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Technical Information
Liquicap M
FMI52

Capacitive



Continuous level measurement for liquids

Application

The device is independent of the dielectric constant (DC) as of a liquid conductivity of 100 µS/cm and allows measurement of various liquids without the need for recalibration.

- Process connections: Flanges and threads
- Process pressure: Vacuum to +100 bar (+1 450 psi)
- Measuring range: 0.42 to 10 m (1.38 to 33 ft)
- Temperature: −80 to +200 °C (−112 to +392 °F)
- International explosion protection certificates, overfill prevention WHG, SIL, hygienic certificates, marine approvals

Your benefits

- Use also in safety systems requiring functional safety to SIL2 in accordance with IEC 61508
- Reliable and universal application thanks to a wide range of certificates and approvals
- No calibration necessary (factory preconfiguration). No calibration necessary for media with a conductivity of 100 µS/cm and higher
- Material in contact with the process made of corrosion-resistant material, FDA-listed materials
- Menu-guided local configuration via plain text display (optional)
- Two-stage overvoltage protection

Endress+Hauser
People for Process Automation

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About this document

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

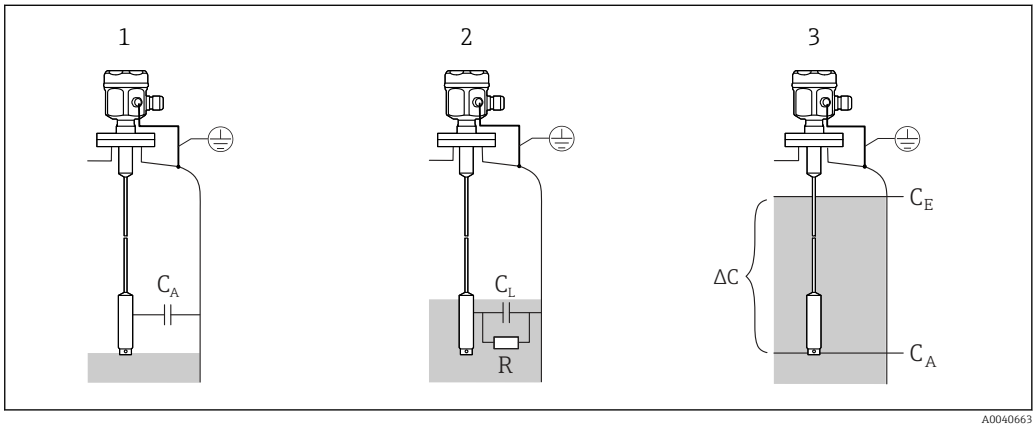
Temperature resistance of the connection cables
Specifies the minimum value of the temperature resistance of the connection cables

Function and system design

Measuring principle

The principle of capacitance level measurement is based on the change in capacitance of the capacitor due to the change in the level. The probe and container wall made of conductive material form an electric capacitor.

When the probe is in the air, a certain low initial capacitance is measured. When the container is filled, the capacitance increases the more the probe is covered. As of conductivity of 100 µS/cm, the measurement is independent of the value for the dielectric constant (DC) of the liquid. As a result, fluctuations in the DC value do not affect the measured value display. Furthermore, the system also prevents the effect of medium buildup or condensate near the process connection for probes with an inactive length.



1 The probe in the air
2 The probe covered by the liquid
3 The probe fully covered by the liquid
R Conductivity of the liquid
C_L Capacitance of the liquid
C_A Initial capacitance when the probe is not covered
C_E Final capacitance when the probe is covered
ΔC Change in capacitance

Function

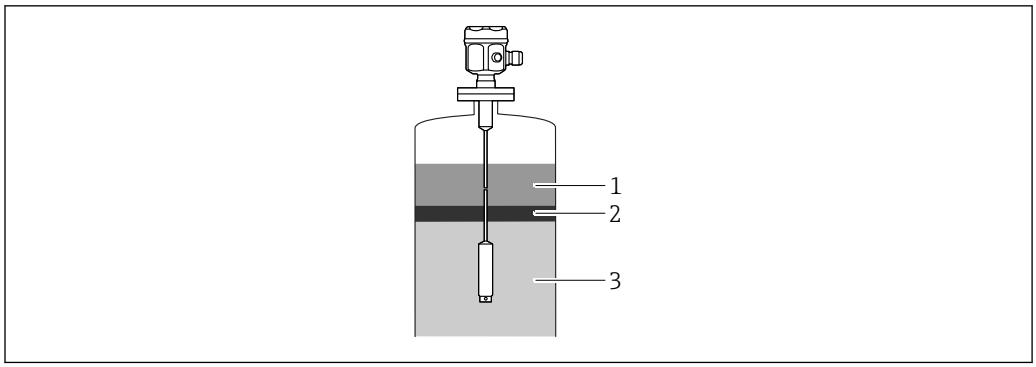
The selected electronic insert of the probe (e.g. FEI50H HART) converts the measured change in capacitance of the liquid to a signal that is proportional to the level.

Phase-selective measurement

The evaluation of the container capacitance works along the principle of phase-selective measurement. In this process, the amount of alternating current and the phase shift between the voltage and current is measured. With these two characteristic quantities, the capacitance idle current can be calculated by the medium capacitor and the real current by the medium resistance. Conductive buildup stuck to the probe rope acts like additional medium resistance and causes an error in measurement. As the size of the medium resistance can be determined with phase-selective measurement, the system compensates for the buildup on the probe.

Interface

A prior adjustment also ensures a certain and definite measured value even if the emulsion layer is of varying thickness. In this process, the average value of the emulsion film is always measured. The adjustment values for empty and full adjustment can be calculated with the FieldCare operating program from Endress+Hauser.



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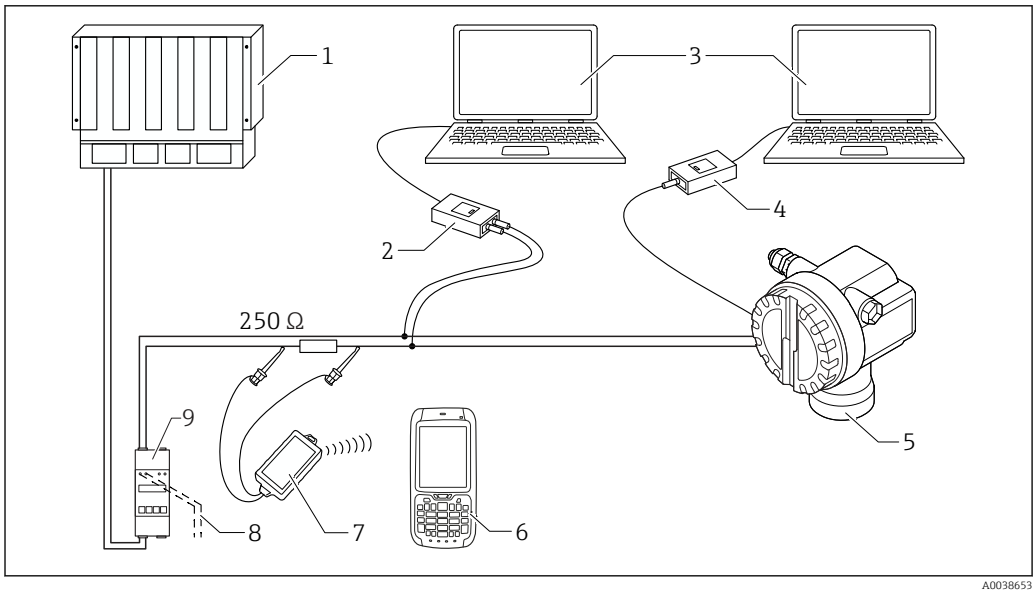
1 *Noncoductive medium < 1 µS/cm, DC < 5*
2 *Emulsion*
3 *Conductive medium ≥ 100 µS/cm*

Measuring system

4 to 20 mA output with HART protocol (FEI50H)

The complete measuring system consists of:
- the capacitance Liquicap M FMI52 level probe
- the FEI50H electronic insert
- the transmitter power supply unit

DC voltage must be supplied to the electronic insert. The twin-core feeder is also used for HART protocol signal transmission.



A0038653

1 *PLC*
2 *Commubox FXA195*
3 *Computer with operating tool FieldCare*
4 *Commubox FXA219*
5 *Probe with FEI50H electronic instert*
6 *Field Xpert*
7 *VIATOR Bluetooth modem with connecting cable*
8 *Output to FXA195*
9 *Transmitter power supply unit RN221N*

Local operation:
- Standard
  - using keys and switches on the electronic insert
- Optional
  - using display and operating module

Remote operation:
- with HART
- with a personal computer, Commubox FXA195, and the operating program FieldCare

FieldCare is a graphic operating program and is used to support commissioning, data backup, signal analysis and documentation of the measuring point.

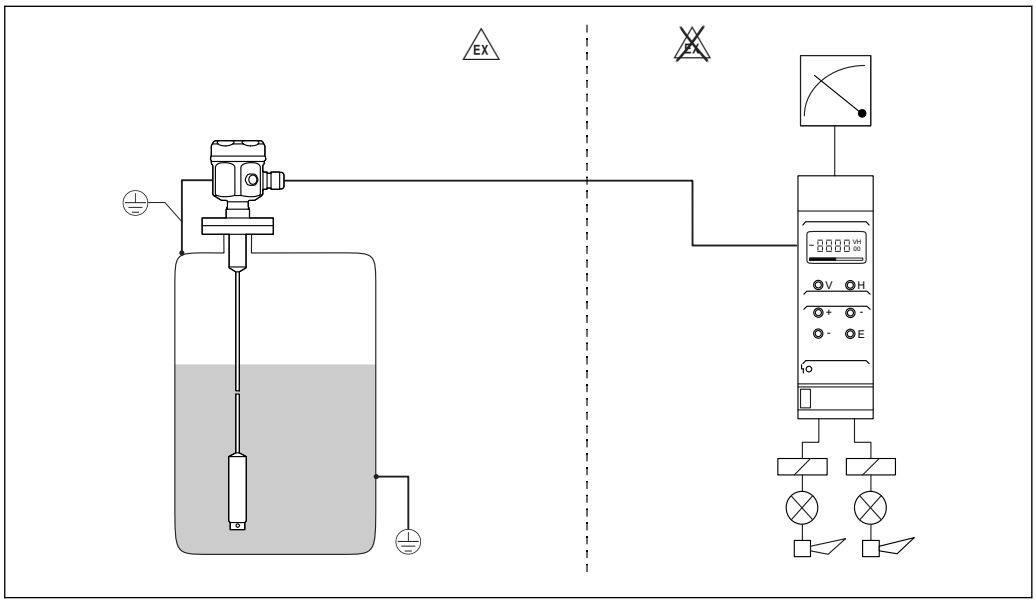
PFM output (FEI57C)

The complete measuring system consists of:
- the capacitance Liquicap M FMI52 level probe
- the FEI57C electronic insert
- a transmitter power supply unit

The twin-core feeder is also used for PFM signal transmission.

In combination with a power supply unit, the FEI57C will only run in a 1-channel-mode and without an automatic alignment correction.

For FEI57C a transmitter power supply unit is not available anymore (retrofit device). For new installations FMI52 with FEI50H is recommended.



1 *Level measurement*

Input

Measured variable

Continuous measurement of change in capacitance between the probe rope and container wall, depending on the level of a liquid.

The probe covered -> high capacitance.

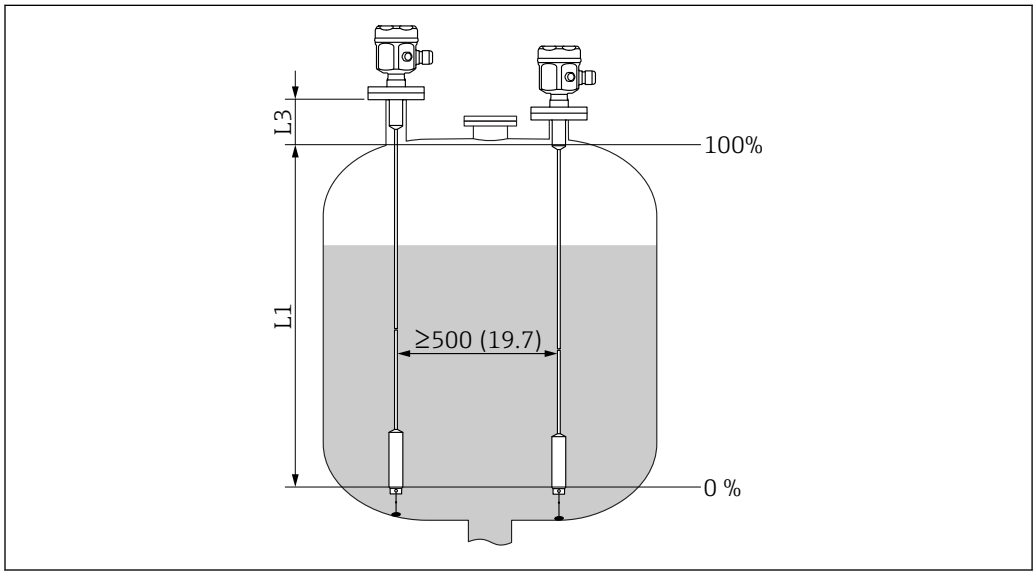
The probe not covered -> low capacitance.

