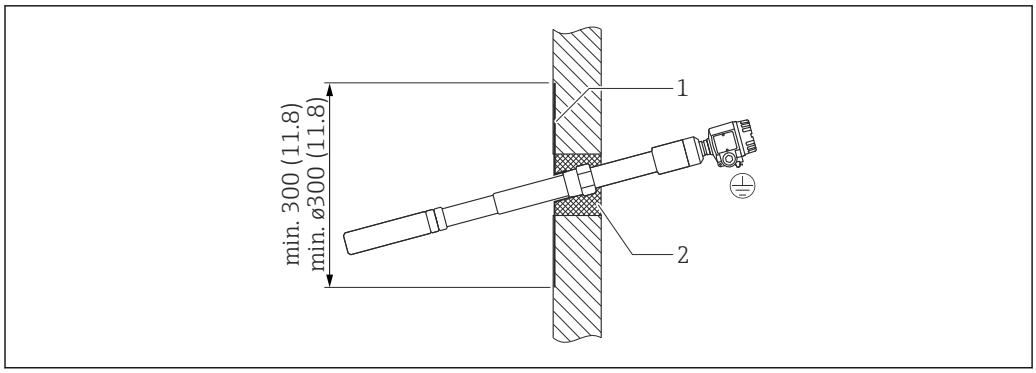
11 *Side mounting examples. Unit of measurement mm (in)*

1 *For maximum level limit detection*
2 *For minimum point level detection*
3 *The protective cover protects the probe sword from collapsing mounds or mechanical strain at the outflow.*

Mounting the sword probe FTI77

Mounting the probe in a silo with concrete walls

The grounded steel plate forms the counter electrode. The heat insulation prevents condensation and therefore buildup on the steel plate.



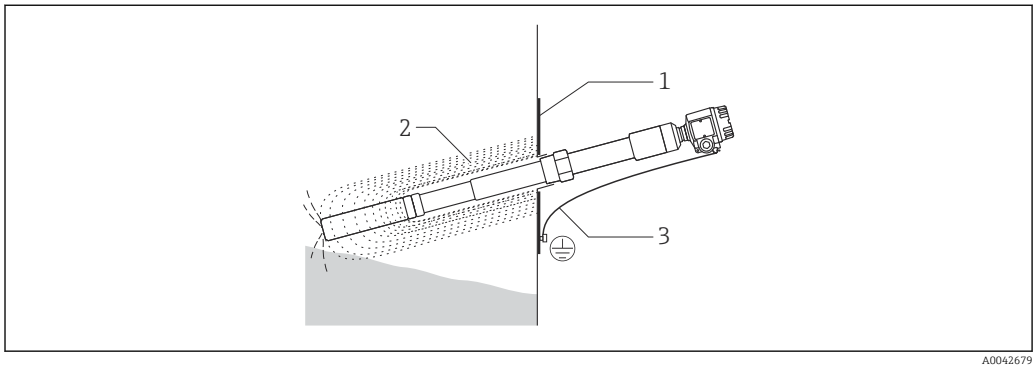
12 Probe mounted in a concrete wall. Unit of measurement mm (in)

1 Sheet metal plate with threaded socket
2 Heat insulation

Installing the probe in a silo with plastic walls

When the probe is installed in the silo with plasic walls, a sheet metal plate must be attached to the exterior of the silo as a couters electrode. The plate can be in square or round shape.

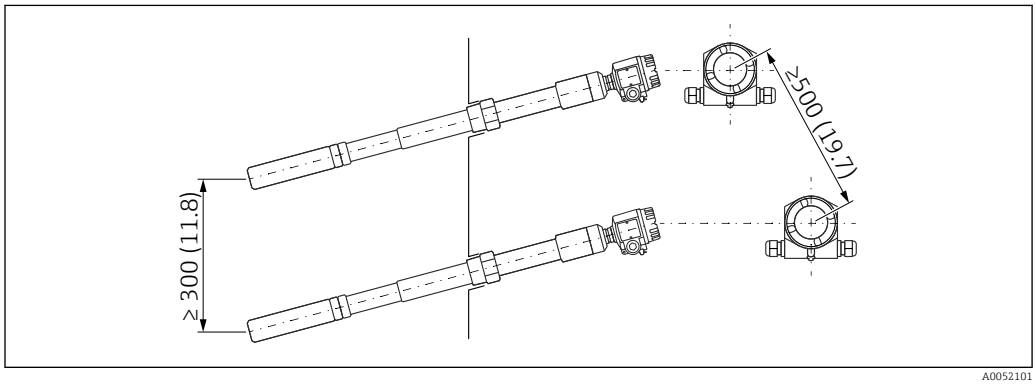
The dimentions of the plate are:
- approximately square of 500 mm (19.7 in) each side or round Ø500 mm (19.7 in) for thin wall with low dielectric constant
- approximately square of 700 mm (27.6 in) each side or round Ø700 mm (27.6 in) for thick wall with high dielectric constant



13 Probe monted in a plastic wall

1 Sheet metal plate
2 Electrical HF field
3 Ground connection

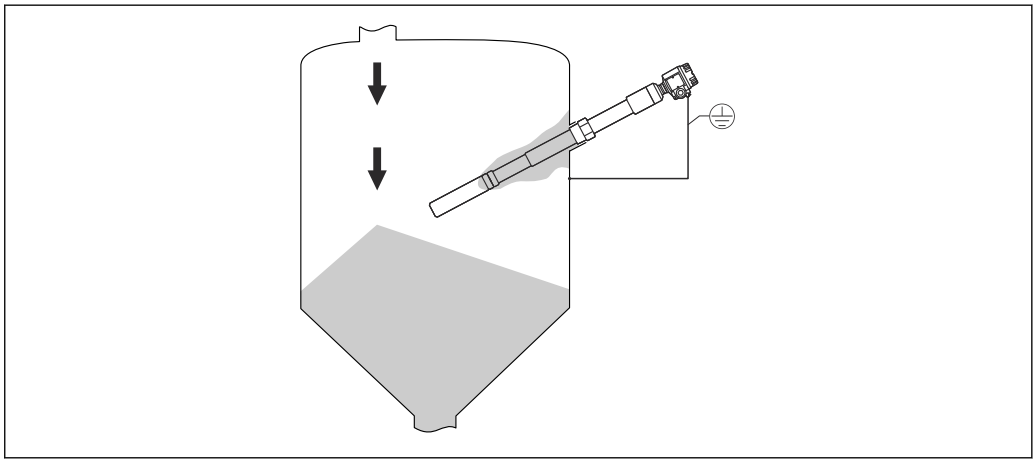
The required minimum distances can be achieved by offset installation.



14 For small differences in level

Active buildup compensation

To prevent the measurement distortions coming from the material buildup on the sword probe, use the active buildup compensation function. The cleaning of the sword is not necessary anymore.

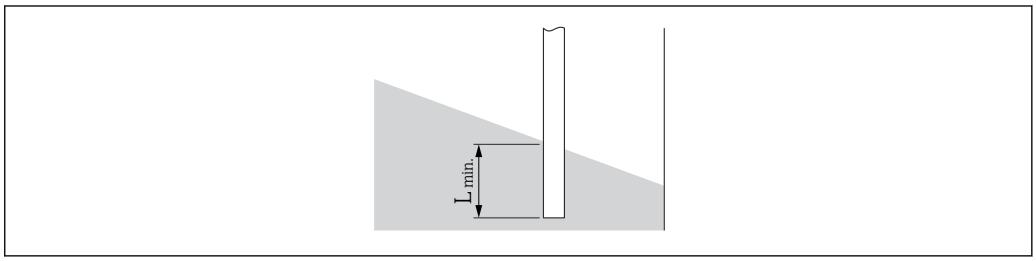


A0042684

15 *Material biuldup on the probe*

Probe length and minimum coverage

- To ensure problem-free operation, it is important that the difference in capacitance between the covered and uncovered parts of the probe is at least 5 pF.
- If you do not know the dielectric constant of the material, contact the E+H service.



A0044003

16 *The minimum probe coverage*

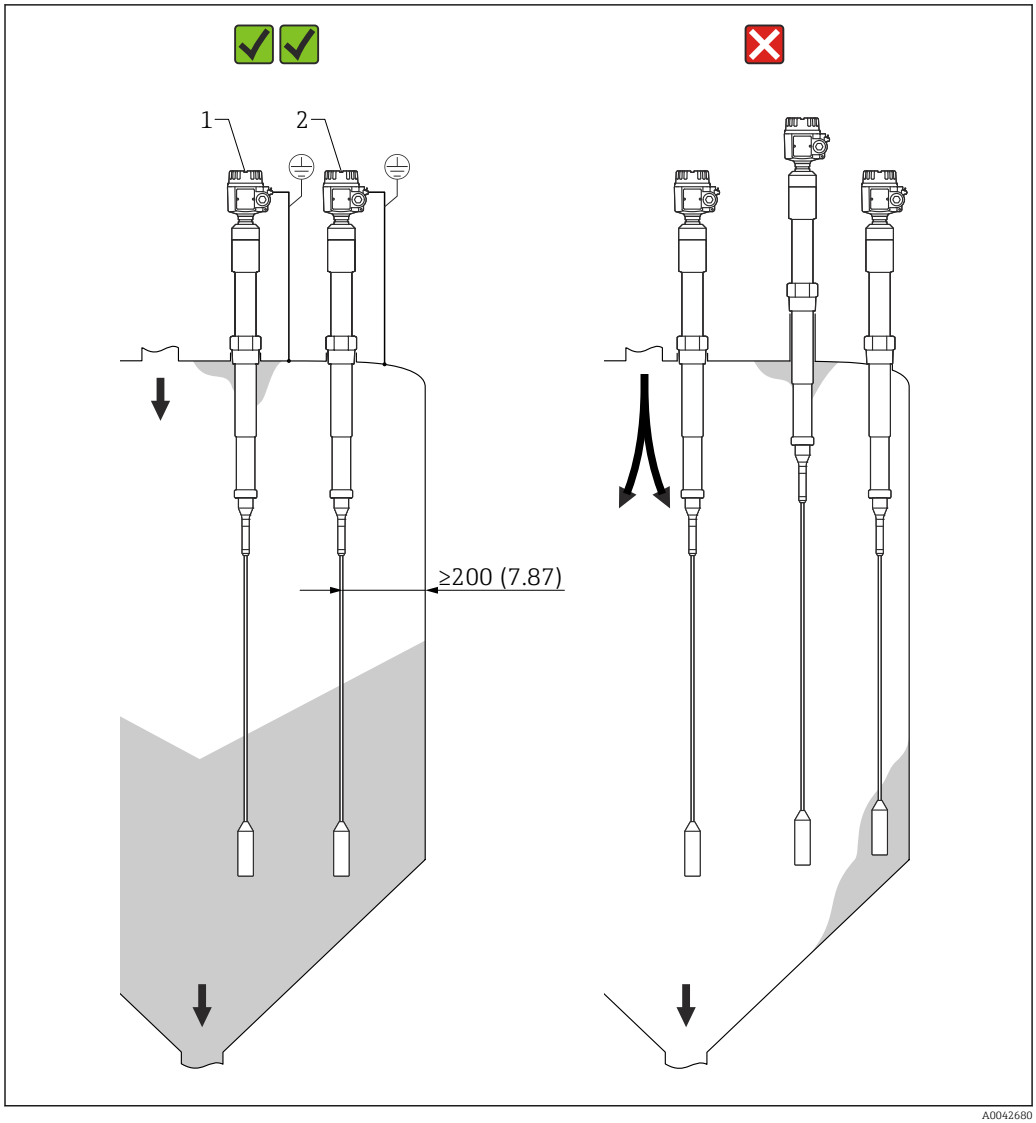
L_{min} *Minimum coverage of the probe*

Pay attention to the dependency between the relative dielectric constant ε_r and the minimum amount the probe rod that needs to be covered.

