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Technical Information
Levelflex FMP51
Modbus

Guided-wave radar

Level and interface measurement in liquids

Application

- Rod, rope or coax probe
- Process connection: Starting 3/4" thread or flange
- Process temperature: −50 to +200 °C (−58 to +392 °F)
- Process pressure: −1 to +40 bar (−14.5 to +580 psi)
- Maximum measuring range: Rod 10 m (33 ft); rope 45 m (148 ft); coax 6 m (20 ft)
- Accuracy: ±2 mm (±0.08 in)
- International explosion protection certificates; EN10204-3.1
- Linearity protocol (3-point)

Your benefits

- Reliable measurement even for changing product and process conditions
- HistoROM data management for easy commissioning, maintenance and diagnostics
- Highest reliability due to Multi-Echo Tracking
- Seamless integration into control or asset management systems
- Intuitive user interface in national languages

Endress+Hauser
People for Process Automation

Table of contents

Important 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

Direct current

Alternating current

Direct current and alternating 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 inside and outside of the device.
- Inner ground terminal; protective earth is connected to the mains supply.
- Outer ground terminal; device is connected to the plant grounding system.

Symbols for certain types of information and graphics

Permitted
Procedures, processes or actions that are permitted

Forbidden
Procedures, processes or actions that are forbidden

Tip
Indicates additional information

Reference to documentation

Reference to graphic

Notice or individual step to be observed

1., 2., 3.
Series of steps

Result of a step

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

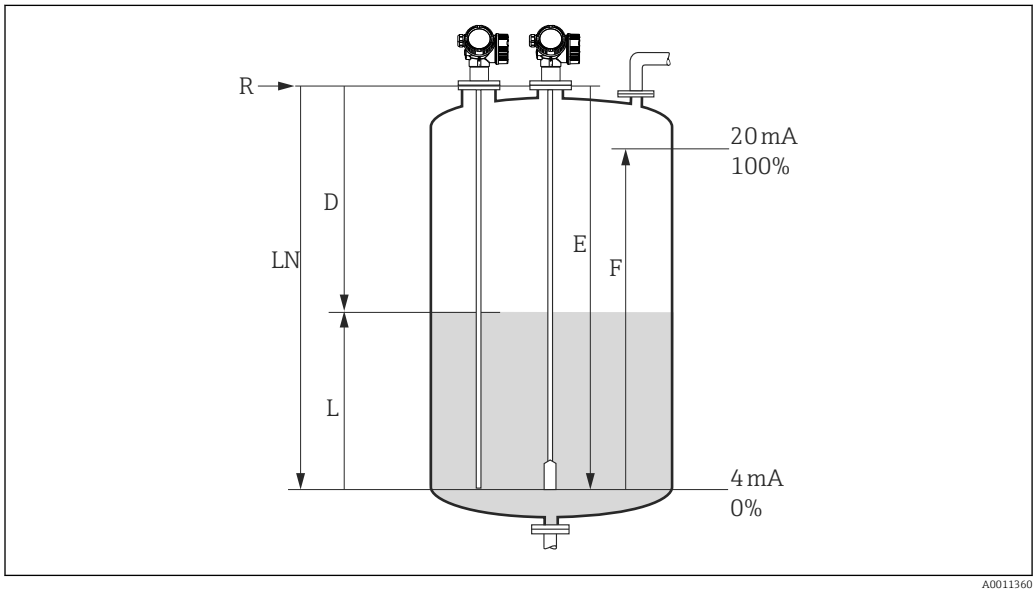
Temperature resistance of the connection cables
Specifies the minimum value of the temperature resistance of the connection cables

Function and system design

Measuring principle

General principles

The Levelflex is a "downward-looking" measuring system that functions according to the time-of-flight method (ToF). The distance from the reference point to the product surface is measured. High-frequency pulses are injected to a probe and led along the probe. The pulses are reflected by the product surface, received by the electronic evaluation unit and converted into level information. This method is also known as TDR (time domain reflectometry).



1 *Parameters for level measurement with guided wave radar*

LN Probe length
D Distance
L Level
R Reference point of measurement
E Empty calibration (= zero)
F Full calibration (= span)

If the ε_r value is less than 7 in the case of rope probes, measurement is not possible in the area of the tensioning weight (0 to 250 mm (0 to 9.84 in) from the probe end), (lower blocking distance).

The reference point **R** of the measurement is located at the process connection.

Dielectric constant

The dielectric constant (DC) of the medium directly affects the degree of reflection of the high-frequency pulses. In the case of large DC values, such as with water or ammonia, there is strong pulse reflection while, in the case of low DC values, such as with hydrocarbons, pulse reflection is weak.

Input

The reflected pulses are transmitted from the probe to the electronics. Here, a microprocessor evaluates the signals and identifies the level echo which was caused by the reflection of the high-frequency pulses at the product surface. This clear signal detection system benefits from over 30 years of experience with pulse time-of-flight procedures that have gone into the development of the PulseMaster® software.