Measuring range

- measuring frequency:
  500 kHz
- span ΔC
  - recommended: 25 to 4 000 pF
  - possible: 2 to 4 000 pF
- final capacitance C_E:
  max. 4 000 pF
- adjustable initial capacitance C_A:
  - < 6 m (20 ft) 0 to 2 000 pF
  - > 6 m (20 ft) 0 to 4 000 pF

Measuring condition

Measuring range L1 is possible from the tip of the probe to the process connection.



Unit of measurement mm (in)

L1 Measuring range
L3 Inactive length

When installing in a nozzle, use inactive length L3.

The 0 % and 100 % calibration can be inverted.

Output

Output signal

FEI50H (4 to 20 mA / HART version 5)

3.8 to 20.5 mA with HART protocol

FEI57C (PFM output)

The transmitter superimposes current pulses (PFM signal 60 to 2 800 Hz) with a pulse width of approximately 100 µs and a current strength of approximately 8 mA on the supply current.

Signal on alarm

FEI50H (4 to 20 mA / HART version 5)

Fault diagnosis can be called up via:
- red LED on the local display
- error symbol on the local display
- plain text on the display
- current output 22 mA
- digital interface: HART status error message

FEI57C (PFM output)

Fault diagnosis can be called up via:
- red LED on the local display
- local display at switching units

Linearization

FEI50H (4 to 20 mA / HART version 5)

The Liquicap M linearization function enables the conversion of the measured value into any desired length or volume units. Linearization tables for volume calculation of horizontal cylindrical tanks and spherical tanks are pre-programmed. Any other tables with up to 32 value pairs can be input manually or semi-automatically.

FEI57C (PFM output)

Linearization is performed in the transmitters.

Power supply

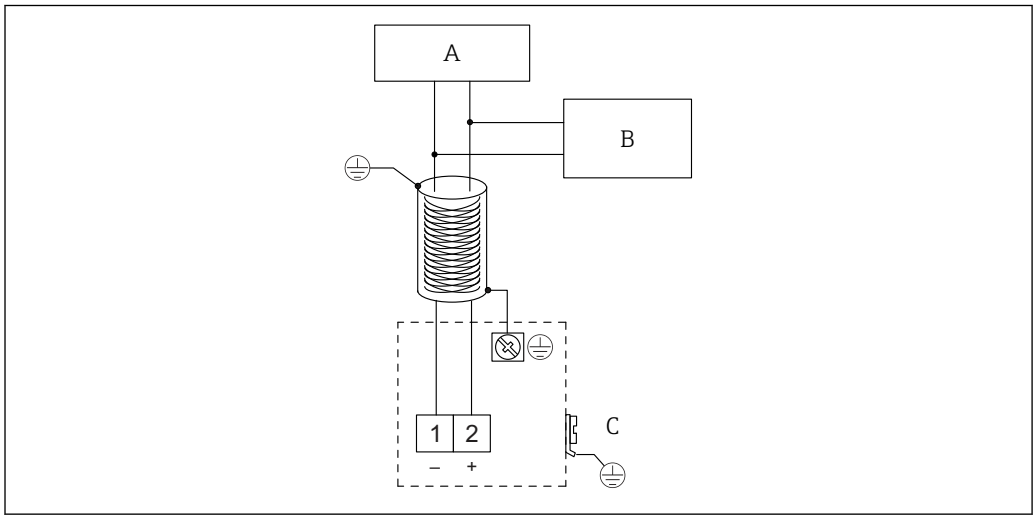
Terminal assignment

FEI50H (4 to 20 mA / HART version 5)

The twin-core connecting cable is connected to the screw terminals with conductor cross-section 0.5 to 2.5 mm^2 (20 to 13 AWG) in the connection compartment at the electronic insert. If the superimposed communication signal (HART) is used, a shielded cable must be used with the shielding connected at the sensor and power supply. Protective circuits against reverse polarity, HF influences, and overvoltage peaks are integrated.

The shielding must be connected to the sensor and power supply. Protective circuits against reverse polarity, HF influences, and overvoltage peaks are integrated.

For more information see document "EMC test procedures" TI00241F.



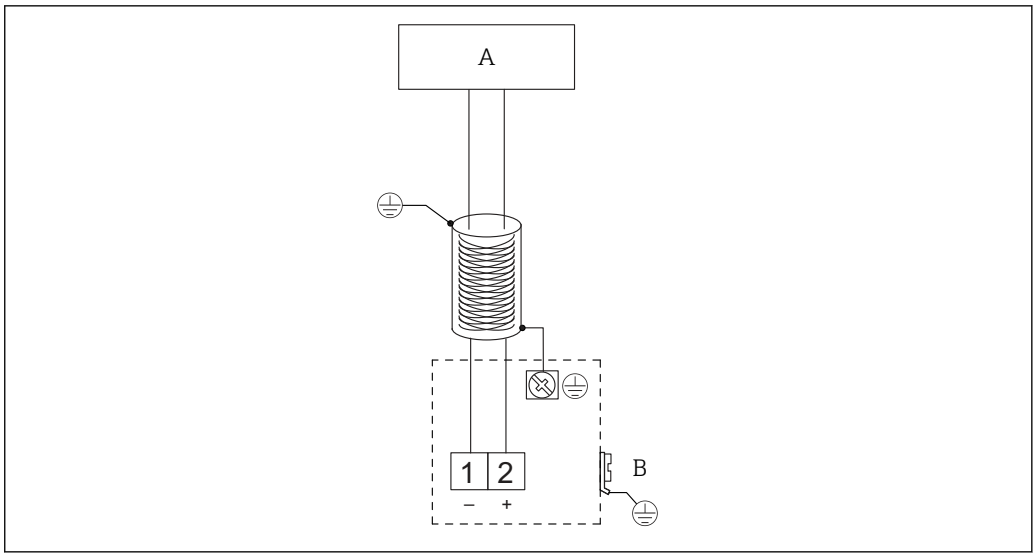
A Supply voltage, communication resistor 250 Ω
B Commubox FXA195
C Grounding terminal

FEI57C (PFM output)

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

The shielding must be connected to the sensor and power supply. Protective circuits against reverse polarity, HF influences, and overvoltage peaks are integrated.

For more information see document "EMC test procedures" TI00241F.



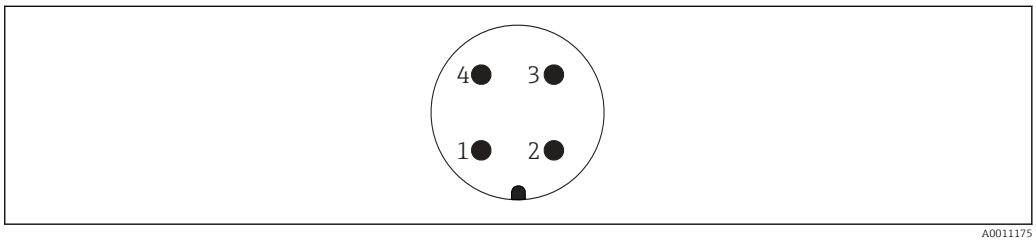
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A Switching unit
B Grounding terminal

Connector

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

PIN assignment for M12 connector



A0011175

1 Positive potential
2 Not used
3 Negative potential
4 Ground

Supply voltage

All of the following voltages are terminal voltages directly at the device.

FEI50H (4 to 20 mA / HART version 5)
- 12.0 to 36.0 V_{DC} - a device mounted in the non-hazardous area
- 12.0 to 30.0 V_{DC} - a device mounted in the hazardous areas Ex ia
- 14.4 to 30.0 V_{DC} - a device mounted in the hazardous areas Ex d

FEI57C (PFM output)
14.8 V_{DC} from the associated supply unit

Both electronic inserts have integrated reverse polarity protection.

Power consumption

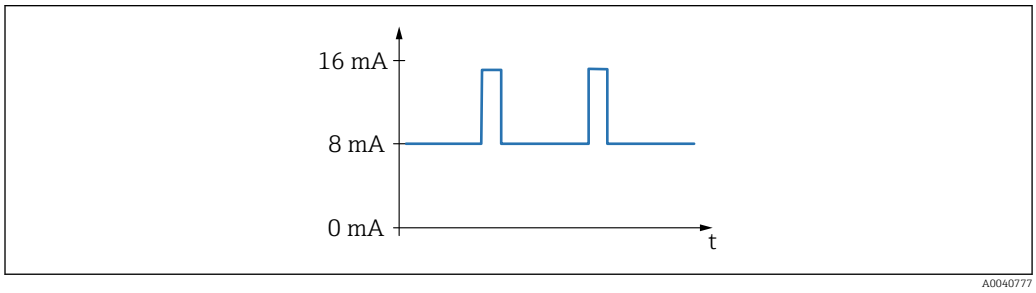
FEI50H (4 to 20 mA / HART version 5)
- minimum: 40 mW
- maximum: 800 mW

FEI57C (PFM output)
maximum: 250 mW

Current consumption

FEI50H (4 to 20 mA / HART version 5)
- current consumption: 3.8 to 22 mA
- HART multidrop operation: 4 mA
- residual ripple HART: 47 to 125 Hz U_{SS} = 200 mV with 500 Ω
- noise HART: 0.5 to 10 kHz U_{eff} < 2.2 mV with 500 Ω

FEI57C (PFM output)



2 *Frequency 60 to 2 800 Hz*

Cable entries

Cable gland
M20×1.5 [1] - for Ex d only cable entry
Two cable glands are included in the scope of delivery.

Cable entry
G½ or ½NPT

Performance characteristics

Reference operating conditions

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

Span: ΔC = 25 to 4 000 pF recommended, 2 to 4 000 pF possible.

Maximum measured error

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

Non-linearity for limit point setting (linearity) as per DIN 61298-2:
maximum ±0.5 %

Influence of ambient temperature

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

Separate housing
change in capacitance of connecting cable 0.015 pF / m per K

Influence of process pressure

In the case of fully insulated probes in conductive liquids:

< 10.0 % related to the full scale value

Switch-on behavior

FEI50H (4 to 20 mA / HART version 5)

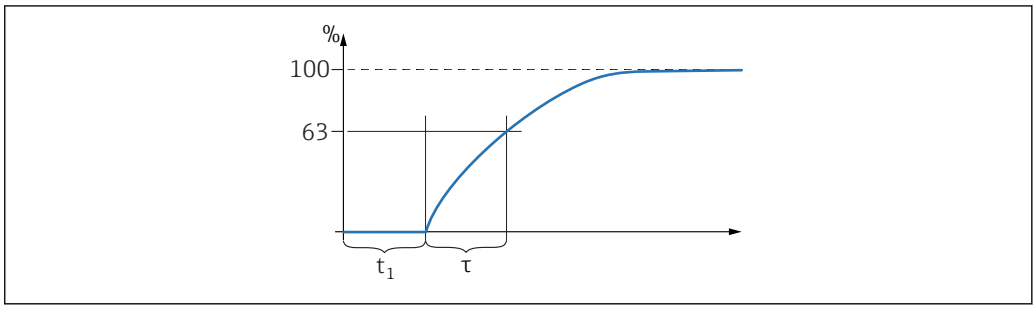
14 s, stable measured value after the switch-on procedure, start-up in safe status 22 mA

FEI57C (PFM output)

1.5 s, stable measured value after the switch-on procedure, start-up in safe status 22 mA

1) Metric fine thread.

Measured value reaction time



A0040622

τ *Time constant*
t_1 *Dead time*

FEI50H (4 to 20 mA / HART version 5)

Operating mode: $t_1 \leq 0.3$ s

SIL operating mode: $t_1 \leq 0.5$ s

FEI57C (PFM output)

Observe time constant of switching unit.