Minimum lenght of the probe rod (L_{min}) that needs to be covered

- 25 mm (0.98 in) for electrically conductive product
- 100 mm (3.94 in) for nonconductive product $\varepsilon_r > 10$
- 200 mm (7.87 in) for nonconductive product $\varepsilon_r > 5$ to 10
- 500 mm (19.7 in) for nonconductive product $\varepsilon_r > 2$ to 5

Mounting the rope probe FTI77



17 *The rope probe mounting examples*

1 *FTI77 with inactive length in the event of condensation and material buildup on the silo roof*
2 *FTI77 mounted at correct distance from the silo wall, the material inlet and the material outlet*

Mounting of the probe in the silo roof

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

Abrasive bulk solids

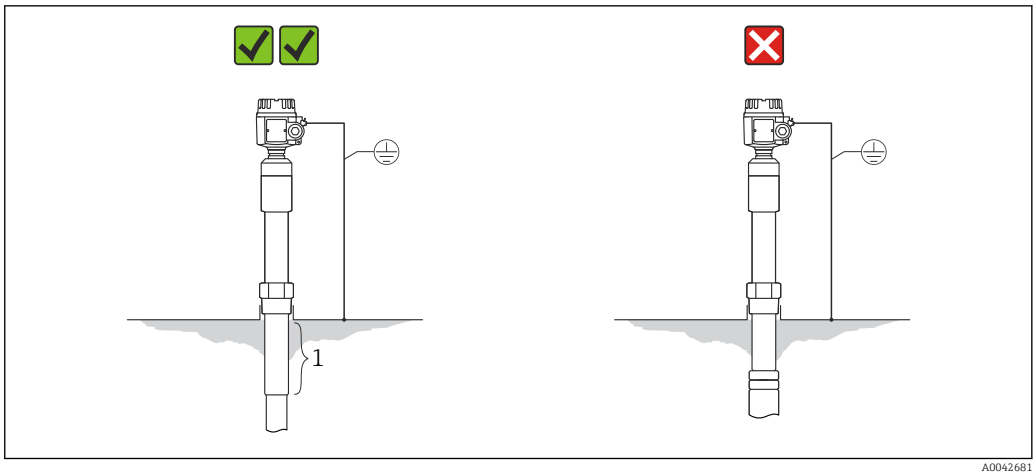
In silos with extremely abrasive bulk solids, use Solicap S FTI77 only for maximum detection.

Distance between the rope probes

The minimum distance between the rope probes is 500 mm (19.7 in). This also applies when installing several Solicap S units in adjacent silos with nonconductive walls.

Mounting probe in the event of condensation

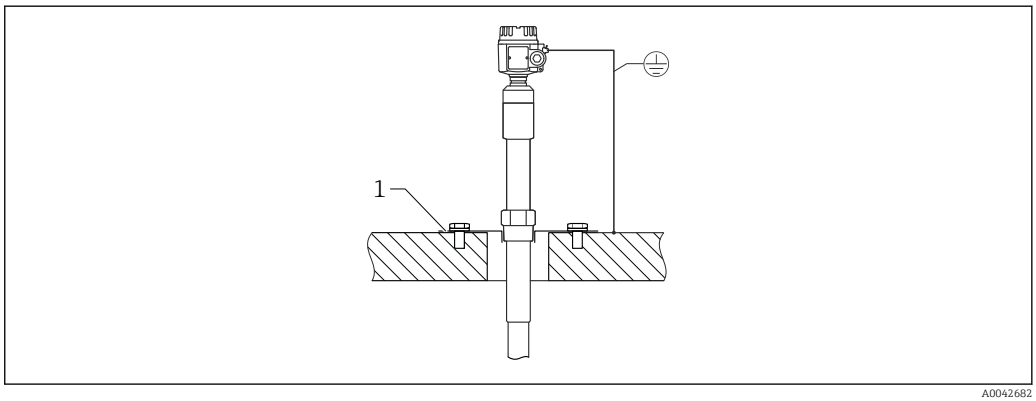
In the event of condensation use only probes with inactive lenght. The inactive length prevents moisture and buildup forming between the active part of the probe and the silo roof.



18 *Silo with conducting walls*

1 Inactive length

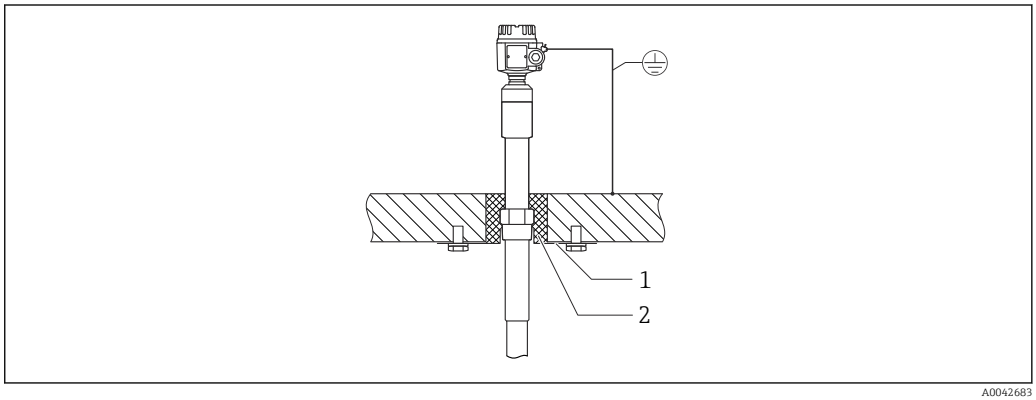
To reduce the effects of condensation and buildup, the threaded coupling must project into the silo. Maximum lenght of the threaded coupling is 25 mm (0.98 in).



19 *Silo with a concrete walls*

1 Steel plate connected to the reinforcing steel

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

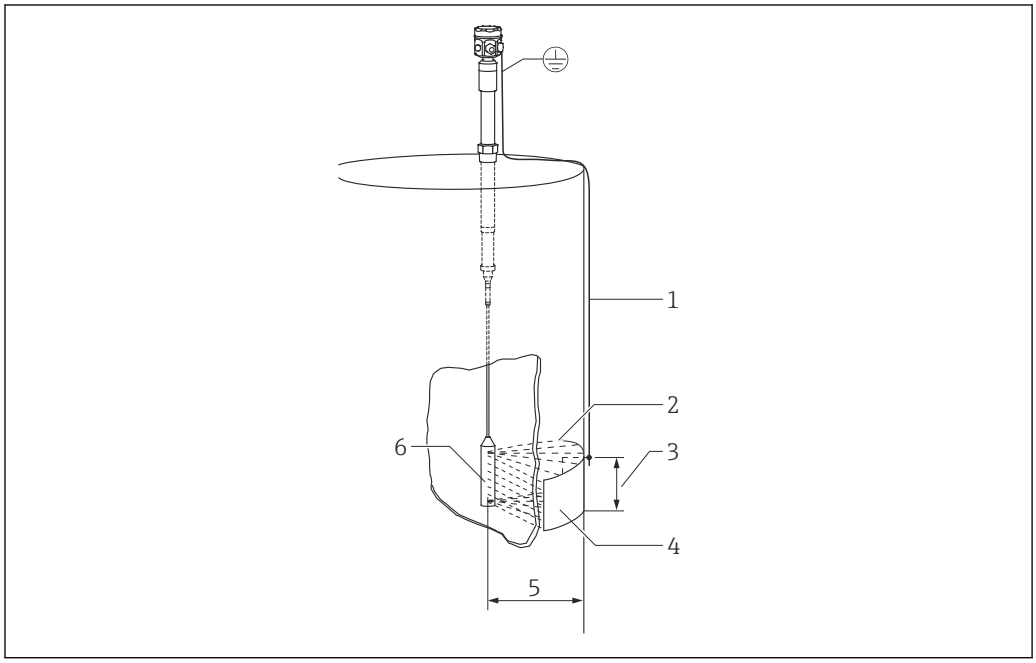


20 *Silo with a concrete walls*

1 Steel plate
2 Heat insulation

Mounting the probe in a nonconductive tank

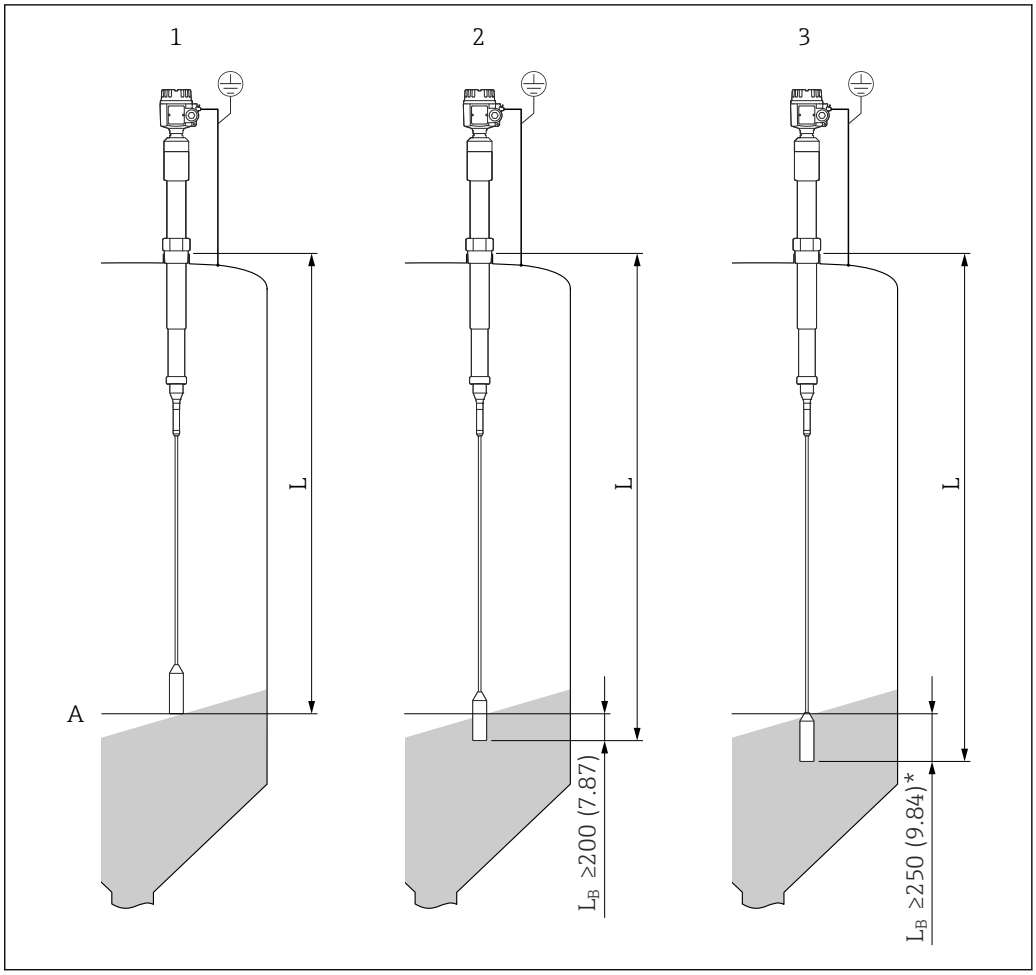
When installing in a silo made of concrete, a counter electrode must be mounted on the silo exterior at the same height as the tensioning weight. The length of the edge of the counter electrode should be approximately the same length as the distance between the tensioning weight and the silo wall.