The distance D to the product surface is proportional to the time-of-flight t of the pulse:

$D = c \cdot t/2$,

where c is the speed of light.

Based on the known empty distance E, the level L is calculated:

L = E – D

The reference point R of the measurement is located at the process connection. For details, see: FMP51: (Verweisziel existiert nicht, aber @y.link.required='true')

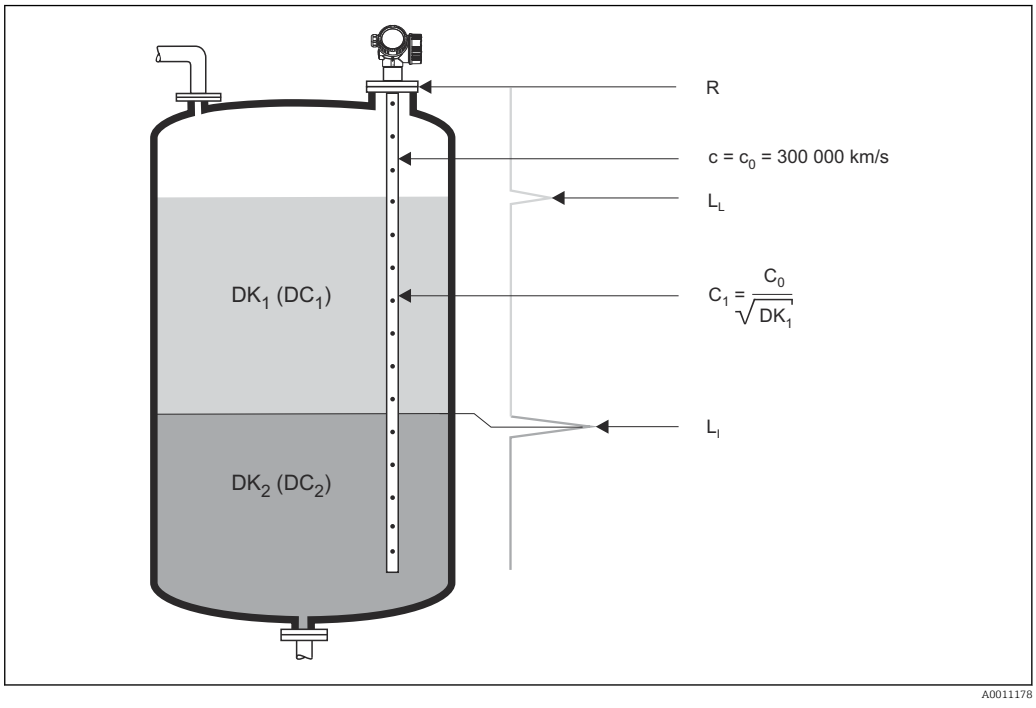
The Levelflex includes user-activated functions for filtering out interference echos (mapping). These functions guarantee that interference echoes from internal fixtures and struts, for example, are not interpreted as level echoes.

Output

The Levelflex is preadjusted at the factory to the probe length ordered so that in most cases only the application parameters that automatically adapt the device to the measuring conditions need to be entered. For models with a current output, the factory adjustment for zero point E and span F is 4 mA and 20 mA, for digital outputs and the display module 0 % and 100 %. A linearization function with max. 32 points, which is based on a table entered manually or semi-automatically, can be activated on site or via remote operation. This function allows the level to be converted into units of volume or mass, for example.

Interface measurement

When the high-frequency pulses hit the surface of the medium, only a percentage of the transmission pulse is reflected. In the case of medium with a low DC_1, in particular, the other part enters the medium. The pulse is reflected once more at the interface point to a second medium with a higher DC_2. The distance to the interface layer can now also be determined, taking into account the delayed time-of-flight of the pulse through the upper medium.



2 *Interface measurement with the guided-wave radar*

LL Total level
LI Interface level
R Reference point of measurement

In addition, the following general conditions must be observed for interface measurement:
- The DC of the upper medium must be known and constant. If the interface thickness is known, the DC can be calculated automatically in FieldCare.
- The DC of the upper medium must not exceed 10.
- The DC difference between the upper and lower medium must be >10.
- The minimum thickness of the upper medium is 60 mm (2.4 in).
- Emulsion layers in the area of the interface can greatly attenuate the signal. However, emulsion layers up to 50 mm (2 in) are permitted.