$t_1 = 0.3$ s

Response time

FEI50H (4 to 20 mA / HART version 5)

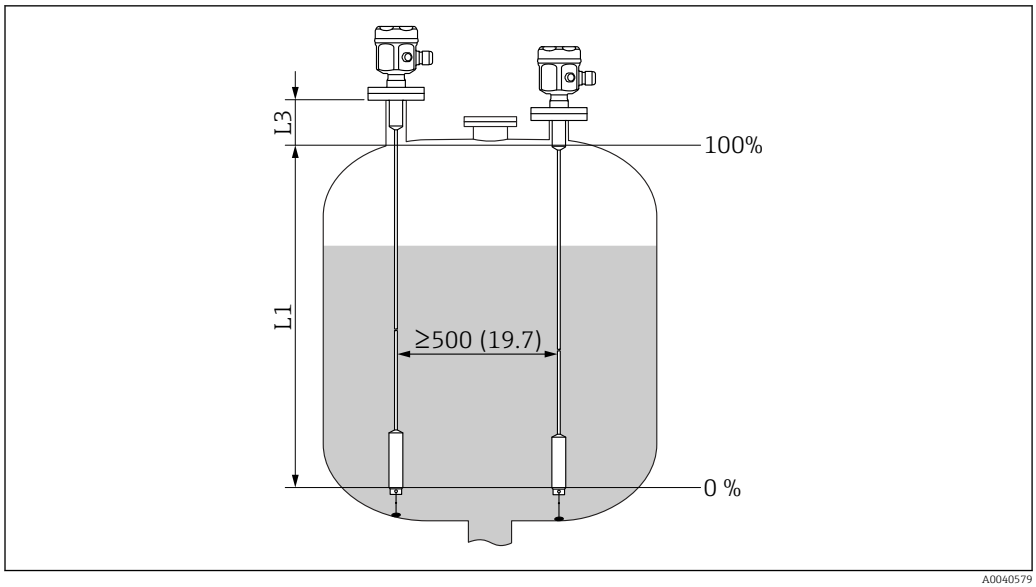
The response time affects the speed at which the display and the current output react to changes in the level.

The factory setting for time constant τ = 1 s; 0 to 60 s can be set.

Accuracy of factory calibration

Empty calibration (0 %) and full calibration (100 %):
- probe length < 2 m (6.6 ft)
  ≤ 5 mm (0.2 in)
- probe length > 2 m (6.6 ft)
  approximately ≤ 2 %

Reference conditions for the factory calibration:
- medium conductivity ≥ 100 µS/cm
- minimum distance to tank wall = 250 mm (9.84 in)



Unit of measurement mm (in)

L1 Measuring range from the tip of the probe to the process connection
L3 The inactive length

In an installed state, recalibration is only necessary when:

- the 0 % or the 100 % values have to be adjusted specifically for the customer
- the liquid is not conductive
- the probe distance to the tank wall is < 250 mm (9.84 in)

Resolution

FEI50H (4 to 20 mA / HART version 5)

Analog in % (4 to 20 mA)

- 11 bit/ 2 048 steps, 8 µA
- the resolution of the electronics can be directly converted to units of length of the probe e.g. rope probe length is 1 000 mm, resolution equals 1 000 mm/2048 = 0.48 mm

FEI57C (PFM output)

Zero frequency f_0 = 60 Hz

- sensitivity of the electronic insert = 0.685 Hz/pF
- entry in switching unit FMC671 under V3H5 and V3H6 or V7H5 and V7H6

Installation

Rope probes

The probe can be installed from above in conductive tanks made from metal.

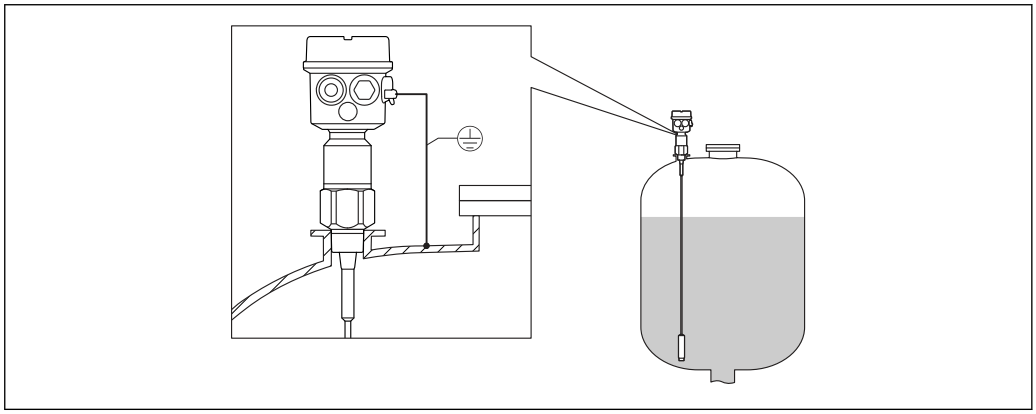
If the process connection of the probe is insulated from the metal tank using a seal material, then the ground connection on the probe housing must be connected to the tank using a short line.

- The probe may not come into contact with the container wall! Do not install probes in the area of the filling curtain.
- If multiple probes are mounted next to each other, a minimum distance of 500 mm (19.7 in) between the probes must be observed.
- When mounting, ensure there is a good electrically conductive connection between the process connection and the tank. Use an electrically conductive sealing band for example.

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

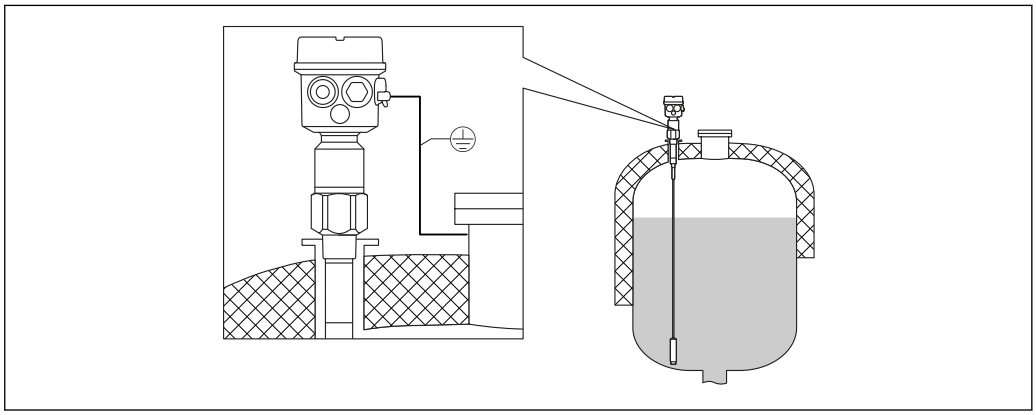
Damaged insulation of the probe rope causes improper measurements.

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



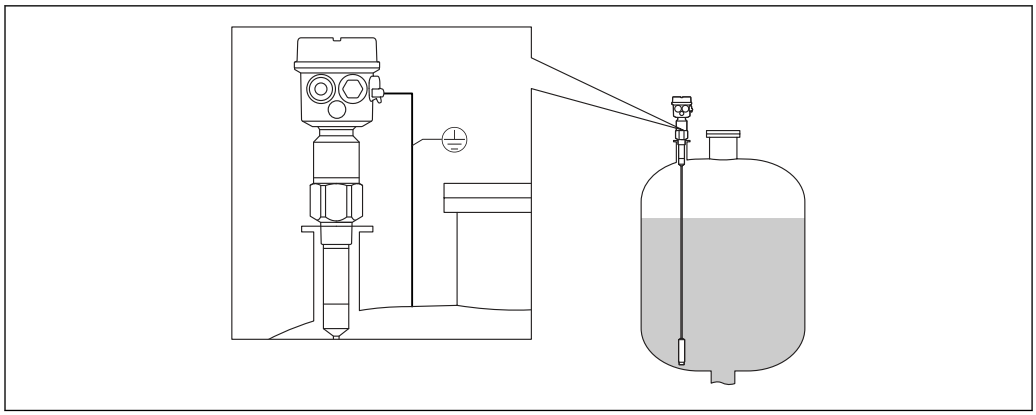
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3 Rope probe



A0040452

4 A probe with inactive length for the insulated tanks



5 A probe with fully insulated inactive length for mounting nozzles

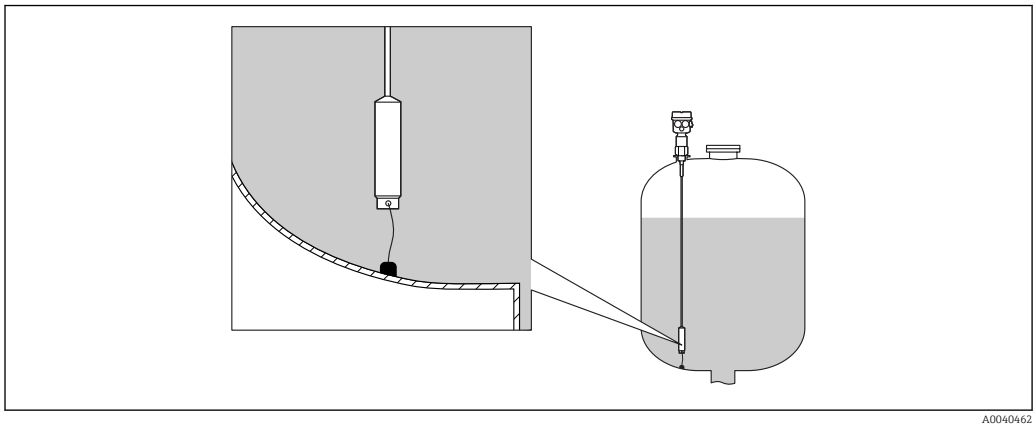
Shortening the rope

For information about the shortening kit, see Brief Operating Instructions KA061F/00.

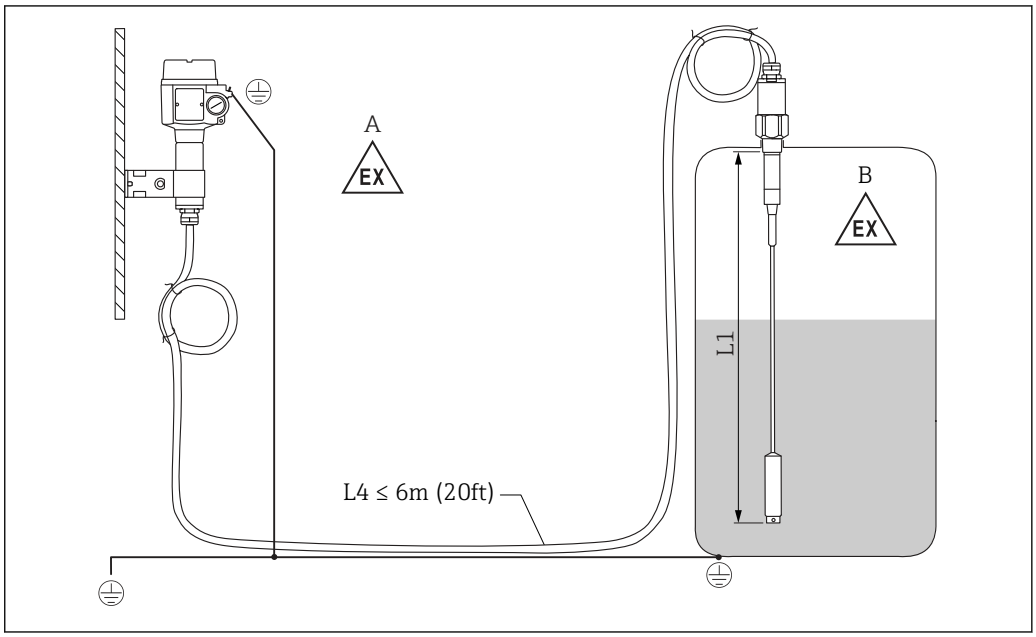
Tensioning weight with tension

The end of the probe needs to be secured if the probe would otherwise touch the silo wall or another part in the tank. This is what the internal thread in the probe weight is intended for. The bracing can be conductive or insulating to the tank wall.

To avoid too high tensile load, the rope should be loose or guyed with a spring. The maximum tensile load may not exceed 200 Nm (147.5 lbf ft).



Probe with separate housing



6 *Connection of the probe and separate housing*

A Explosive zone 1
B Explosive zone 0
L1 Rope length: max 9.7 m (32 ft)
L4 Cable length: max. 6 m (20 ft)

The maximum cable length L4 and rope length L1 cannot exceed 10 m (33 ft).