21 Mounting the probe in plastic tanks

1 Ground connection
2 Electrical HF field
3 Surface area e.g. 1 m² (10.7 ft²)
4 Metal counter electrode
5 Distance of 1 m (3.3 ft)
6 Weight

Range of sensor lengths

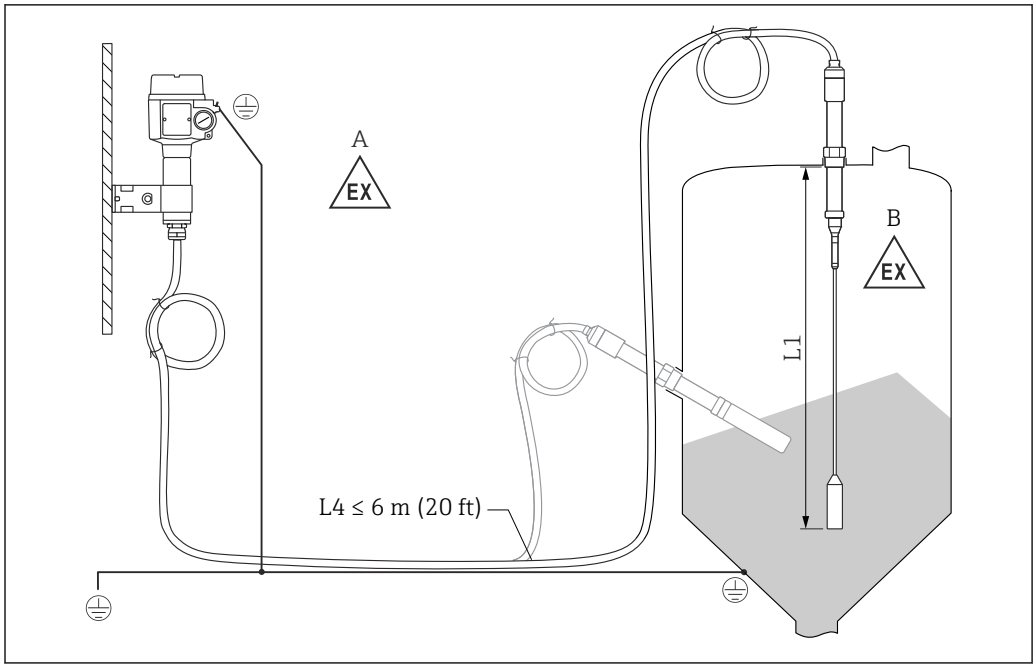


22 *Rope length in correlation with the material. Unit of measurement mm (in)*

L_B Covered length
1 Rope lenght (L) for electrically conductive bulk solids, e.g. coal
2 Rope lenght (L) for bulk solids with high dielectric constant, e.g. rock salt
3 Rope lenght (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).

Probe with separate housing



23 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

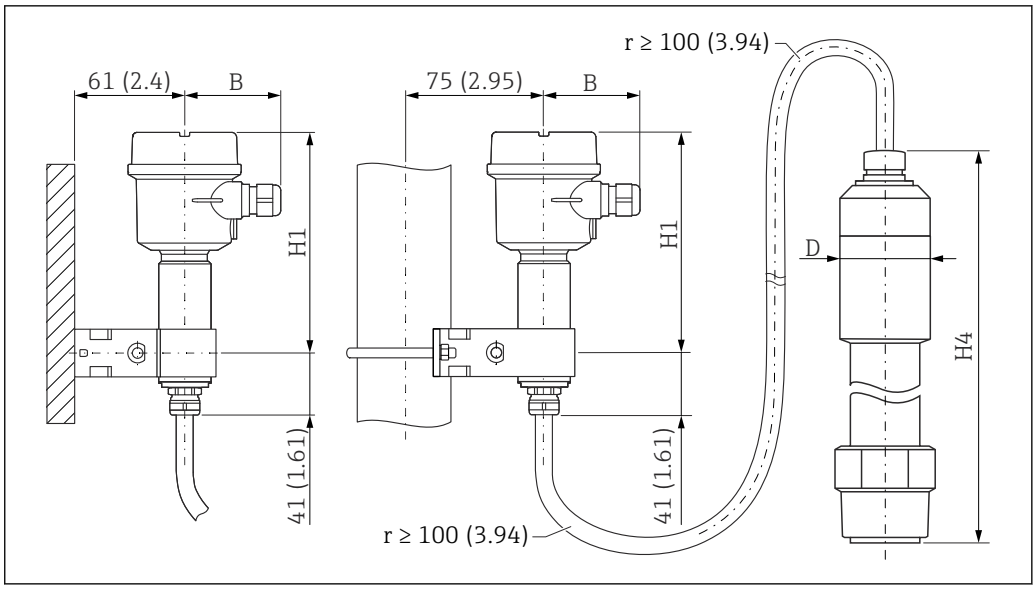
The maximum cable length L4 and rope length L1 cannot exceed 20 m (66 ft).

- 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



24 *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)

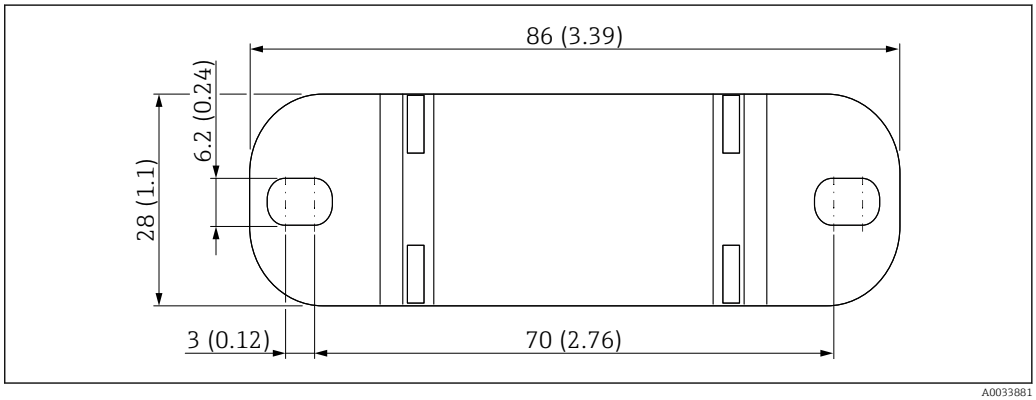
H1 parameter
- polyester housing (F16): 172 mm (6.77 in)
- stainless steel housing (F15): 166 mm (6.54 in)
- aluminum housing (F17): 177 mm (6.97 in)

D parameter
Ø50 mm (1.97 in)

H4 parameter
330 mm (13 in)

Wall bracket

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



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

5) See parameters on the drawings.

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 +58 °C (−58 to +136.4 °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

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

Cleaning

Housing

6) Only with M20 cable entry or G½ thread.

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 rod. 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 rod 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.

Process

Process temperature range

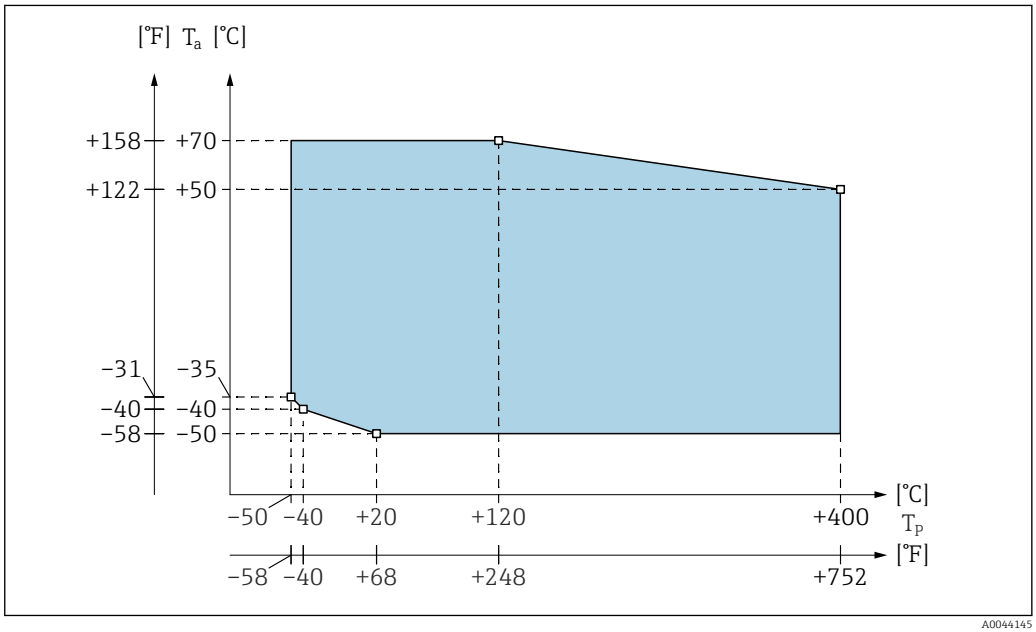
The following process temperature ranges only apply for standard applications outside hazardous areas.

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.

Compact version

Sword and rope version

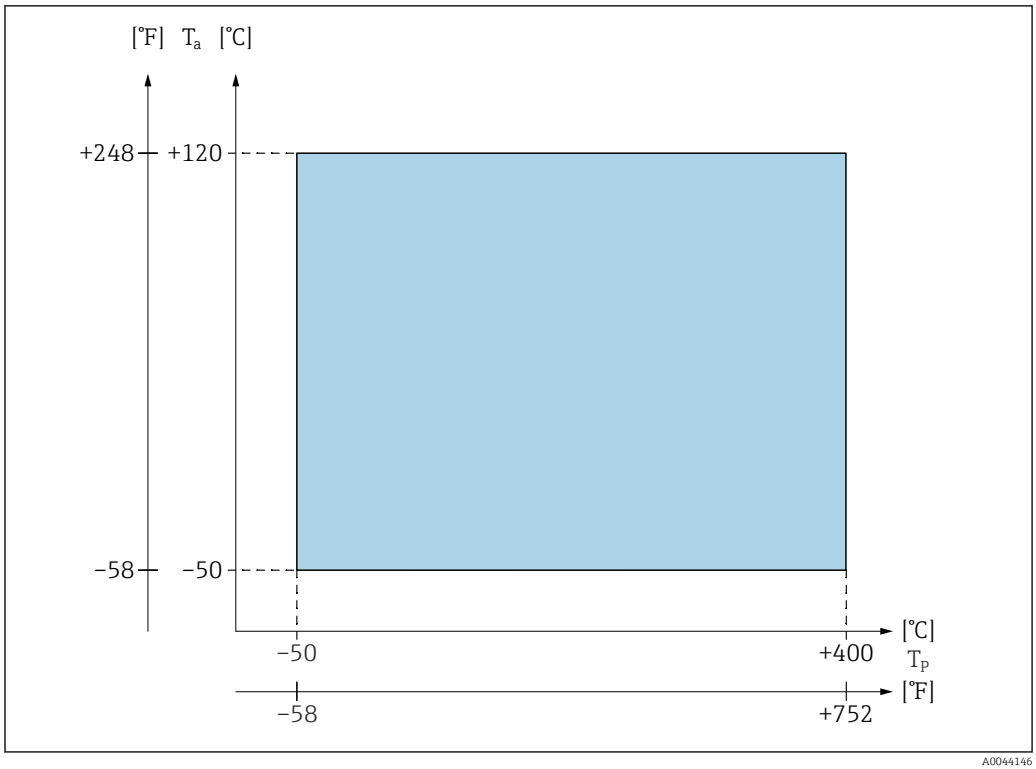


26 *Process temperature range diagram: sword and rope probe*

T_a *Ambient temperature*
T_p *Process temperature*

Version with separate housing

The temperature at separate housing: −40 °C (−40 °F) ≤ T_a ≤ +70 °C (+158 °F)



27 *Process temperature diagram: separate housing*

T_a *Ambient temperature*
T_p *Process temperature*

Process pressure range

Process pressure range is −1 to 10 bar (−14.5 to 145 psi).

The permitted pressure values depend on the flange selected. In the case of higher temperatures, the permitted pressure values can be taken from the following standards:
- pR EN 1092-1: 2005 table, Appendix G2
- ASME B 16.5a - 1998 Tab. 2-2.2 F316
- ASME B 16.5a - 1998 Tab. 2.3.8 N10276
- JIS B 2220

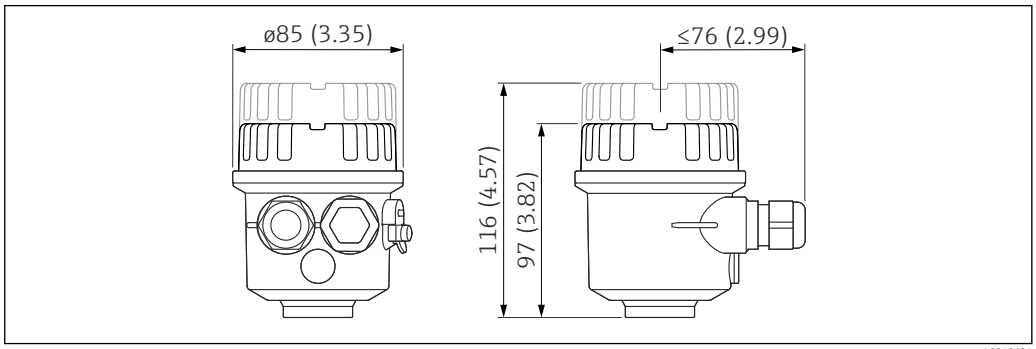
Application examples

Bulk solids with a relative dielectric constant $\varepsilon_r \geq 2.5$ as: fly ash, sand, glass aggregate, gravel, molding sand, lime, ore (crushed), plaster, aluminum shavings, cement, pumice, dolomite, kaolin and similar bulk solids.