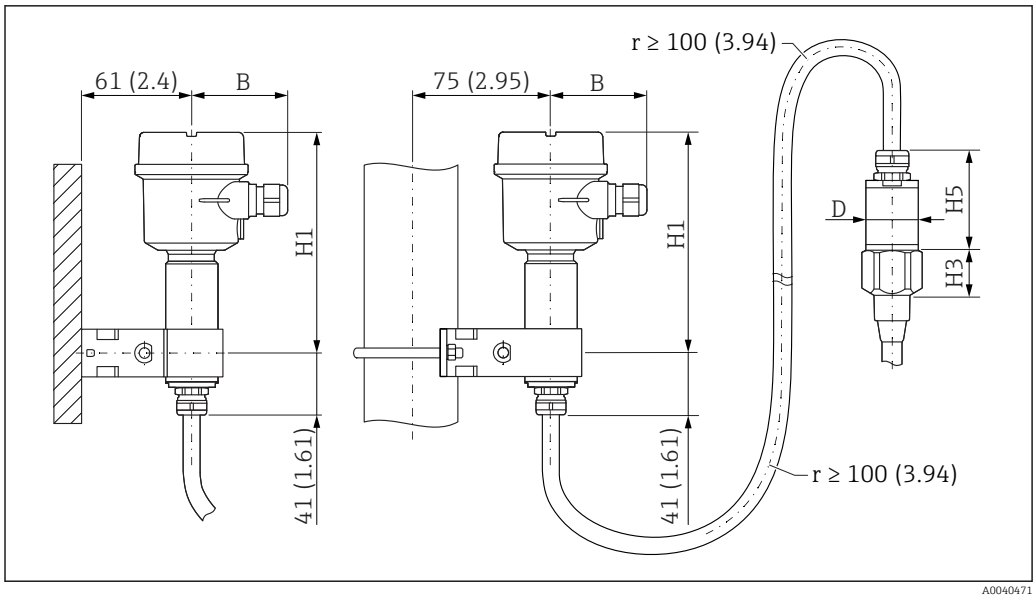
The maximum cable length between the probe and separate housing is 6 m (20 ft). The required cable length must be indicated in the ordering process of a Liquicap M with separate housing.

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

Extension heights: separate housing

The cable:

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



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

Values of parameters [2]:

Polyester housing (F16)
- B: 76 mm (2.99 in)
- H1: 172 mm (6.77 in)

Polyester housing (F15)
- B: 64 mm (2.52 in)
- H1: 166 mm (6.54 in)

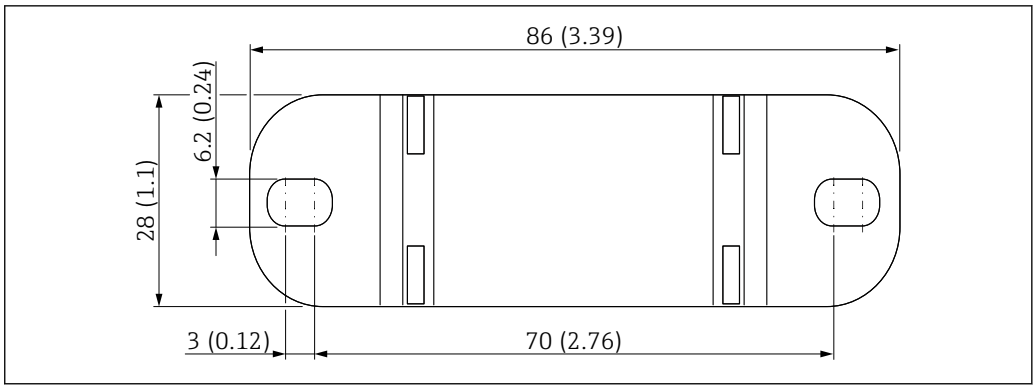
Aluminum housing (F17)
- B: 65 mm (2.56 in)
- H1: 177 mm (6.97 in)

D and H5 parameter
- rope probe without fully insulated inactive length and threads G¾", G1", NPT¾", NPT1", Clamp 1", Clamp 1½", Universal Ø44 mm (1.73 in), flange < DN50, ANSI 2", 10K50:
  - D: 38 mm (1.5 in)
  - H5: 66 mm (2.6 in)
- rope probe without fully insulated inactive length and threads G1½", NPT1½", Clamp 2", DIN 11851, flange ≥ DN50, ANSI 2", 10K50
  - D: 50 mm (1.97 in)
  - H5:89 mm (3.5 in)
- rope probe with fully insulated inactive length:
  - D: 38 mm (1.5 in)
  - H5: 89 mm (3.5 in)

Wall bracket

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

2) See parameters on the drawings.



Unit of measurement mm (in)

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 and transport

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

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

Cleaning

Housing:

Make sure that the housing surface and seals are resistant to cleaning agents.

Probe:

Depending on the application, buildup of contamination or soiling can form on the rope. A high level of material buildup can affect the measurement result.

The regular cleaning of the rope is recommended if the medium tends to create a high level of buildup.

Make sure that the insulation of the rope is not damaged if hosing down or during mechanical cleaning.

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 [3]
- Type4X

Stainless steel housing F27 with gas-tight process seal
Protection degree:
- IP66
- IP67
- IP68 [3]
- Type4X

Aluminum housing T13 with gas-tight process seal and separate connection compartment (Ex d)
Protection degree:
- IP66
- IP68 [3]
- Type4X

Separate housing
Protection degree:
- IP66
- IP68 [3]
- Type4X

Electromagnetic compatibility (EMC)

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

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

A standard commercial instrument cable can be used.

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

3) Only with M20 cable entry or G½ thread.

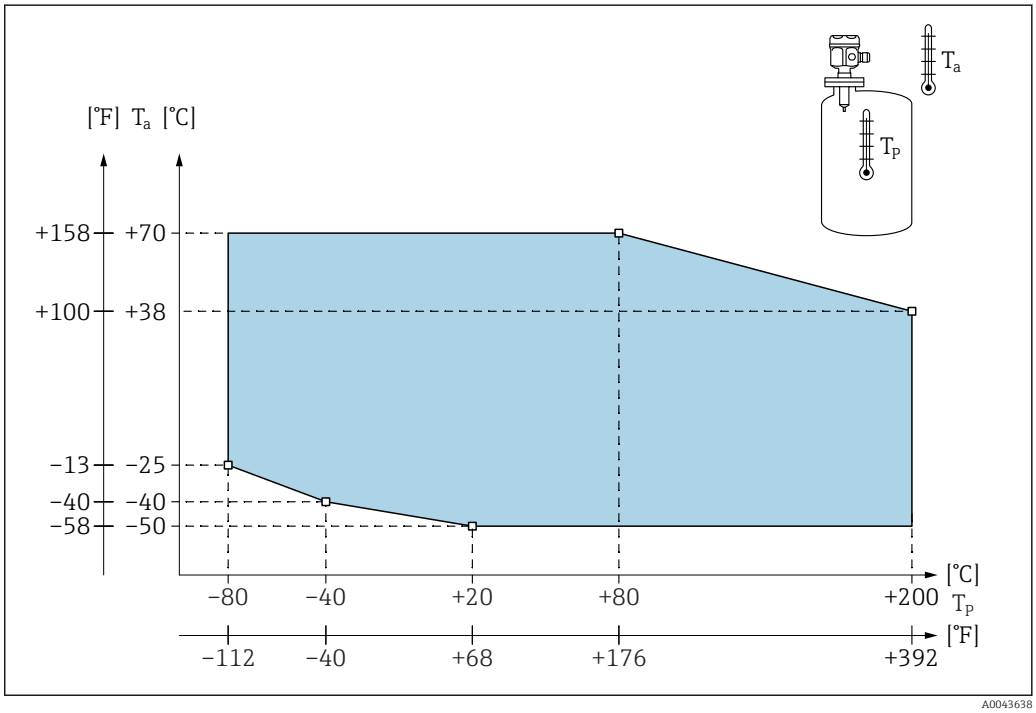
Process

Process temperature range

The following diagrams apply for:
- insulation
  - PTFE
  - PFA
  - FEP
- standard applications outside hazardous areas

The temperature is restricted to T_a −40 °C (−40 °F) when the polyester housing F16 is used or if additional option B is selected.

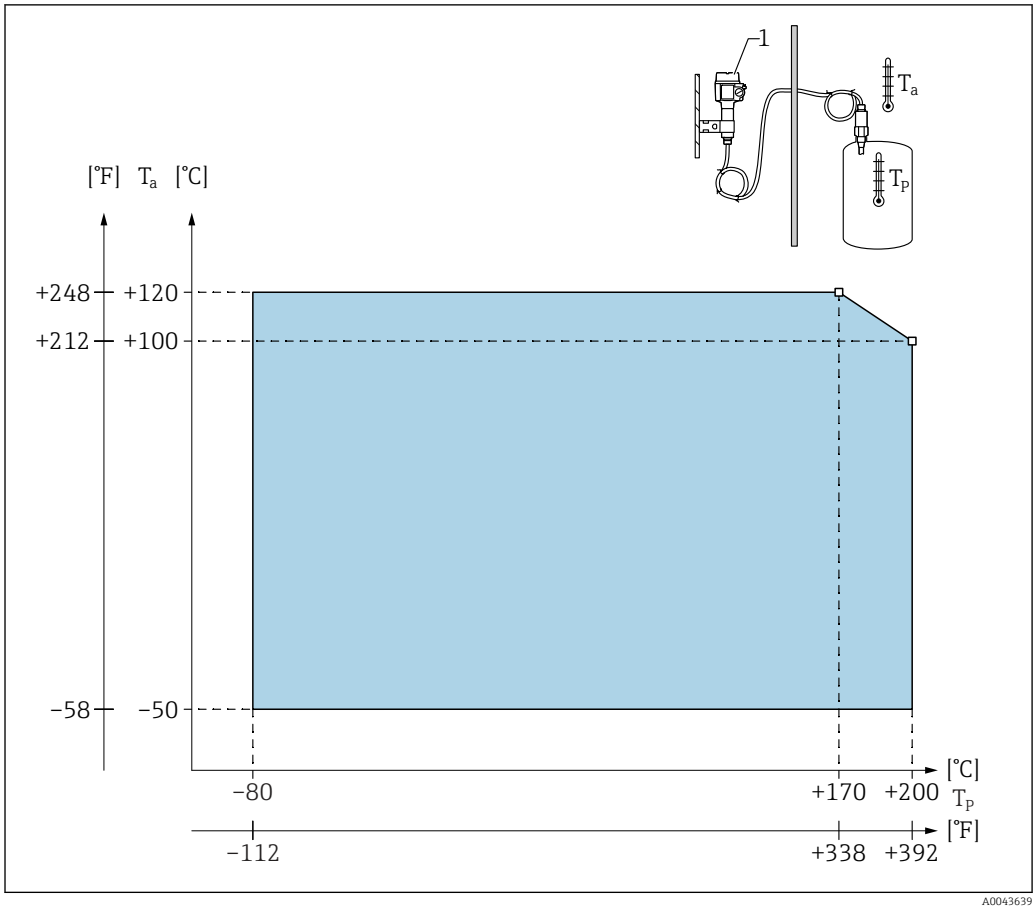
Probe with compact housing



8 *Process pressure range diagram: probe with compact housing*

T_a *Ambient temperature*
T_p *Process temperature*

Probe with separate housing



9 *Process pressure range diagram: probe with separate housing*

T_a *Ambient temperature*
T_p *Process temperature*
1 *The permitted ambient temperature at the separate housing is the same as indicated for the compact housing.*

Influence of process temperature

Error in case of fully insulated probes typically 0.13 %/K related to the full-scale value.

Process pressure limits

The process pressure limits depends on process connections.

See also chapter "Process connections" → 29.

Rope probe without inactive length or with inactive length in 316L

E+H Configurator settings:
- Feature: 20
- Options: 1, 2, 5

- −1 to 25 bar (−14.5 to 362.5 psi)
- −1 to 100 bar (−14.5 to 1450 psi)
- in regards to an inactive length, the maximum permitted process pressure is 63 bar (913.5 psi)
- for CRN approval and inactive length: the maximum permitted process pressure is 32 bar (464 psi)

Rope probe with fully insulated inactive length

E+H Configurator settings:
- Feature: 20
- Options: 3, 6

−1 to 50 bar (−14.5 to 725 psi)

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

- 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 composition 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

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

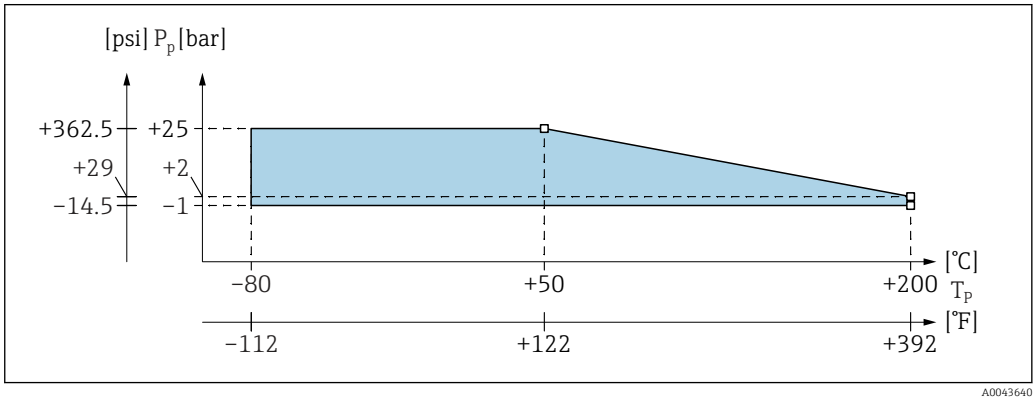
Pressure and temperature derating

See also chapter "Process connections" → 29

For rope probes without inactive length or with inactive length in 316L, process connections ¾", 1", flanges <DN50, <ANSI 2", <JIS 10K and process connections ¾", 1", flanges <DN50, <ANSI 2", <JIS 10K

Rope insulation: FEP, PFA

E+H Configurator settings:
- Feature: 20
- Options: 1, 2, 5

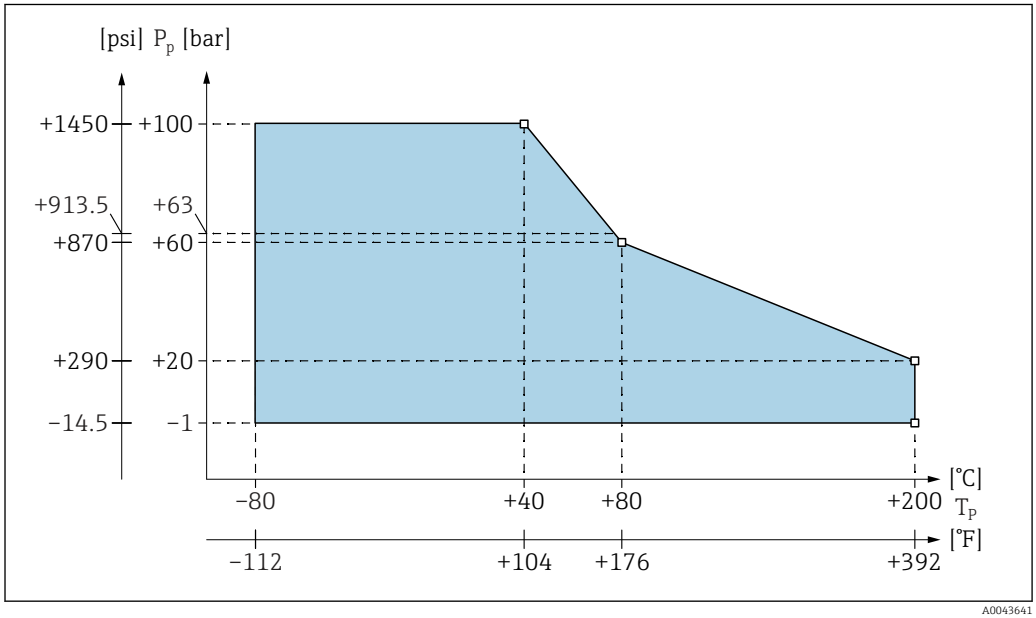


P_p *Process pressure*
T_p *Process temperature*

For rope probes without inactive length or with inactive length in 316L, process connections 1½", flanges ≥DN50, ≥ANSI 2", ≥JIS 50A

Rope insulation: FEP, PFA

E+H Configurator settings:
- Feature: 20
- Options: 1, 2, 5

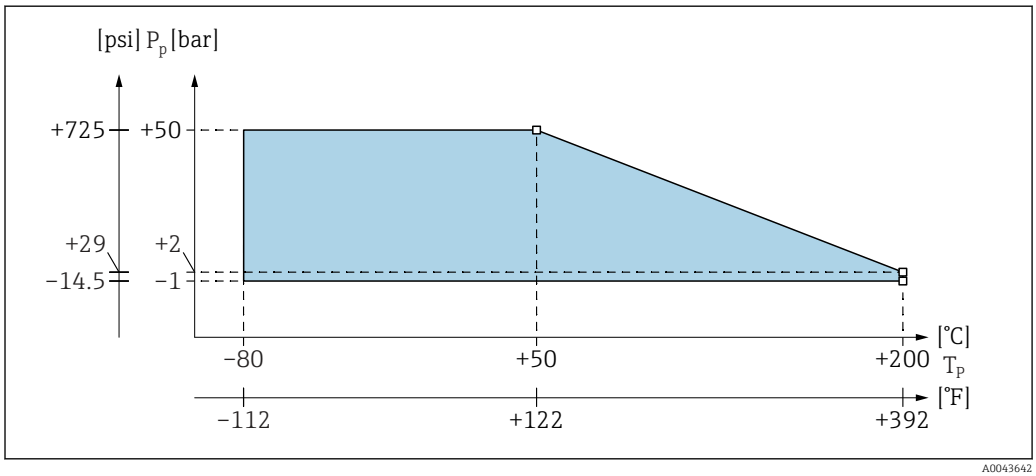


P_p *Process pressure*
T_p *Process temperature*
63 Process pressure for probes with an inactive length

For rope probe with a fully insulated inactive length

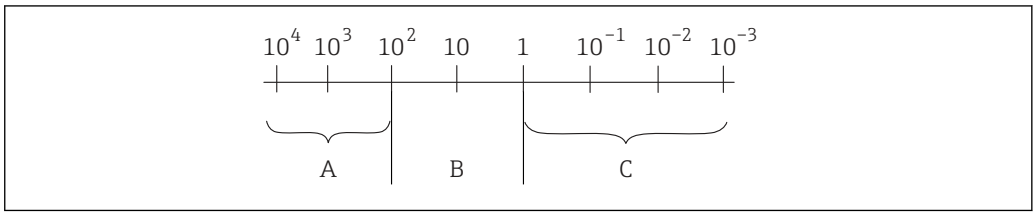
Rope insulation: FEP, PFA

E+H Configurator settings:
- Feature: 20
- Options: 3, 6



P_p *Process pressure*
T_p *Process temperature*

Conductivity



10 Unit of measurement: µS/cm

A The measuring accuracy is independent of the conductivity and dielectric constant value. The factory calibration is valid in this range.
B The measuring accuracy depends on the dielectric constant value and the conductivity of the medium. Measurement not recommendable, select therefore a different measurement principle.
C The measuring accuracy depends on the dielectric constant value.

Typical dielectric constant (DC) values:
- air: 1 µS/cm
- vacuum: 1 µS/cm
- general liquified gases: 1.2 to 1.7 µS/cm
- gasoline: 1.9 µS/cm
- diesel fuel: 2.1 µS/cm
- general oils: 2 to 4 µS/cm
- methyl ether: 5 µS/cm
- butanol: 11 µS/cm
- ammonia: 21 µS/cm
- latex: 24 µS/cm
- ethanol: 25 µS/cm
- caustic soda: 22 to 26 µS/cm
- acetone: 20 µS/cm
- glycerine: 37 µS/cm
- water: 81 µS/cm

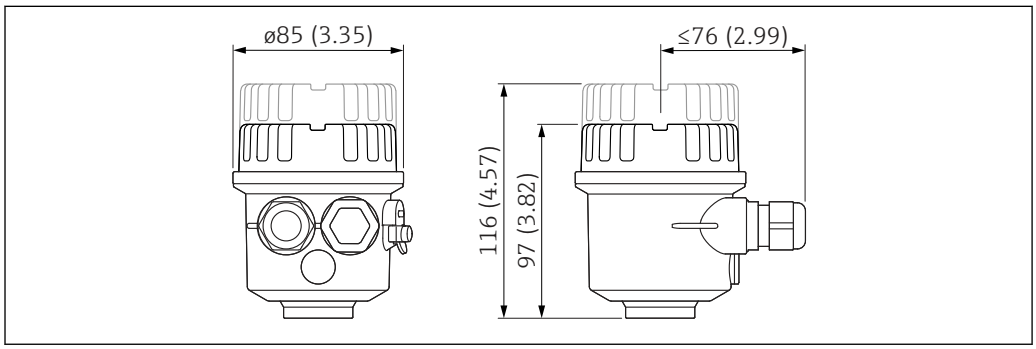
Further information and dielectric constants (DC values) in the Download Area of the Endress+Hauser web site:
- Endress+Hauser DC manual (CP01076F)
- Endress+Hauser "DC Values App" on Android and iOS

Mechanical construction

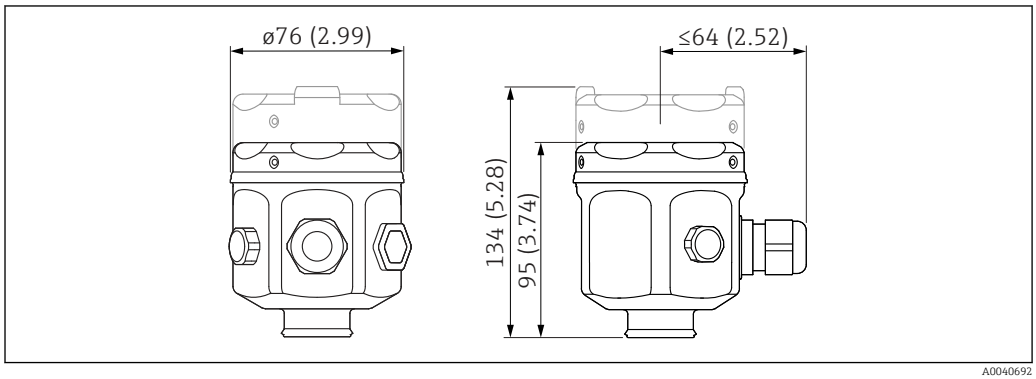
Design dimensions

Housing

Polyester housing F16

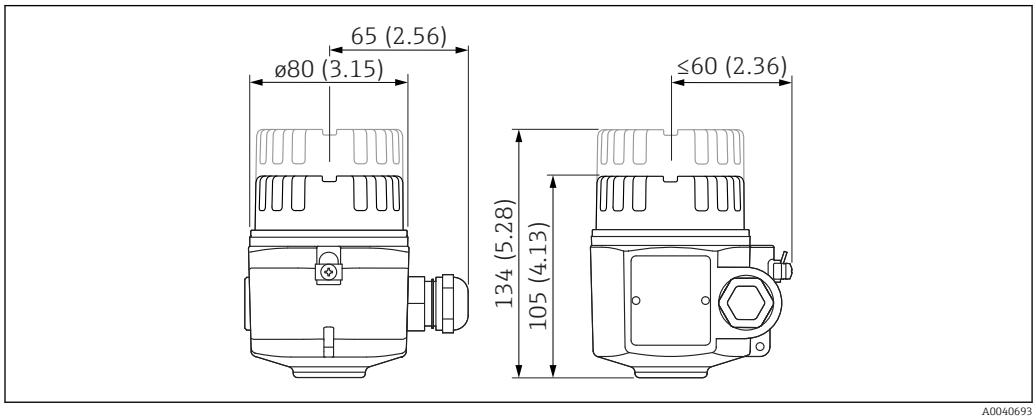


Stainless steel housing F15



Unit of measurement mm (in)

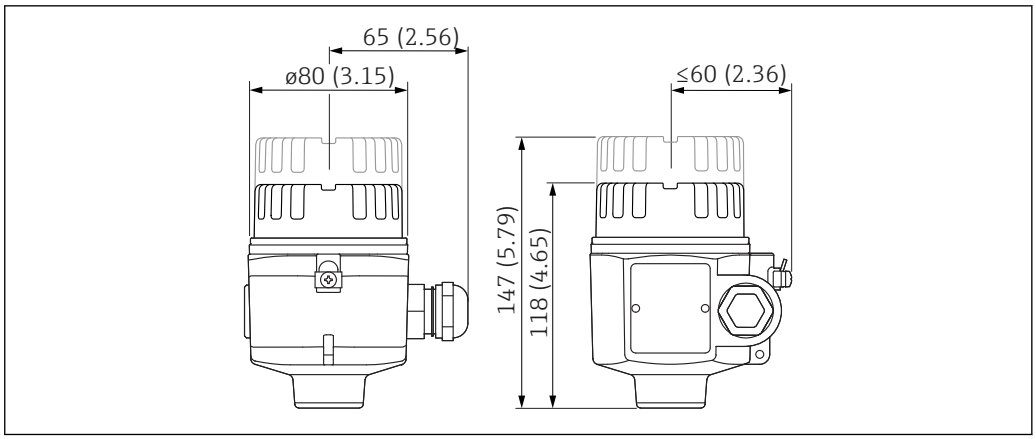
Aluminium housing F17



Unit of measurement mm (in)