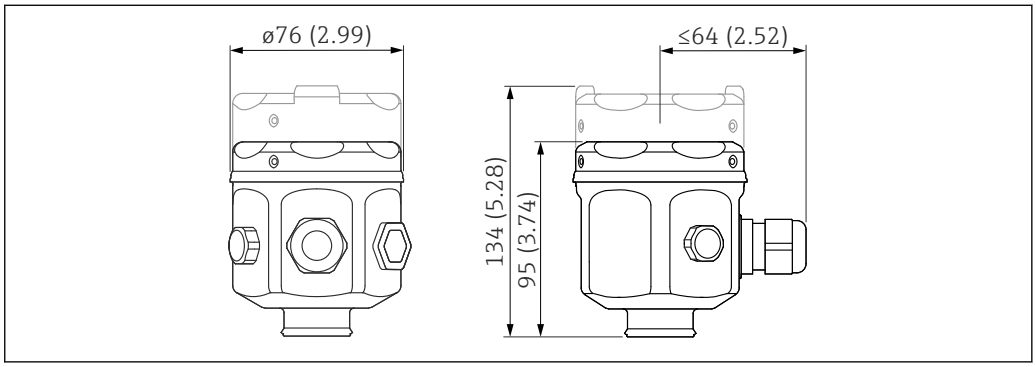
Mechanical construction

Housing

Polyester housing F16

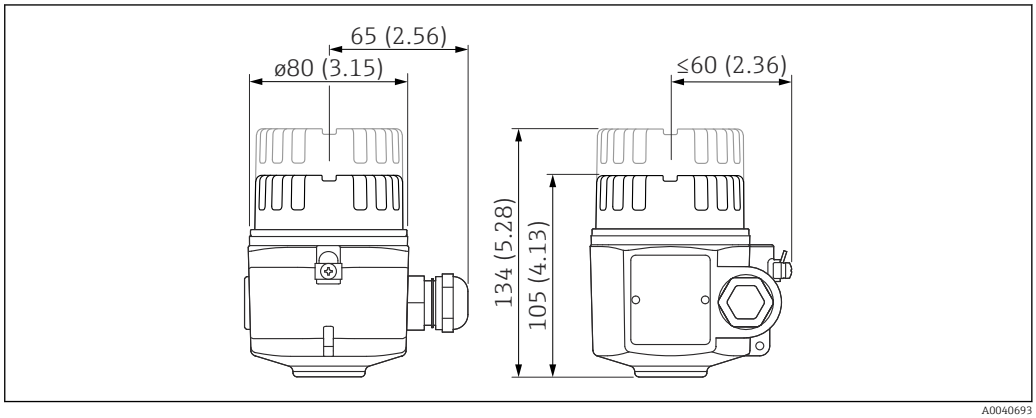


Stainless steel housing F15



Unit of measurement mm (in)

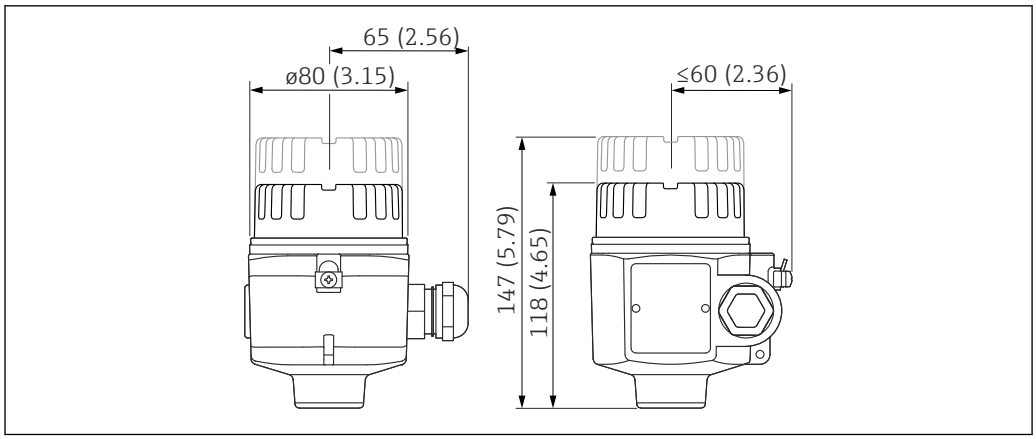
Stainless steel housing F17



Unit of measurement mm (in)

Aluminum housing F13

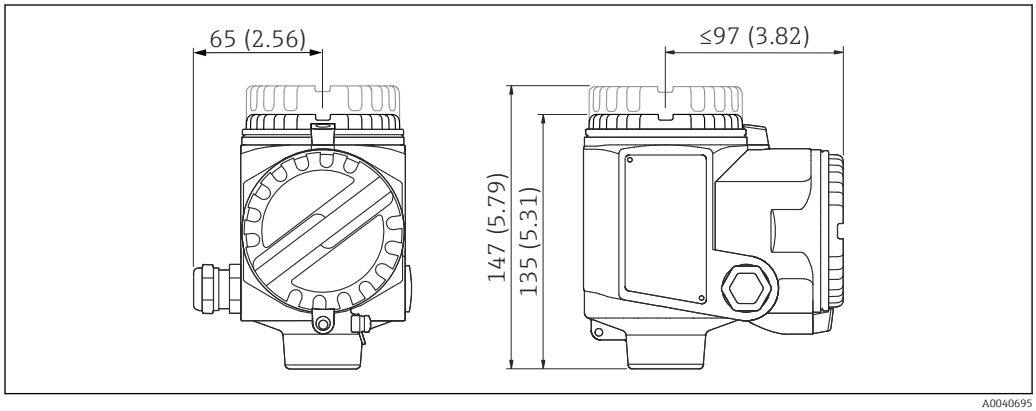
With the gas-tight process seal.



Unit of measurement mm (in)

Aluminum housing T13

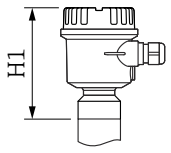
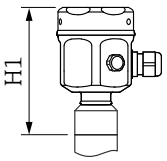
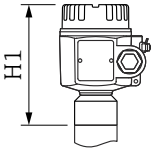
With separate connection compartment and gas-tight process seal.



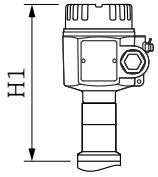
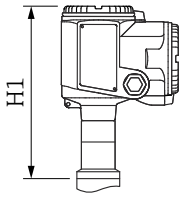
Unit of measurement mm (in)

Housing heights with adapter

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

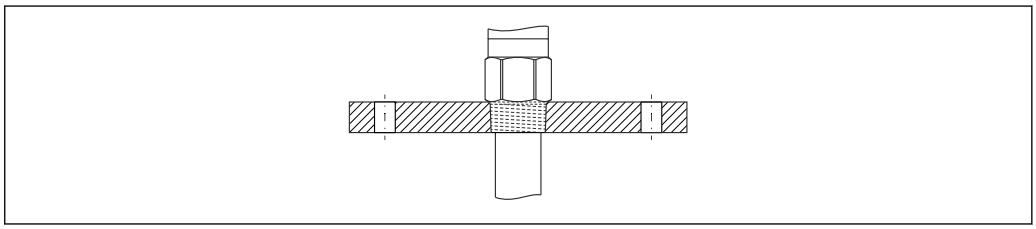
	A [1]	B [2]	C [3]
			
G	2	1	3
H1	125 mm (4.92 in) [4]/177 (6.97)	121 mm (4.76 in) [5]/173 (6.81)	131 mm (5.16 in) [6]/183 (7.20)

1) Polyester housing F16
2) Stainless steel housing F15
3) Stainless steel housing F17
4) For Approval: A (Non-hazardous area) or K (CSA General Purpose, CSA C US). => Device identification.
5) For Approval: A (Non-hazardous area) or K (CSA General Purpose, CSA C US). => Device identification.
6) For Approval: A (Non-hazardous area) or K (CSA General Purpose, CSA C US). => Device identification.

	D [1]	E [2]
	 A0052106	 A0052108
G	4	5
H1	181 mm (7.13 in)	198 mm (7.80 in)

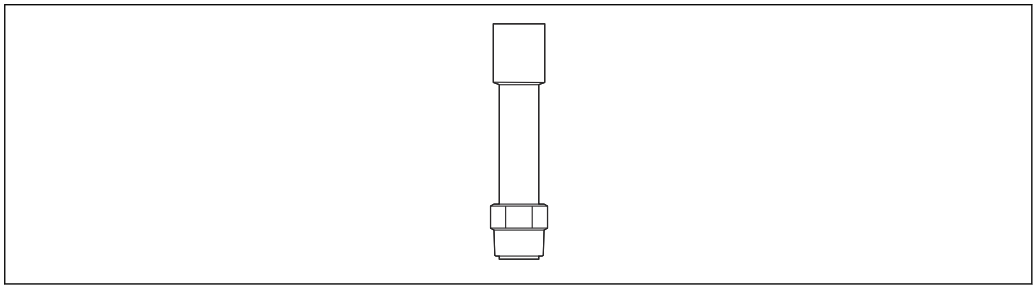
1) Aluminum housing F13 with gas-tight process seal
2) Aluminum housing with separate connection compartment T13 and gas-tight process seal

Process connections and flanges


A0044144

28 Process connection

Thread: R 1½ [7] (DIN EN 10226-1)


A0044248

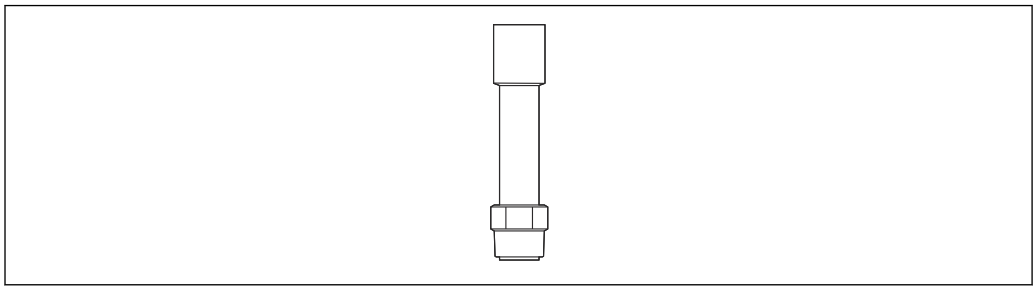
29 Process connection with a thread R 1½

Pressures up to: 10 bar (145 psi)

Order code:
- RVJ: for 316L
- RVI: for steel

7) Optional with adapter flange (for steel)

Thread: NPT 1½ [8] (ANSI B 1.20.1)



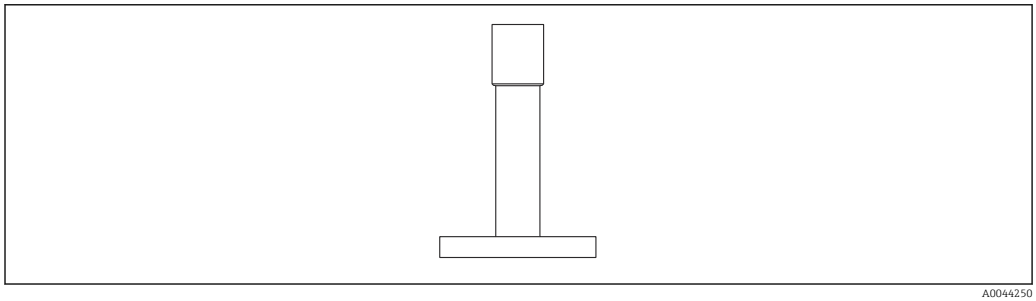
A0044249

30 Process connection with a thread NPT 1½

Pressures up to: 10 bar (145 psi)