Aluminum housing F13

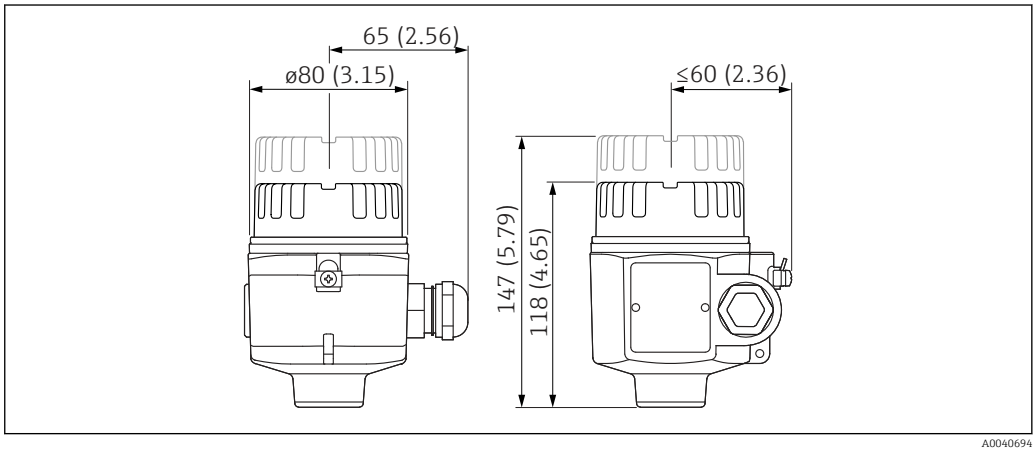
With the gas-tight process seal.



Unit of measurement mm (in)

Stainless steel housing F27

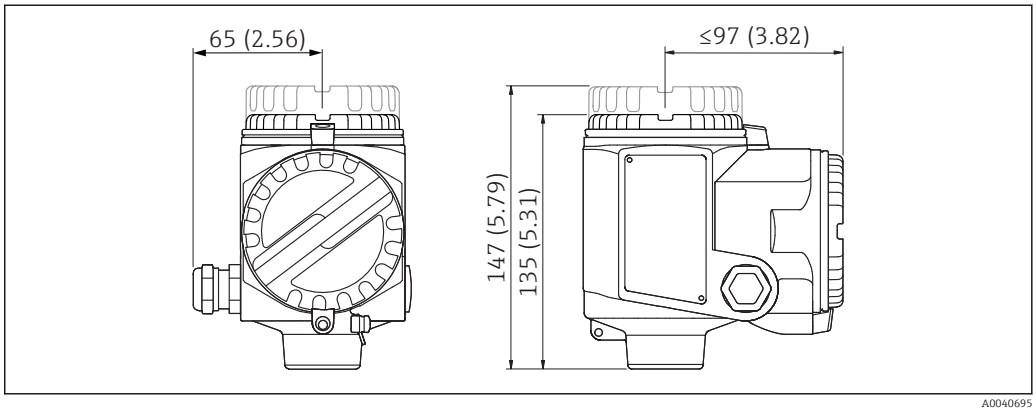
With the gas-tight process seal.



Unit of measurement mm (in)

Aluminum housing T13

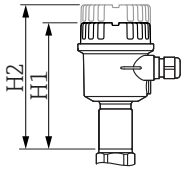
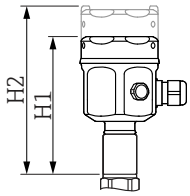
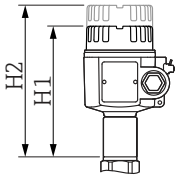
With separate connection compartment and gas-tight process seal.



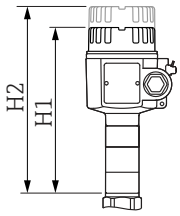
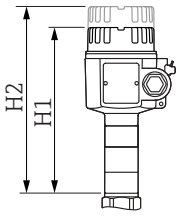
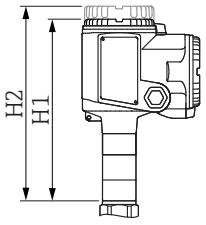
Unit of measurement mm (in)

The extension height of housing with adapter

List of abbreviations:
- G - order code
- H1 - height without display
- H2 - height with display

	A [1]	B [2]	C [3]
	 A0040696	 A0040697	 A0040698
G	2	1	3
H1	143 mm (5.63 in)	141 mm (5.55 in)	150 mm (5.91 in)
H2	162 mm (6.38 in)	179 mm (7.05 in)	179 mm (7.05 in)

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

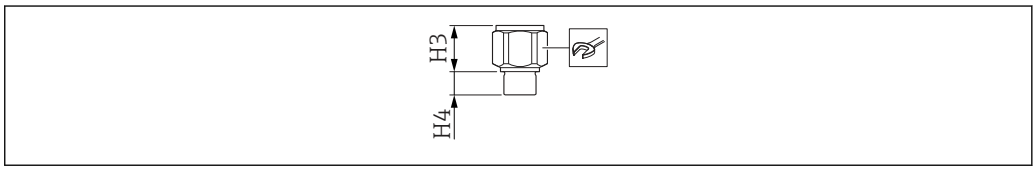
	D [1]	E [2]	F [3]
	 A0040699	 A0040699	 A0040700
G	4	6	5
H1	194 mm (7.64 in)	194 mm (7.64 in)	210 mm (8.27 in)
H2	223 mm (8.78 in)	223 mm (8.78 in)	223 mm (8.78 in)

1) Aluminum housing F13
2) Stainless steel housing F27
3) Aluminum housing T13

Process connections

Thread G - DIN EN ISO 228-1

Seal material: elastomer



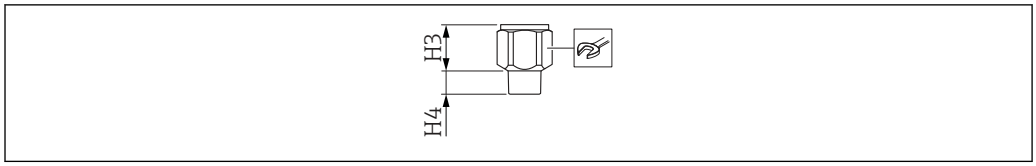
A0042280

List of abbreviations:
- p_{max} - maximum pressure value
- H3 - cone heights
- H4 - thread heights

A [1]			B [2]
E+H Cofigurator settings:			
Feature: 20 Option: 1, 2, 5			**Feature: 20 Option: 3, 6**
Version			
G¾	G1	G1½	G1½
Order code			
GDJ	GEJ	GGJ	GGJ
p_{max}			
25 bar (362.5 psi)	25 bar (362.5 psi)	100 bar (1450 psi)	50 bar (725 psi)
H3			
38 mm (1.5 in)	38 mm (1.5 in)	41 mm (1.61 in)	85 mm (3.35 in)
H4			
19 mm (0.75 in)	19 mm (0.75 in)	25 mm (0.98 in)	25 mm (0.98 in)
 A0011222			
41	41	55	55

1) Rope probe without inactive length or with inactive length in 316L
2) Rope probe with fully insulated inactive length

Thread NPT - ANSI B 1.20.1



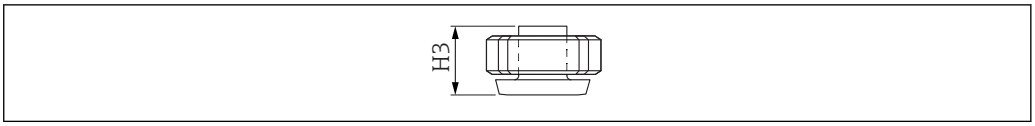
A0040702

List of abbreviations:
- p_{max} - maximum pressure value
- H3 - cone heights
- H4 - thread heights

A [1]						B [2]
E+H Cofigurator settings:						
Feature: 20 Option: 1, 2, 5						**Feature: 20 Option: 3, 6**
Version						
NPT½	NPT¾	NPT1	NPT¾	NPT1	NPT1½	NPT1½
Order code						
RCJ	RDJ	REJ	RDJ	REJ	RGJ	RGJ
p_{max}						
25 bar (362.5 psi)	25 bar (362.5 psi)	25 bar (362.5 psi)	25 bar (362.5 psi)	25 bar (362.5 psi)	100 bar (1450 psi)	50 bar (725 psi)
H3						
38 mm (1.5 in)	38 mm (1.5 in)	38 mm (1.5 in)	38 mm (1.5 in)	38 mm (1.5 in)	41 mm (1.61 in)	85 mm (3.35 in)
H4						
19 mm (0.75 in)	19 mm (0.75 in)	19 mm (0.75 in)	19 mm (0.75 in)	19 mm (0.75 in)	25 mm (0.98 in)	25 mm (0.98 in)
 A0011222						
41	41	41	41	41	55	55

1) Rope probe without inactive length or with inactive length in 316L
2) Rope probe with fully insulated inactive length

Threaded pipe joint - DIN11851



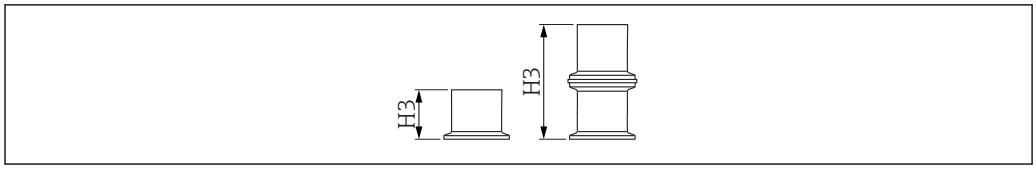
A0040703

List of abbreviations:
- p_{max} - maximum pressure value
- H3 - cone heights

A [1]
E+H Configurator settings:
Feature: 20 **Option: 1, 2, 5**
Version
DN50 PN40
Order code
MRJ
p_{max}
40 bar (580 psi)
H3
66 mm (2.6 in)
Surface roughness [2]
≤0.8 µm (31.5 µin)

1) Rope probe without inactive length or with inactive length in 316L
2) Not in conjunction with inactive length

Tri-Clamp - ISO2852



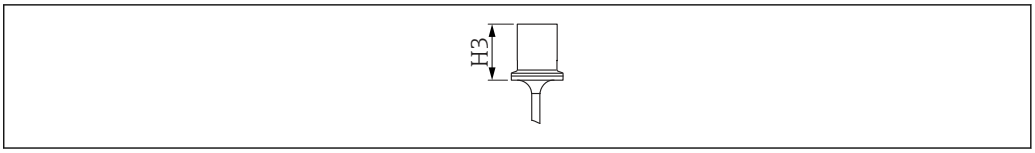
A0040704

List of abbreviations:
- p_{max} - maximum pressure value
- H3 - cone heights

A [1]		
E+H Configurator settings:		
Feature: 20 **Option: 1, 2, 5**		
Version		
DN25 1 in	DN38 1.5 in	DN40-51 2 in
Order code		
TCJ	TJJ	TDJ
p_{max} [2]		
25 bar (362.5 psi)	25 bar (362.5 psi)	40 bar (580 psi)
H3		
57 mm (2.24 in)	57 mm (2.24 in)	66 mm (2.6 in)
Surface roughness [3]		
≤ 0.8 µm (31.5 µin)	≤ 0.8 µm (31.5 µin)	≤ 0.8 µm (31.5 µin)

1) Rope probe without inactive length or with inactive length in 316L
2) In the event of CRN approval, the maximum permitted process pressure is 11 bar (159.5 psi).
3) Not in conjunction with inactive length

Tri-Clamp clad - ISO2852



A0040705

List of abbreviations:
- p_{max} - maximum pressure value
- H3 - cone heights

A [1]	
E+H Configurator settings:	
Feature: 20 **Option: 1**	
Version	
DN38 1.5 in	DN40-51 2 in
Order code	
TJK	TDK
p_{max} [2]	
16 bar (232 psi)	16 bar (232 psi)
H3	
66 mm (2.6 in)	66 mm (2.6 in)
Surface roughness [3]	
≤ 0.8 µm (31.5 µin)	≤ 0.8 µm (31.5 µin)

1) Rope probe without inactive length
2) In the event of CRN approval, the maximum permitted process pressure is 11 bar (159.5 psi).
3) Not in conjunction with inactive length

Flanges

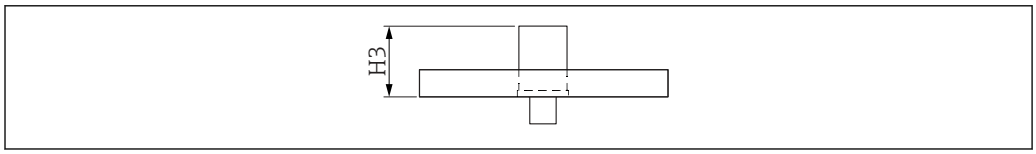
The process pressure depends on the chosen feature and the flange.