Order code:
- RGJ: for 316L
- RGI: for steel

Flanges (EN1092-1), (ANSI B 16.5), (JIS B2220)



A0044250

31 Flange

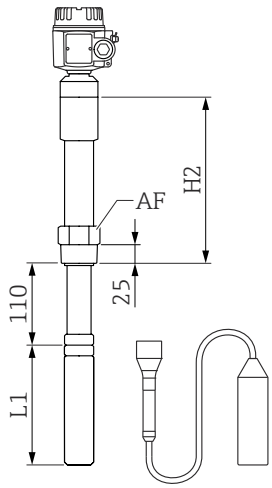
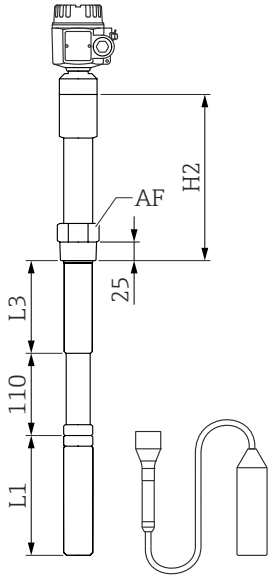
Pressure: depends on flange, maximum 10 bar (145 psi)

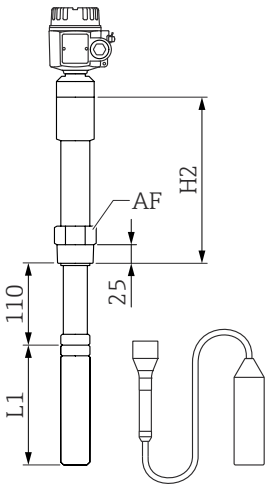
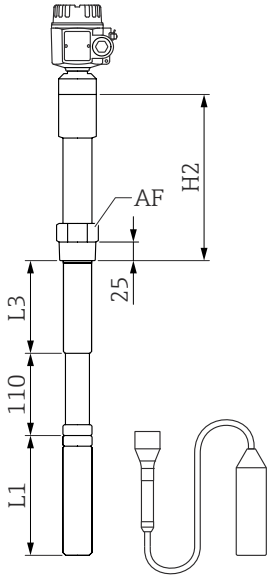
FTI77 probes for fine-grained bulk solids

The total length of the probe from the start of the thread equals:
- L = L1 + L3 + 110 mm (4.33 in) for ceramic fixture
- L = L1 + L3 + 110 mm (4.33 in) + 125 mm (4.92 in) for optional active buildup compensation

Length tolerance
- Sword probes
  - < 1 m (3.3 ft): 0 to −5 mm (0 to −0.2 in)
  - > 1 m (3.3 ft) up to 3 m (9.8 ft): 0 to −10 mm (0 to −0.39 in)
- Rope probes
  - < 1 m (3.3 ft): 0 to −10 mm (0 to −0.39 in)
  - > 1 to 3 m (3.3 to 9.98 ft): 0 to −20 mm (0 to −0.79 in)
  - > 3 to 6 m (9.98 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)

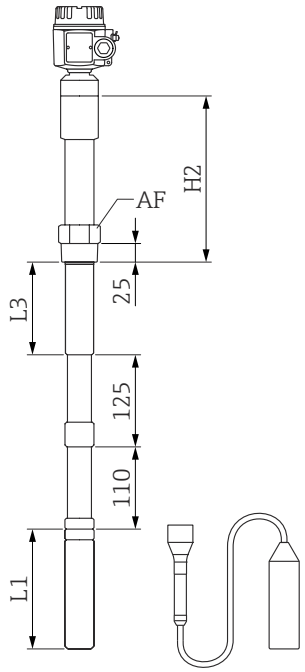
8) Optional with adapter flange (for steel)

A [1]		B [2]	
 A0044251		 A0044252	
C [3]	D [4]	C [5]	D [6]
H2			
259 mm (10.2)	259 mm (10.2)	259 mm (10.2)	259 mm (10.2)
AF			
55	55	55	55
Total length (L)			
310 to 1 110 mm (12.2 to 43.7 in)	610 to 20 000 mm (24 to 787 in)	410 to 2 110 mm (16.1 to 83.1 in)	710 to 20 000 mm (28 to 787 in)
Active length (L1)			
200 to 1 000 mm (7.87 to 39.4 in)	500 to 19 890 mm (19.7 to 783 in)	200 to 1 000 mm (7.87 to 39.4 in)	500 to 19 790 mm (19.7 to 779 in)
Inactive length (L3)			
-	-	100 to 1 000 mm (3.94 to 39.4 in)	100 to 1 000 mm (3.94 to 39.4 in)
Inactive length diameter - steel			
-	-	38 mm (1.5 in)	38 mm (1.5 in)
Inactive length diameter - 316L			
-	-	42.5 mm (1.67 in)	42.5 mm (1.67 in)
Sword width			
40 mm (1.57 in)	-	40 mm (1.57 in)	-
Rope diameter			
-	6 mm (0.24 in)	-	6 mm (0.24 in)
Active buildup compensation diameter			
-	-	-	-
Tensioning weight diameter			
-	30 mm (1.18 in)	-	30 mm (1.18 in)
Tensioning weight length			
-	150 mm (5.91 in)	-	150 mm (5.91 in)
Lateral loading capacity of the probe rope at 20 °C (68 °F)			
250 Nm (184.4 lbf ft)	-	250 Nm (184.4 lbf ft)	-
Tensile loading capacity			

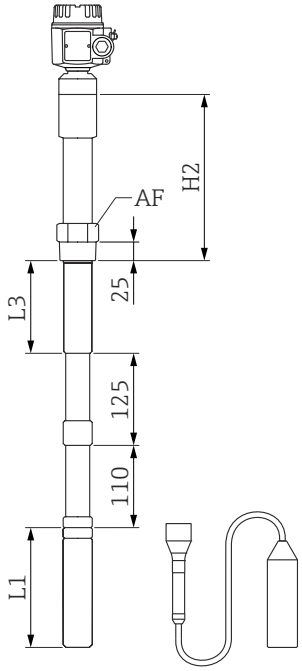
A [1]		B [2]	
			
-	7 500 N (1 686 lbf)	-	7 500 N (1 686 lbf)
Probe can be used in mounting nozzles			
-	-	✔	✔
Probe can be used in the event of condensate on tank ceiling			
-	-	✔	✔

1) Probe without inactive length
2) Probe with inactive length
3) Sword probe
4) Rope probe
5) Sword probe
6) Rope probe

Probe without inactive length

E [1]
 A0044253

C [2]	D [3]
H2	
259 mm (10.2)	259 mm (10.2)
AF	
55	55
Total length (L)	
535 to 2 235 mm (21.1 to 88 in)	835 to 20 000 mm (32.9 to 787 in)
Active length (L1)	
200 to 1 000 mm (7.87 to 39.4 in)	500 to 19 665 mm (19.7 to 774 in)
Inactive length (L3)	
100 to 1 000 mm (3.94 to 39.4 in)	100 to 1 000 mm (3.94 to 39.4 in)
Inactive length diameter - steel	
38 mm (1.5 in)	42.5 mm (1.67 in)
Inactive length diameter - 316L	
-	-
Sword width	
40 mm (1.57 in)	-
Rope diameter	
-	6 mm (0.24 in)
Active buildup compensation diameter	
40 mm (1.57 in)	40 mm (1.57 in)
Tensioning weight diameter	
-	30 mm (1.18 in)
Tensioning weight length	
-	150 mm (5.91 in)

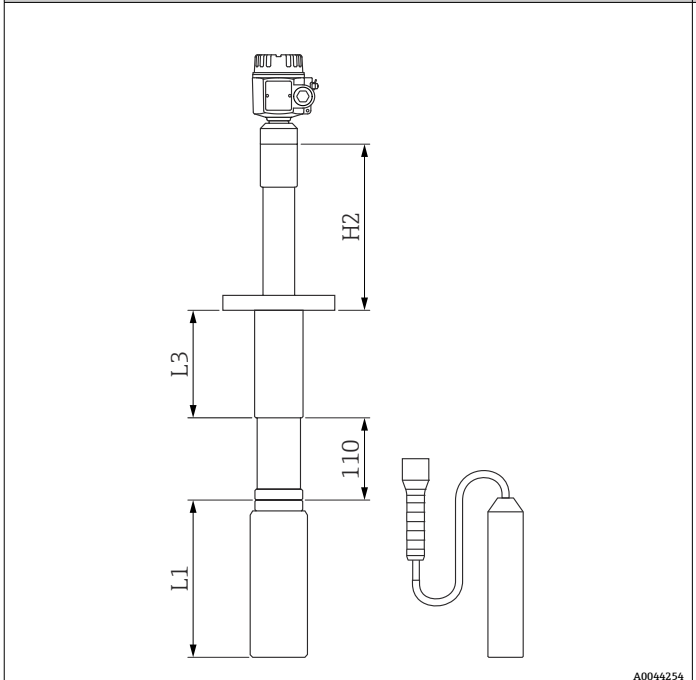
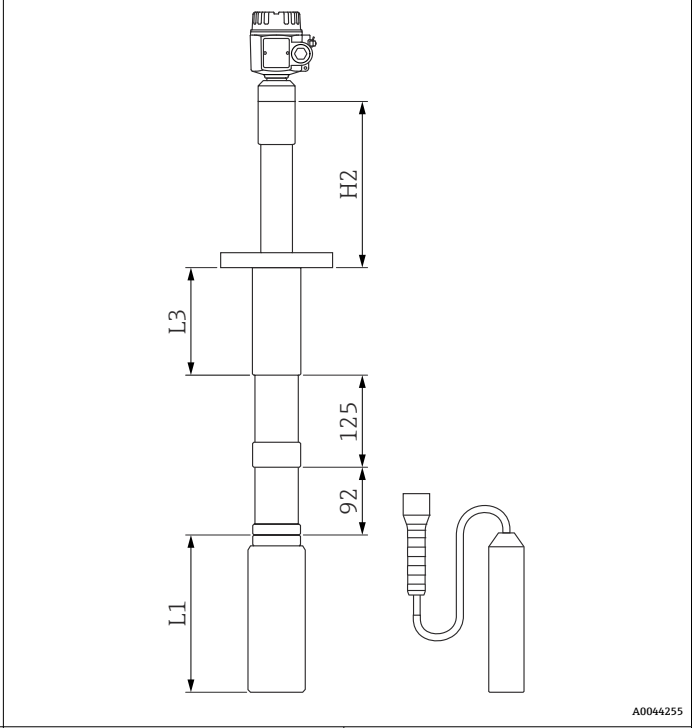
E [1]
 A0044253
Lateral loading capacity of the probe rope at 20 °C (68 °F)
250 Nm (184.4 lbf ft) / -
Tensile loading capacity
- / 7 500 N (1 686 lbf)
Probe can be used in mounting nozzles
✔ / ✔
Probe can be used in the event of condensate on tank ceiling
✔ / ✔

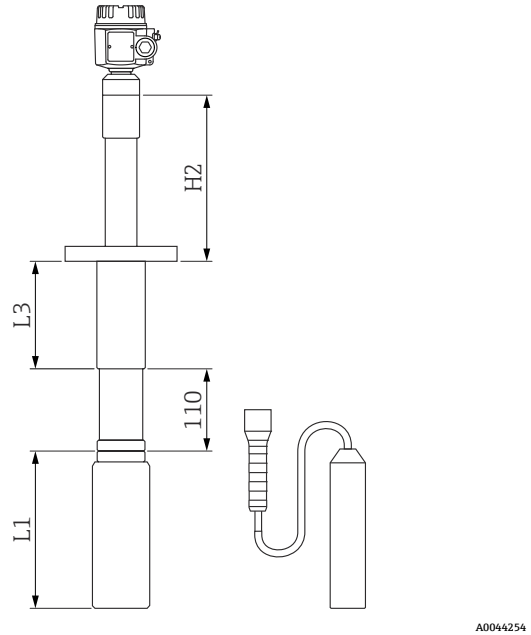
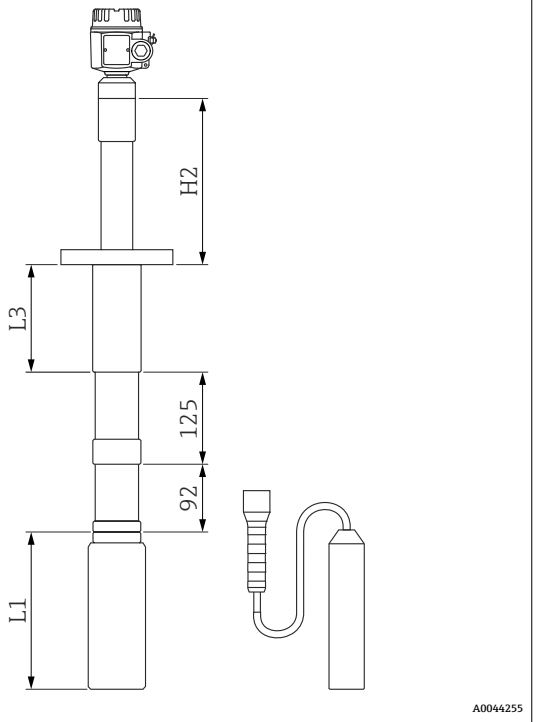
1) Probe without inactive length
2) Sword probe
3) Rope probe

FTI77 probes for coarse-grained bulk solids

The total length of the probe from the start of the thread equals:
- L = L1 + L3 + 110 mm (4.33 in) for ceramic fixture and inactive length
- L = L1 + L3 + 92 mm (3.62 in) + 125 mm (4.92 in) for optional active buildup compensation

Length tolerance
- Sword probes
  - < 1 m (3.3 ft): 0 to −5 mm (0 to −0.2 in)
  - > 1 m (3.3 ft) up to 3 m (9.8 ft): 0 to −10 mm (0 to −0.39 in)
- Rope probes
  - < 1 m (3.3 ft): 0 to −10 mm (0 to −0.39 in)
  - > 1 to 3 m (3.3 to 9.98 ft): 0 to −20 mm (0 to −0.79 in)
  - > 3 to 6 m (9.98 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)

A [1]		B [2]	
			
C [3]	D [4]	C [5]	D [6]
H2			
259 mm (10.2)	259 mm (10.2)	259 mm (10.2)	259 mm (10.2)
AF			
55	55	55	55
Total length (L)			
410 to 2 110 mm (16.1 to 83.1 in)	710 to 20 000 mm (28 to 787 in)	517 to 2 235 mm (20.4 to 88 in)	817 to 20 000 mm (32.2 to 787 in)
Active length (L1)			
200 to 1 000 mm (7.87 to 39.4 in)	500 to 19 790 mm (19.7 to 779 in)	200 to 1 000 mm (7.87 to 39.4 in)	500 to 19 665 mm (19.7 to 774 in)
Inactive length (L3)			
100 to 1 000 mm (3.94 to 39.4 in)	100 to 1 000 mm (3.94 to 39.4 in)	100 to 1 000 mm (3.94 to 39.4 in)	100 to 1 000 mm (3.94 to 39.4 in)
Inactive length diameter			
77 mm (3.03 in)	77 mm (3.03 in)	77 mm (3.03 in)	77 mm (3.03 in)
Sword width			
40 mm (1.57 in)	-	40 mm (1.57 in)	-
Rope diameter			
-	6 mm (0.24 in)	-	6 mm (0.24 in)
Active buildup compensation diameter			
-	-	76 mm (2.99 in)	76 mm (2.99 in)
Tensioning weight diameter			
-	40 mm (1.57 in)	-	40 mm (1.57 in)
Tensioning weight length			
-	250 mm (9.84 in)	-	250 mm (9.84 in)
Lateral loading capacity of the probe rope at 20 °C (68 °F)			
800 Nm (590 lbf ft)	-	800 Nm (590 lbf ft)	-
Tensile loading capacity			

A [1]		B [2]	
			
-	20 000 N (4 496 lbf)	-	20 000 N (4 496 lbf)
Probe can be used in mounting nozzles			
✔	✔	✔	✔
Probe can be used in the event of condensate on tank ceiling			
✔	✔	✔	✔

1) Probe without inactive length
2) Probe with inactive length
3) Sword probe
4) Rope probe
5) Sword probe
6) Rope probe

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, 1.4405 (316L) or steel
- Probe rope: 1.4401 (AISI 316)

Weight

Probes for fine-grained bulk solids

The probe weighs approximately 3 kg (6.62 lb).

This weight comprises:
- housing
- process connection: thread
- temperature spacing sleeve

Additional weights have to be taken into consideration depending on the make-up of the device:
- flange weight
- inactive length: 288 g (10.158 oz)/100 mm (3.94 in)
- probe sword: 250 g (8.818 oz)/100 mm (3.94 in)
- probe rope Ø 6 mm (0.24 in) 180 g (6.349 oz)/1 m (3.3 ft)

Probes for coarse-grained bulk solids [9)]

The probe weighs approximately 9 kg (19.85 lb).

This weight comprises:
- housing
- process connection: flange
- temperature spacing sleeve

Additional weights have to be taken into consideration depending on the make-up of the device:
- inactive length: 844 g (31.179 oz)/100 mm (3.94 in)
- probe sword: 600 g (21.162 oz)/100 mm (3.94 in)
- probe rope Ø12 mm (0.47 in): 550 g (19.399 oz)/1 m (3.3 ft)

Operability

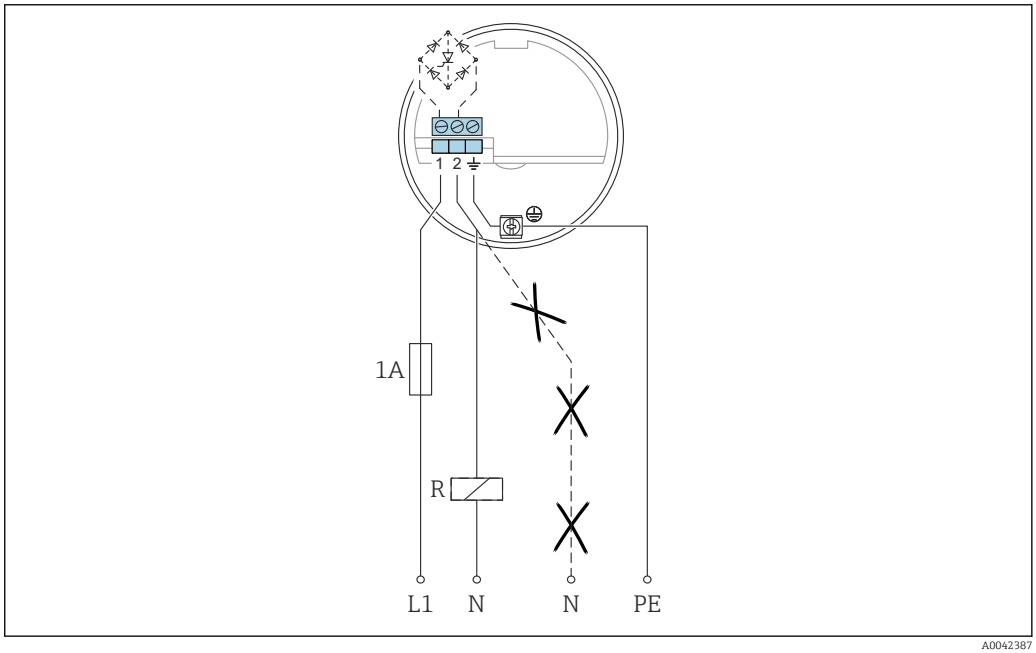
2-wire AC electronic insert FEI51

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

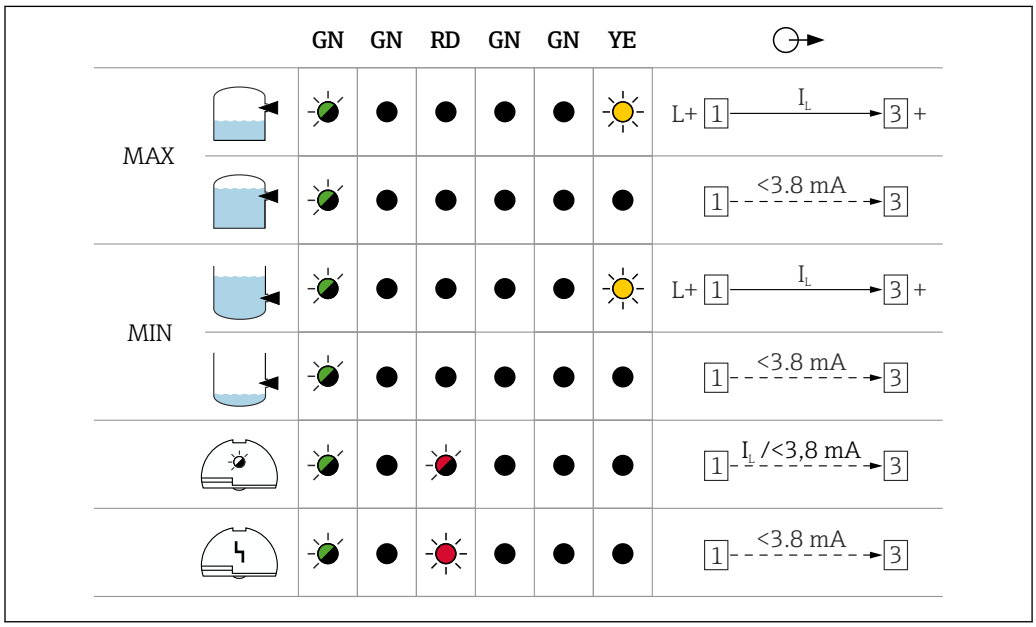
L1 L1 phase cable
N Neutral cable
PE Grounding cable
R External load

9) Always with flange

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 [10)]