EN1092-1

ANSI B 16.5

JIS B2220

Version and order code:
- EN / B##
- ANSI / A##
- JIS / K##



A0040706

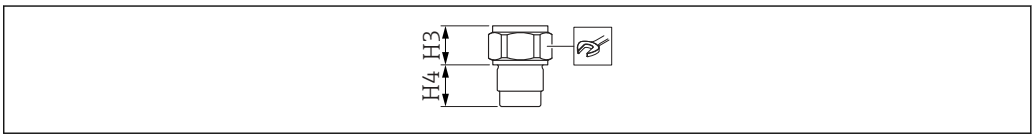
A [1]		B [2]
< DN50, < ANSI 2", < JIS 50A	**≥ DN50, ≥ ANSI 2", ≥ JIS 50A**	
E+H Configurator settings:		
Feature: 20 Option: 1, 2, 5		**Feature: 20 Option: 3, 6**
p_{max} [3]		
25 bar (362.5 psi)	100 bar (1450 psi)	50 bar (725 psi)
H3		
57 mm (2.24 in)	66 mm (2.6 in)	111 mm (4.37 in)
Dimensions with inactive length		
-	56 mm (2.2 in)	-
Additional information		
1 [4]	1 [4]	2 [5]

1) Rope probe without inactive length or with inactive length in 316L
2) Rope probe with fully insulated inactive length
3) Depends on flange
4) Also clad (PTFE)
5) Only clad (PTFE)

Hygiene connections for rope probes without inactive length

Thread G1 with flush-mounted seal

For weld-in adapter, see chapter "Accessories" → 📄 45.



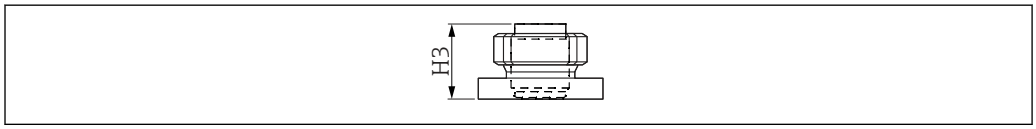
List of abbreviations:
- p_{max} - maximum pressure value
- H3 - cone heights
- H4 - thread heights

A [1]
E+H Configurator settings:
Feature: 20 **Option: 1**
Version
G1
Order code
GWJ
p_{max}
25 bar (362.5 psi)
H3
30 mm (1.18 in)
H4
27 mm (1.06 in)
 A0011222
41

1) Rope probe without inactive length

Adapter 44 mm (1.73 in) with flush-mounted seal

Version
Universal adapter



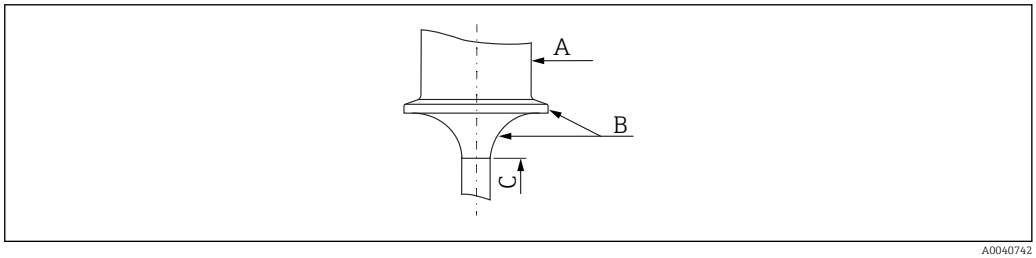
A0040709

A [1]
E+H Configurator settings:
Feature: 20 **Option: 1**
Order code
UPJ
p_{max} [2]
16 bar (232 psi)
H3
57 mm (2.24 in)

1) Rope probe without inactive length
2) Tightening torque 10 Nm (7.37 lbf ft)

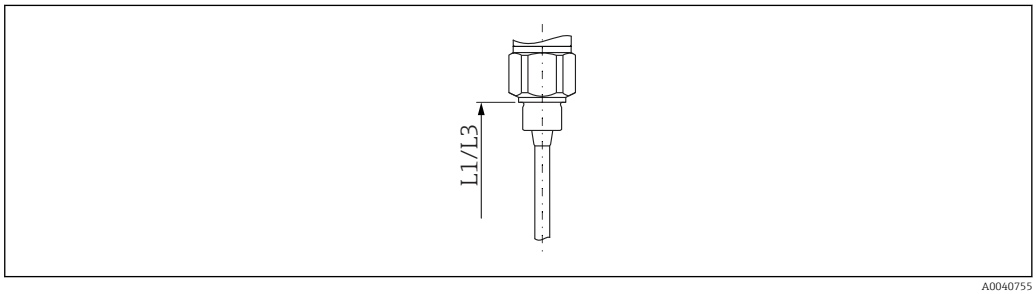
Rope probes

Remeber that:
- the rope probe is not suitable for agitator tanks, high-viscosity liquids and plastic tanks
- the active probe rod (L1) is always fully insulated
- the total length of the probe from the sealing surface equals: L = L1 + L3
- the thickness of insulation for probe rope is 0.75 mm (0.03 in)
- for conductive liquids > 100 µS/cm, the probe is adjusted at the factory to the probe length ordered 0 to 100 %
- for nonconductive liquids < 1 µS/cm the 0 % adjustment is performed at the factory and the 100 % adjustment has to be carried out on site
- in the range of the anchor weight the measurement is not linear
- all rope probes are prepared for tensioning in containers - tensioning weight or anchor hole
  - in case of media < 1 µS/cm, appropriate measures must be taken, e.g. a metallic reference point or a metallic tank
  - back-and-forth swinging of the rope directly influences the switch point. The probe must therefore be tightened
- the length tolerances L1, L3 equals:
  - < 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 to 12 m (20 to 39 ft) = 0 to −40 mm (0 to −1.57 in)



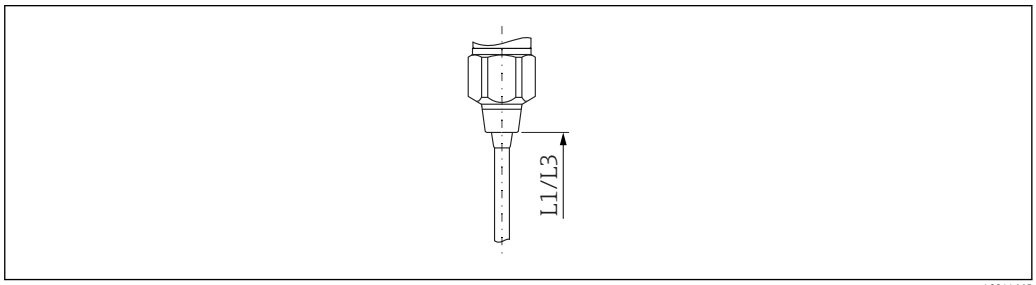
A0040742

A 316L
B PTFE
C PFA



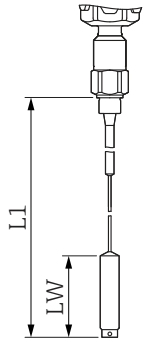
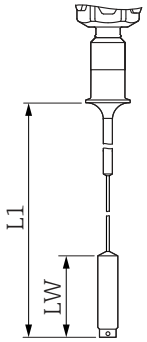
A0040755

11 The probe with G thread

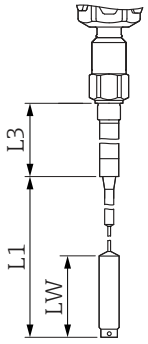
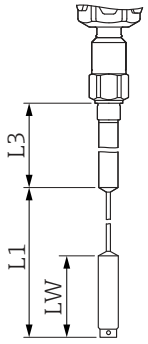


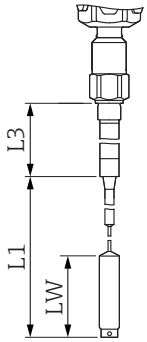
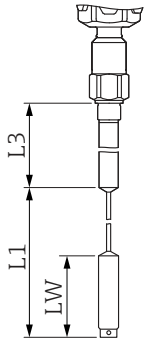
A0044665

12 The probe with the conical thread NPT

A [1]	B [2]
	
Total length L	
420 to 10000 mm (1.4 to 33 ft)	420 to 10000 mm (1.4 to 33 ft)
Active rope length L1	
420 to 10000 mm (1.4 to 33 ft)	420 to 10000 mm (1.4 to 33 ft)
Inactive length L3	
-	-
Rope diameter	
4 mm (0.16 in)	4 mm (0.16 in)
Inactive length diameter	
-	-
Anchor weight length (LW)	
120 mm (4.72 in)	120 mm (4.72 in)
Anchor weight diameter	
22 mm (0.87 in)	22 mm (0.87 in)
Anchor hole diameter	
5 mm (0.2 in)	5 mm (0.2 in)
Tensile loading capacity of the rope at 20 °C (68 °F)	
200 N (44.96 lbf)	200 N (44.96 lbf)
For conductive liquids > 100 µS/cm	
✔	✔
Nonconductive liquids < 1 µS/cm	
-	-
For aggressive liquids	
✔	✔
For high-viscosity liquids	
-	-
For use in mounting nozzles	
-	-
The probe can be used in the event of condensate on tank ceiling	
-	-

1) Rope probe
2) Rope probe with Tri-Clamp clad

C [1]		D [2]
 A0040758		 A0040759
Total length L		
570 to 10 000 mm (1.9 to 33 ft)		570 to 10 000 mm (1.9 to 33 ft)
Active rope length L1		
420 to 9 850 mm (1.4 to 32 ft)		420 to 9 850 mm (1.4 to 32 ft)
Inactive length L3		
150 to 2 000 mm (0.5 to 6.6 ft)		150 to 1 000 mm (0.5 to 39.4 in)
Rope diameter		
4 mm (0.16 in)		4 mm (0.16 in)
Inactive length diameter		
22 mm (0.87 in) [3]	43 mm (1.69 in) [4]	22 mm (0.87 in) [5]
Anchor weight length (LW)		
120 mm (4.72 in)		120 mm (4.72 in)
Anchor weight diameter		
22 mm (0.87 in)		22 mm (0.87 in)
Anchor hole diameter		
5 mm (0.2 in)		5 mm (0.2 in)
Tensile loading capacity of the rope at 20 °C (68 °F)		
200 N (44.96 lbf)		200 N (44.96 lbf)
For conductive liquids > 100 µS/cm		
✔		✔
Nonconductive liquids < 1 µS/cm		
✔		✔
For aggressive liquids		
-		✔
For high-viscosity liquids		
-		-
For use in mounting nozzles		
✔		✔

C [1]	D [2]
 A0040758	 A0040759
The probe can be used in the event of condensate on tank ceiling	
✔	✔

1) Rope probe with inactive length
2) Rope probe with fully insulated inactive length
3) The diameter value of the inactive length depends on the process connection selected: Ø22: GDJ, GEJ, RDJ, REJ, TCJ, TJJ; Flange: ASME B16.5: NPS ≤ 1½", EN1092-1: ≤ DN40, JIS: ≤ 10K40;
4) The diameter value of the inactive length depends on the process connection selected: Ø43: GGJ, RGJ, TDJ, MRJ; Flange: ASME B16.5: NPS ≥2", EN1092-1: ≥ DN50, JIS: ≥ 10K50
5) Probe tube

Weight

Housing with process connection:
- F15, F16, F17, F13 approximately 4.00 kg (8.82 lb)
- T13 approximately 4.50 kg (9.92 lb)
- F27 approximately 5.50 kg (10.1 lb)

Flange weight
Probe rope: 0.04 kg/m (0.03 lb/ft)

Measuring rope specifications

Capacitance values of the probe

The basic capacitance of the probe is approximately 18 pF.