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

Signal on alarm



A0042586

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

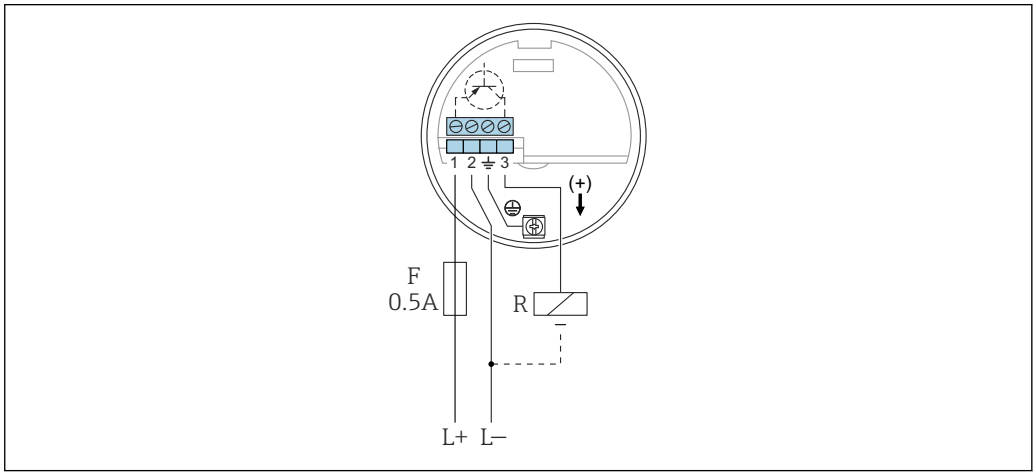
Power supply

- 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

10) 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



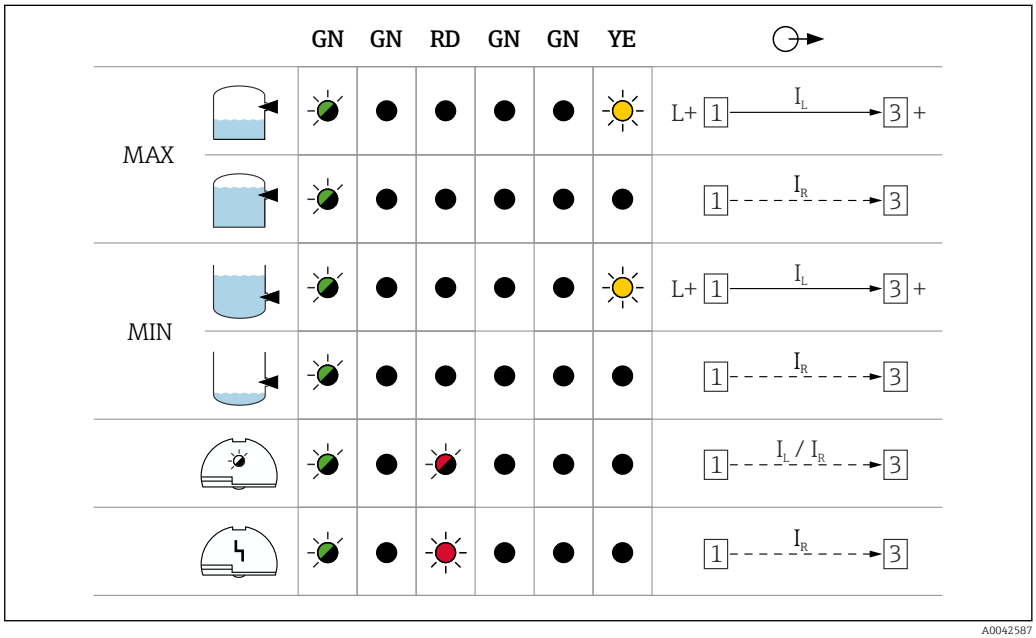
A0042388

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

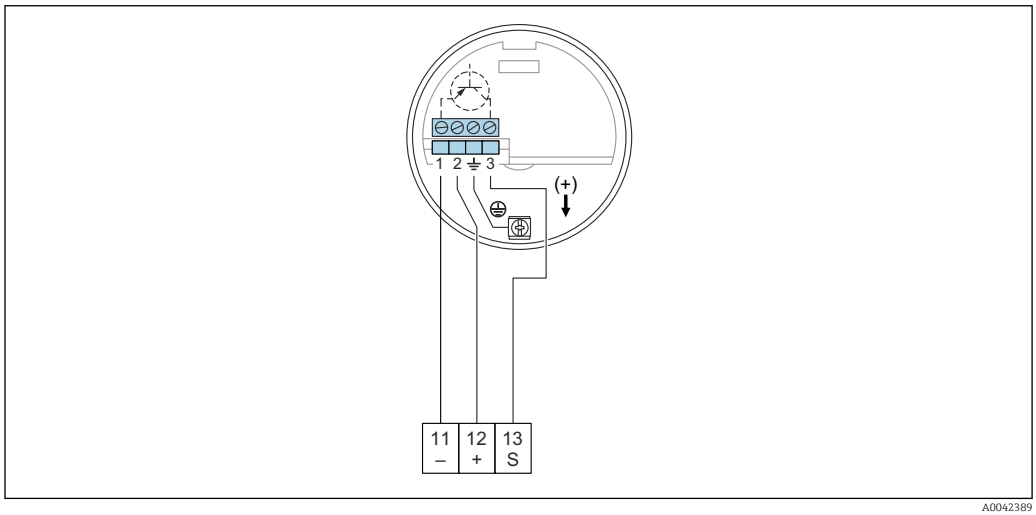
- Load switched via transistor and separate PNP connection: maximum 55 V
- Load current: maximum 350 mA cyclical overload and short-circuit protection
- Residual current: < 100 µA with transistor blocked
- Capacitance load:
  - maximum 0.5 µF at 55 V
  - maximum 1 µF at 24 V
- Residual voltage: < 3 V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

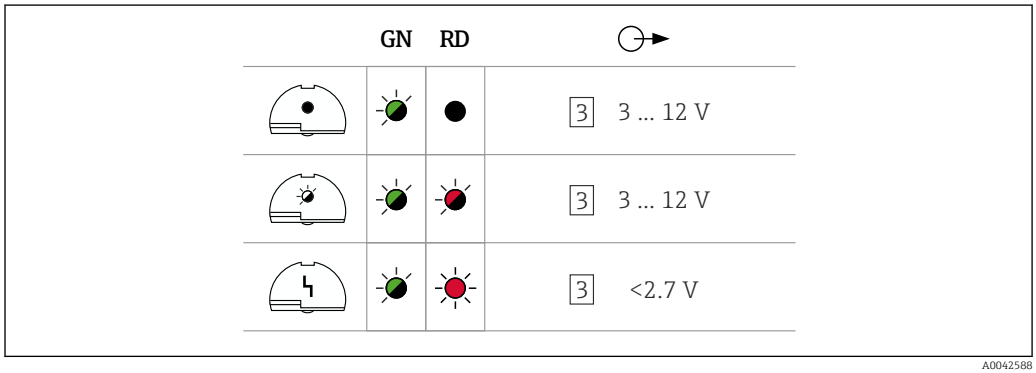
3 to 12 V signal.

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

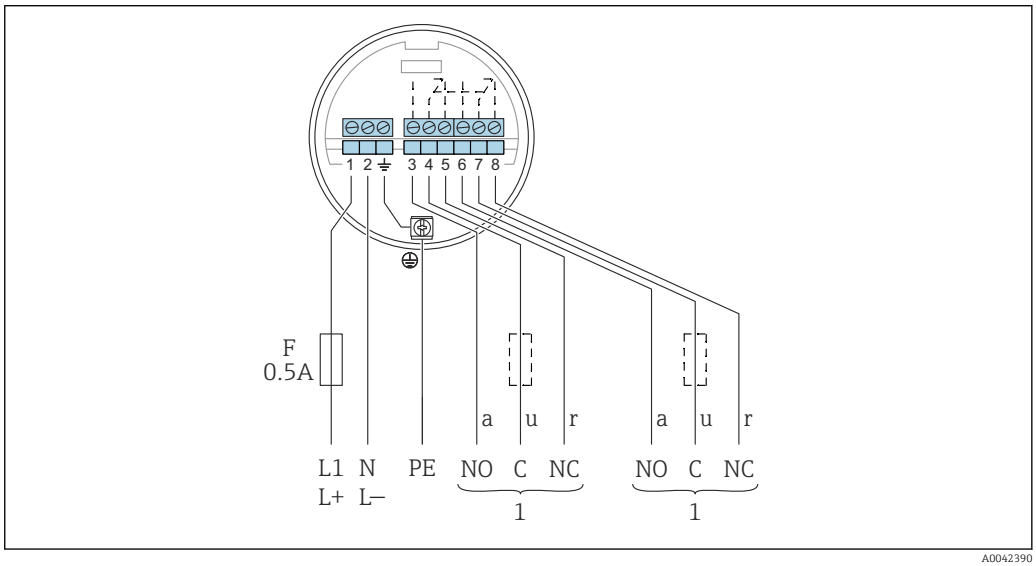
AC and DC with relay output electronic insert FEI54

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

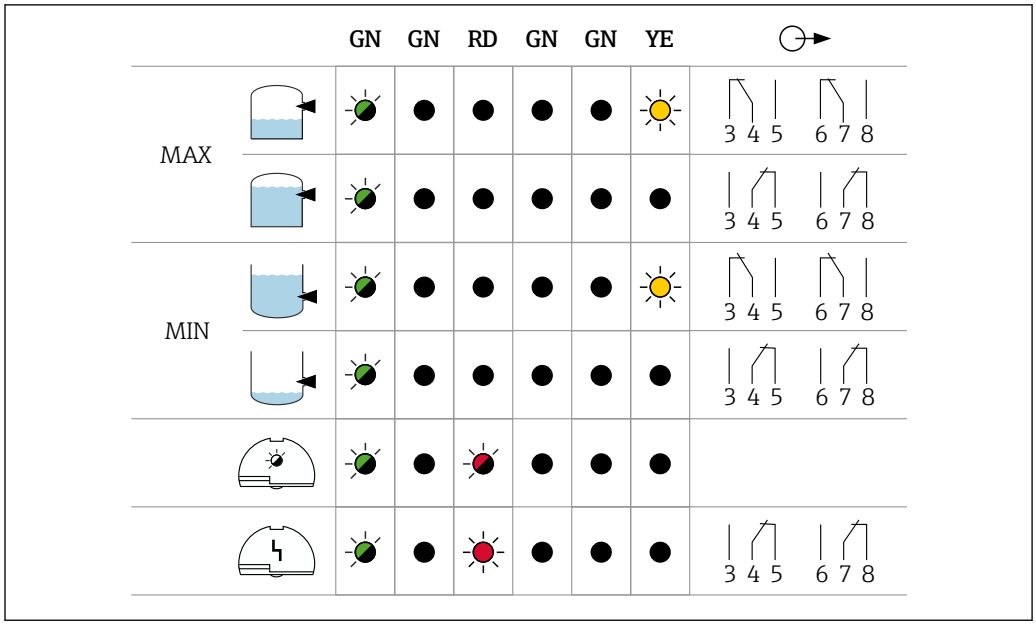
Please note the different voltage ranges for AC and DC.



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

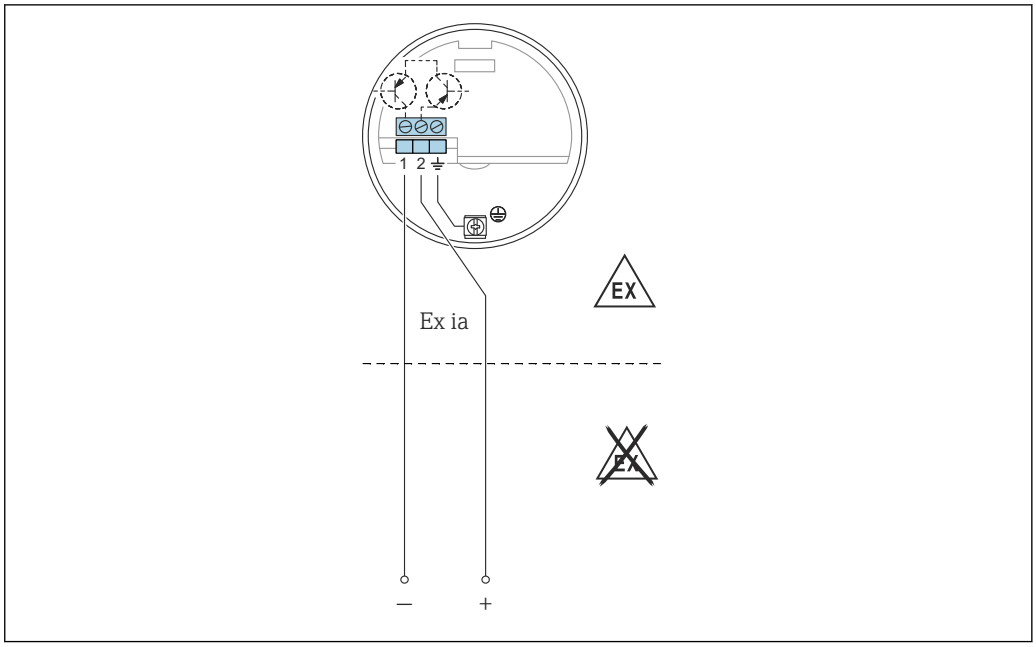
- Loads switched via 2 floating changeover contacts (DPDT)
- maximum values (AC):
  - I_{max} = 6 A
  - U_{max} = 253 V_{AC}
  - P_{max} = 1 500 VA at cosφ = 1
  - P_{max} = 750 VA at cosφ > 0.7
- maximum values (DC):
  - I_{max} = 6 A at 30 V_{DC}
  - I_{max} = 0.2 A at 125 V_{DC}
- The following applies 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

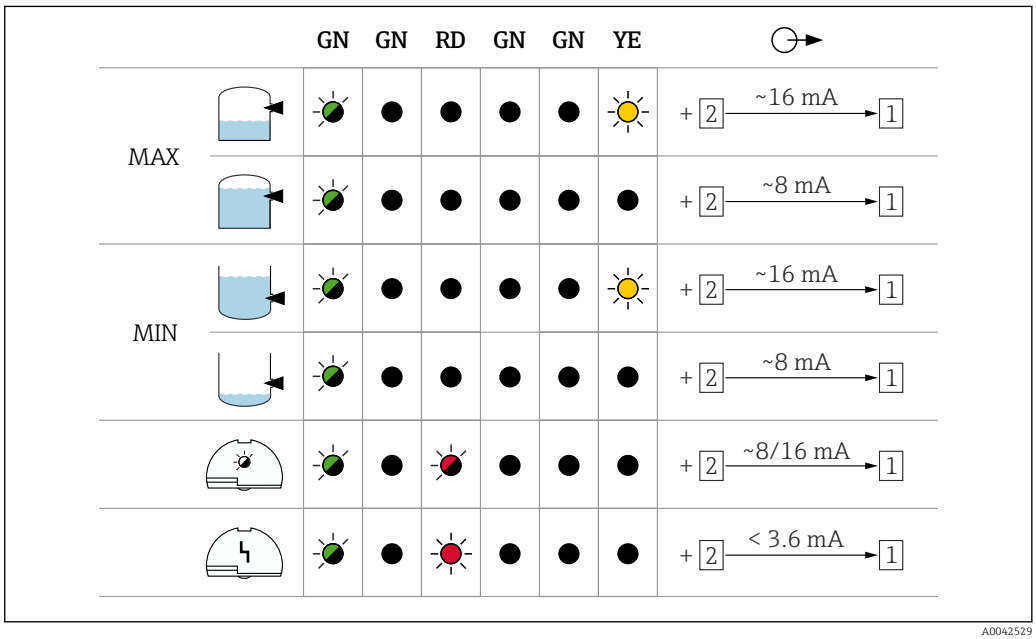


A0042391

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

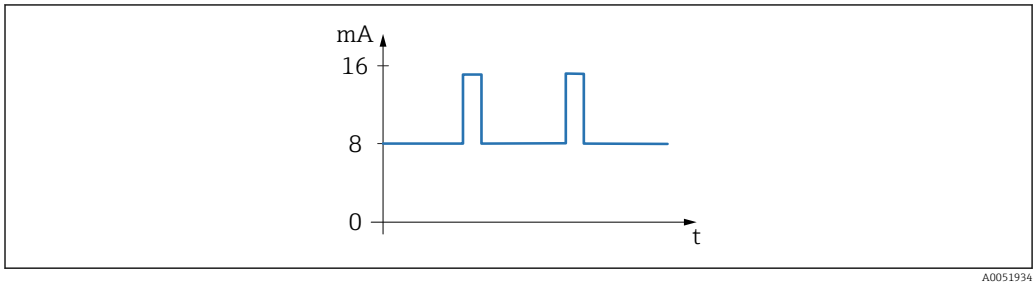
Output signal on power failure or in the event of device failure: < 3.6 mA

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

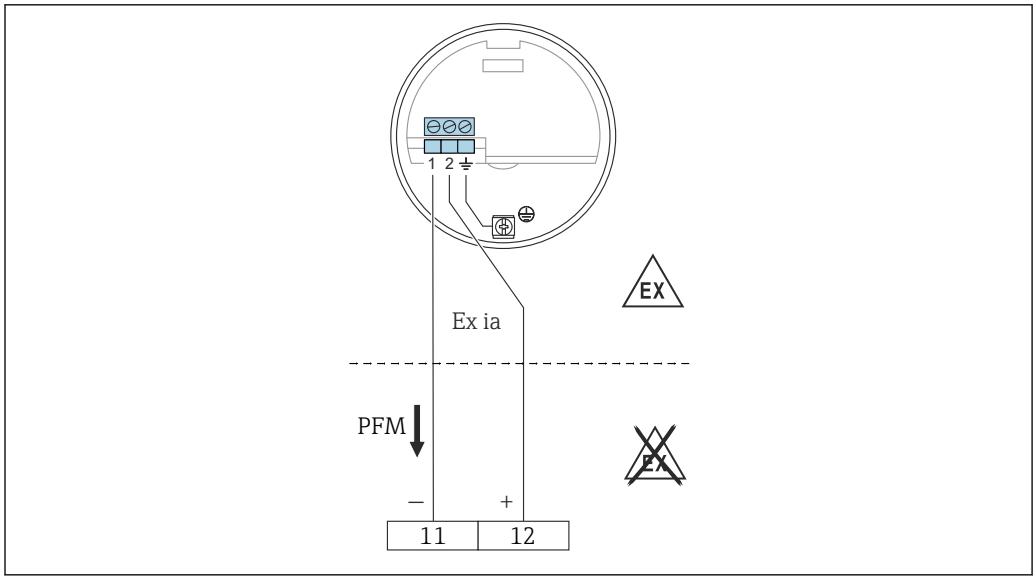


A0051934

32 *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 unit Nivotester FTC325 from Endress+Hauser.

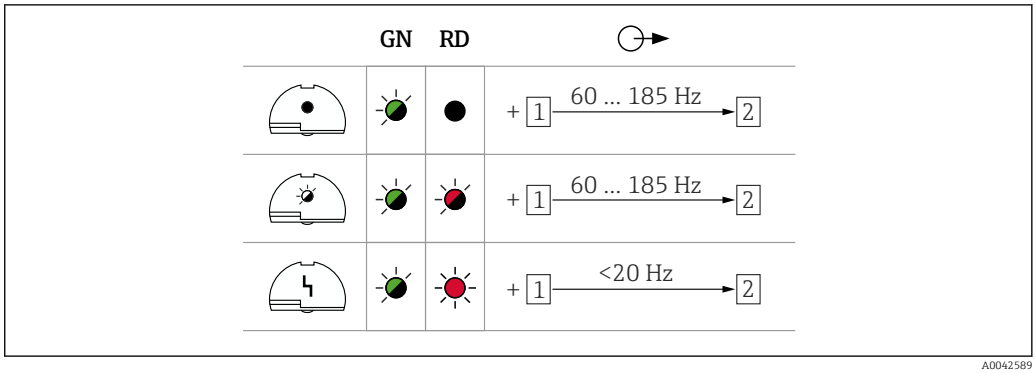
PFM signal 17 to 185 Hz.

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.

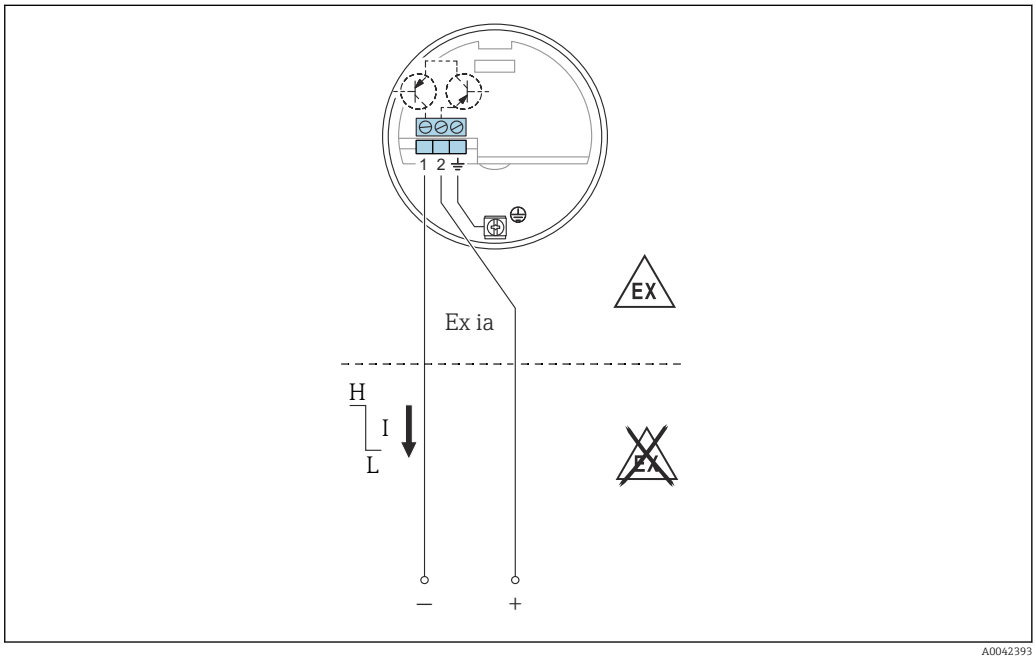
NAMUR electronic insert FEI58

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

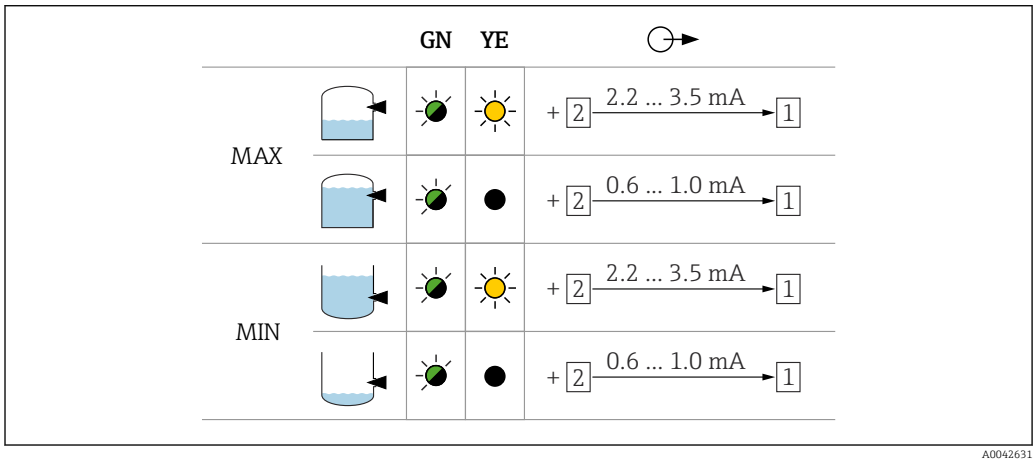
33 *Terminals must be connected to isolating amplifier (NAMUR) IEC 60947-5-6*

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



A0042631

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.

Ordering information

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

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

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

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.

Accessories

Weather protection cover

For F13, F17 housing
Order number: 71040497

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.

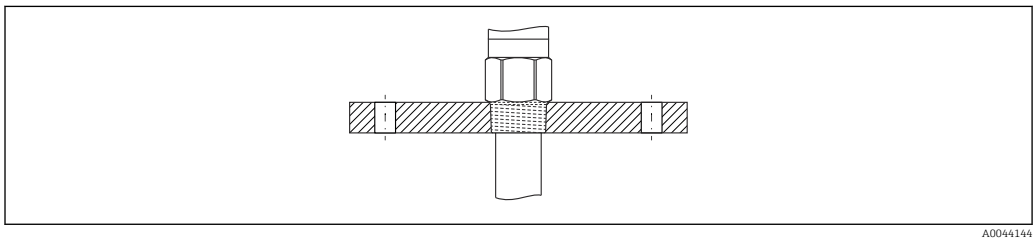
Adapter flange

The steel probe versions are available for fine-grained bulk solids:
- R 1½
- NPT 1½

Adapter flanges that can be ordered via the following FAU70E and FAU70A product structures are optionally available.

FAU70E
- 1233 -> DN50 PN16 A, flange EN1092-1 (DIN2527 B)
- 1433 -> DN80 PN16 A, flange EN1092-1 (DIN2527 B)
- 1533 -> DN100 PN16 A, flange EN1092-1 (DIN2527 B)

FAU70A
- 2253 -> 2" 150lbs FF, flange ANSI B16.5
- 2453 -> 3" 150lbs FF, flange ANSI B16.5
- 2553 -> 4" 150lbs FF, flange ANSI B16.5



A0044144

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.

Document type	Purpose and content of the document
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

Endress+Hauser

People for Process Automation