Additional capacitance

Mount the probe at a minimum distance of 50 mm (1.97 in) from a conductive container wall: approximately 1.0 pF/100 mm (3.94 in) in the air for a rope probe

Insulated probe rope in water:
approximately 19 pF/100 mm (3.94 in) in air

Materials

Material specifications as per AISI and DIN-EN.

In contact with the process
- Probe rope: 316L (1.4401)
- Probe rope insulation:
  - if FEP selected: FEP, PTFE and PFA (FDA 21 CFR 177.1550)
  - if PFA selected: PTFE and PFA (FDA 21 CFR 177.1550)
- Process connection: 316L (1.4435 or 1.4404)
- Flat seal for process connection G¾ or G1: elastomer fiber, asbestos-free
- Sealing ring for process connection G½, G¾, G1, G1½: elastomer fiber, asbestos-free, resistant to lubricants, solvents, steam, weak acids, and alkalis to 300 °C (572 °F) and to 100 bar (1450 psi)

Not in contact with the process
- ground terminals on housing (exterior): 304 (1.4301)
- the nameplate on housing (exterior): 304 (1.4301)
- cable glands:
  - housing F13, F15, F16, F17, F27: polyamide (PA) with C, D, E, F, H, M, J, P, S, 1, 4, 5 approval: nickel-plated brass
  - housing T13: nickel-plated brass

- polyester housing F16: PBT-FR with a cover made of PBT-FR or with sight glass made of PA12
  - cover seal: EPDM
  - adhesive nameplate: polyester foil (PET)
  - pressure compensation filter: PBT-GF20
- stainless steel housing F15: 316L (1.4404)
  - cover seal: silicone
  - cover clamp: 304 (1.4301)
  - pressure compensation filter: PBT-GF20, PA
- aluminum housing F17/F13/T13: EN-AC-AlSi10Mg, plastic-coated
  - cover seal: EPDM
  - cover clamp: nickel-plated brass
  - pressure compensation filter: silicone (not T13)
- stainless steel housing F27: 316L (1.4435)
  - cover seal: FVMQ, optional: EPDM seal available as a spare part
  - cover clamp: 316L (1.4435)

Operability

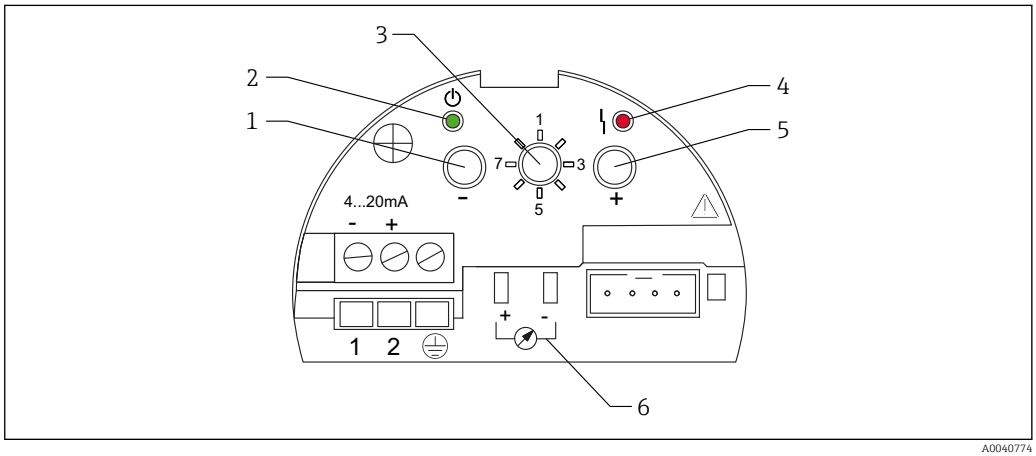
Operating concept

This device can operate with:
- the operating elements at the FEI50H or FEI57C electronic insert
- the display and operating module
- the HART protocol with Commubox FXA195 and FieldCare operating program
- the HART handheld terminal

Local operation

Electronic inserts

FEI50H (4 to 20 mA / HART version 5)



1 Key ⊟
2 Green LED - operational status
3 Mode switch
4 Red LED - fault
5 Key ⊞
6 Current pick-off 4 to 20 mA

Mode switch positions:

1: Operation

2: Empty adjustment

3: Full adjustment

4: Measuring modes - buildup

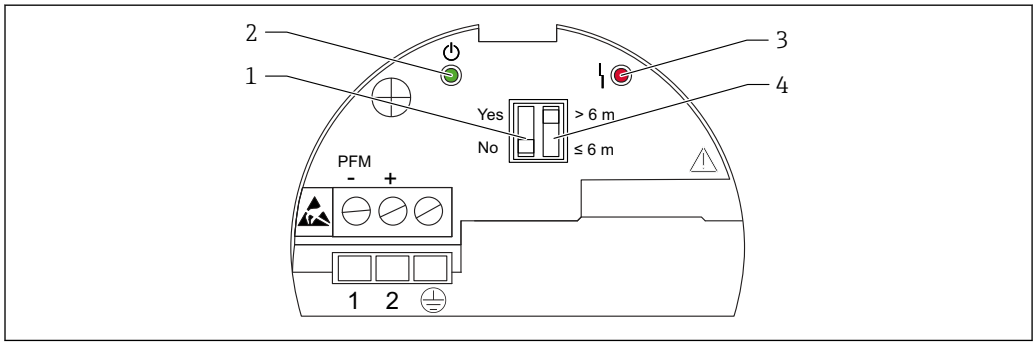
5: Measuring range

6: Self-test

7: Reset

8: Upload sensor EEPROM

FEI57C (PFM output)



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

Elements description

- Two-position DIP switch "Build up" (1):
  - YES: setting is recommended for media that cause heavy buildup, e.g. honey
  - NO: setting is recommended for media that do not cause buildup, e.g. water
- Green LED - operational status (2):
  - indicates that the device is ready for operation when flashes every 5 s
- Red LED - fault (3):
  - flashes 5x a second - Alarm.
  The PFM output signalized an error current signal and sets the output of the connected switching unit to 3.6 mA or 22 mA. The switching unit outputs an alarm itself.
  - flashes 1x a second - Warning
  The temperature in the electronic insert is outside the permitted temperature range.
- Two-position DIP switch "Probe length" (4):
  - probe length > 6 m (20 ft)
  - probe length ≤ 6 m (20 ft)

Local display

The optional display can be used to configure via 3 keys directly at the device. All device functions can be set via menu operation. The menu consists of function groups and functions. Application parameters can be read or set in the functions.

The menu guidance with integrated help texts ensures quick and safe commissioning. For accessing the display, the cover of the electronics compartment can also be opened in hazardous areas (Ex ia).

Remote operation

FieldCare Device Setup - the operating program

FieldCare is a graphic operating program for Endress+Hauser measuring devices based on the time-of-flight principle. It is used to support commissioning, data backup, signal analysis and documentation of the devices.

The following operating systems are supported:
- Windows 7 Professional SP1 (x32+x64)
- Windows 7 Ultimate SP1 (x32+x64)
- Windows 7 Enterprise SP1 (x32+x64)
- Windows Server 2008 R2 SP2
- Windows 8.1
- Windows 8.1 Professional
- Windows 8.1 Enterprise
- Windows 10 Professional
- Windows 10 Enterprise

FieldCare supports the following functions:
- configuration of transmitters in online operation
- tank linearization
- loading and saving device data (upload or download)
- documentation of the measuring point

Further information on FieldCare is provided on the CD-ROM which is supplied with the device.

FieldCare

Function scope

FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field devices in a system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.

For additional information about FieldCare, see Operating Instructions BA00027S and BA00059S

Connection options: HART via Commubox FXA195 and the USB port of a computer

Source for device description files

- www.endress.com → Downloads
- CD–ROM (contact Endress+Hauser)
- DVD (contact Endress+Hauser)

Certificates and approvals

CE mark

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

RoHS

The measuring system complies with the substance restrictions of the Restriction on Hazardous Substances Directive 2011/65/EU (RoHS 2).

RCM-Tick marking

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

Ex approval

- ATEX
- IECEx
- CSA
- FM
- NEPSI
- INMETRO
- EAC

See "Ordering information" → 45.

Hygienic compatibility

Information regarding device versions that meet the requirements of 3A Sanitary Standard No. 74 and/or are certified by the EHEDG:

SD02503F

Suitable fittings and seals must be used to ensure hygiene-compliant design according to 3A and EHEDG specifications.

Comply with the maximum permitted temperature of the process seal.

The gap-free connections can be cleaned of all residue using the typical cleaning methods within this industry (CIP and SIP).

EAC conformity

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

Other standards and guidelines

EN 60529
Degrees of protection by housing (IP code)

EN 61010
Protection measures for electrical equipment for measurement, control, regulation and laboratory procedures

EN 61326
Interference emission (Class B equipment), interference immunity (Annex A - Industrial).

NAMUR
Association for Standards for Control and Regulation in the Chemical Industry

IEC 61508
Functional safety

CRN approval

Versions with a CRN approval (Canadian Registration Number) are listed in the corresponding registration documents. CRN-approved devices are labeled with registration number CRN 0F1988.7C on the nameplate. You can find further details on the maximum pressure values in the "Download Area" of the Endress+Hauser website: www.endress.com.

Additional approvals

The wetted device components are listed in:
- "Mechanical construction" → 📄 26
- "Ordering information" → 📄 45

To find a list of all cetificates go into the chapter "Certificates" → 📄 46.

AD2000
The wetted material (316L) corresponds to AD2000 – W0/W2.

Pressure Equipment Directive 2014/68/EU

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

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

Reasons:

According to Article 2, point 5 of EU Directive 2014/68/EU, pressure accessories are defined as "devices with an operational function and having pressure-bearing housings". If a pressure instrument does not have a pressure-bearing housing (no identifiable pressure chamber of its own), there is no pressure accessory present within the meaning of the Directive.

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 information specific to the measuring point, such as the 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

Accessories

Protective cover	**Protective cover for F13, F17 and F27 housing** order number: 71040497 **Protective cover for F16 housing** order number: 71127760
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the RS232C interface or USB.
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.
Weld-in adapter	All available weld-in adapters are described in the document TI00426F. The documentation is available in the Download section on Endress+Hauser web site: www.endress.com

Documentation

Technical Information

Fieldgate FXA320, FXA520
TI00025S

Operating Instructions

Liquicap M FMI52 HART
BA02021F

Liquicap M FMI52 PFM
BA01986F

Certificates

ATEX safety instructions
Liquicap M FMI52
- II 1/2 G Ex ia IIC T3...T6 Ga/Gb
  II 1/2 G Ex ia IIB T3...T6 Ga/Gb
  II 1/2 D Ex ia IIIC T90 °C Da/Db
  XA00327F
- II 1/2 Ex ia/db IIC T6...T3 Ga/Gb
  II 1/2 Ex ia/db eb IIC T6...T3 Ga/Gb
  II 1/2 D Ex ia /tb IIIC T90 °C Da/Db
  XA00328F
- Ga/Gb Ex ia IIC T3...T6
  Zone 20/21 Ex iaD 20/Ex tD A21 IP65 T 90 °C
  IECEx BVS 08.0027X
  XA00423F
- II 3 G Ex nA IIC T6 Gc
  II 3 G Ex nA nC IIC T5 Gc
  II 3C D Ex tc IIIC T100 °C Dc
  XA00346F

INMETRO safety instructions
Liquicap M FMI52
- Ex d [ia Ga] IIB T3...T6 Ga/Gb
  Ex d [ia Ga] IIC T3...T6 Ga/Gb
  Ex de [ia Ga] IIC T3...T6 Ga/Gb
  XA01171F
- Ex ia IIC T* Ga/Gb
  Ex ia IIB T* Ga/Gb
  Ex ia IIIC T90 °C Da/Db IP66
  XA01172F

NEPSI safety instructions
- Liquicap M FMI52
  Ex ia IIC/IIB T3...T6 Ga/Gb
  XA00417F
- Liquicap M FMI52
  Ex d ia IIC/IIB T3/T4/T6 Ga/Gb
  Ex d e ia IIC/IIB T3/T4/T6 Ga/Gb
  XA00418F
- Liquicap M FMI52
  Ex nA IIC T3...T6 Gc
  Ex nA nC IIC T3...T6 Gc
  XA00430F

Overfill protection DIBt (WHG)
Liquicap M FMI52
ZE00265F

Functional safety (SIL2)
Liquicap M FMI52
SD00198F

Control Drawings (CSA and FM)

- Liquicap M FMI52
  FM IS
  ZD00220F
- Liquicap M FMI52
  CSA IS
  ZD00221F
- Liquicap M FMI52
  CSA XP
  ZD00233F



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