For the relative permittivity values (ε_r values) of many media commonly used in industry, please refer to:
- Relative permittivity (ε_r value), Compendium CP01076F
- The Endress+Hauser "DC Values app" (available for Android and iOS)

Product life cycle

Planning
- Universal measuring principle
- Measurement unaffected by medium properties
- Genuine, direct interface measurement

Procurement
Worldwide support and service

Installation
- No special tools are required
- Protection against reverse polarity
- Modern, detachable terminals
- Main electronics protected by a separate connection compartment

Commissioning
- Fast, menu-guided commissioning in just 6 steps
- Plain text display in local language reduces the risk of error or confusion
- Direct local access to all parameters
- Printed Brief Operating Instructions in the device onsite

Operation
- Multi-echo tracking: Reliable measurement thanks to self-learning echo search algorithms taking into account the short-term and long-term history and plausibility of the detected signals to suppress interference echoes.
- In accordance with NAMUR NE107

Maintenance
- HistoROM: Data backup for device settings and measured values
- Exact device and process diagnostics to assist fast decisions with clear information regarding remedial action
- Intuitive, menu-guided operating concept in local language saves costs for training, maintenance and operation
- Cover of the electronics compartment can also be opened in the hazardous area

Retirement
- Order code translation for subsequent models
- RoHS-compliant (Restriction of certain Hazardous Substances), unleaded soldering of electronic components
- Environmentally friendly recycling approach

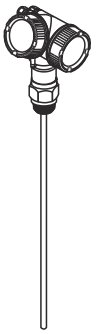
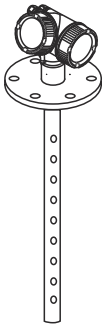
Measuring system

General notes on probe selection

- Normally use rod or coaxial probes for liquids. Rope probes are used in liquids for measuring ranges > 10 m (33 ft) (for FMP52: > 4 m (13 ft)) or if the ceiling clearance does not allow the installation of rigid probes.
- For interface measurement, ideally coaxial probes or rod probes are used in the bypass/stilling well.
- Coaxial probes are suitable for liquids with a viscosity of up to approx. 500 cst. The vast majority of liquefied gases can be measured with coaxial probes, from a dielectric constant of 1.4. Furthermore, installation conditions, such as nozzles, internal fixtures in the tank etc., have no effect on the measurement when a coaxial probe is used. A coaxial probe offers maximum EMC safety when used in plastic tanks.

Probe selection

The various types of probe in combination with the process connections are suitable for the following applications [1]:

Levelflex FMP51						
Type of probe	**Rod probe**		**Rope probe**		**Coaxial probe** [1]	
	 A0011387		 A0011388		 A0011359	
Feature 060 - probe:	**Version:**		**Version:**		**Version:**	
	AA	8 mm (316L)	LA	4 mm (316)	UA	... mm (316L)
	AB	1/3" (316L)	LB	1/6" (316)	UB	... inch (316L)
	AC	12 mm (316L)	MB	4 mm (316) with centering rod	UC	... mm (AlloyC)
	AD	1/2" (316L)	MD	1/6" (316) with centering rod	UD	... inch (AlloyC)
	AL	12 mm (AlloyC)				
	AM	1/2" (AlloyC)				
	BA BC	16 mm (316L) Separable				
	BB BD	0.63 in (316L) Separable				
Max. probe length	10 m (33 ft) [2]		45 m (148 ft)		6 m (20 ft)	
Application for	Level and interface measurement in liquids		Level and interface measurement in liquids		Level and interface measurement in liquids	

1) Punched for 1-1/2" thread or flange process connections; multiple holes for 316L; one hole for AlloyC
2) Maximum probe length for inseparable rod probes: 4 m (13 ft)

Input

Measured variable

The measured variable is the distance between the reference point and the product surface.

The level is calculated based on "E", the empty distance entered.

Optionally, the level can be converted to other variables (volume, mass) by linearization (32 points).

1) Rod and rope probes can be replaced if necessary. They are secured with Nord-Lock washers or a thread coating.

Measuring range

The following table describes the medium groups and the possible measuring range as a function of the medium group.

Levelflex FMP51					
Media group	DC (ε_r)	Typical liquids	Measuring range [1]		
			Bare metallic Rod probes	Bare metallic Rope probes	Coaxial probes
1	1.4 to 1.6	Liquefied gases, e.g. N2, CO2	On request		6 m (20 ft)
2	1.6 to 1.9	▪ Liquefied gas, e.g. propane ▪ Solvents ▪ Freon ▪ Palm oil	▪ One-piece: 4 m (13 ft) ▪ Separable: 10 m (33 ft)	15 to 22 m (49 to 72 ft)	6 m (20 ft)
3	1.9 to 2.5	Mineral oils, fuels	▪ One-piece: 4 m (13 ft) ▪ Separable: 10 m (33 ft)	22 to 32 m (72 to 105 ft)	6 m (20 ft)
4	2.5 to 4	▪ Benzene, styrene, toluene ▪ Furan ▪ Naphthalene	▪ One-piece: 4 m (13 ft) ▪ Separable: 10 m (33 ft)	32 to 42 m (105 to 138 ft)	6 m (20 ft)
5	4to 7	▪ Chlorobenzene, chloroform ▪ Nitrocellulose lacquers ▪ Isocyanate, aniline	▪ One-piece: 4 m (13 ft) ▪ Separable: 10 m (33 ft)	42 to 45 m (138 to 148 ft)	6 m (20 ft)
6	> 7	▪ Aqueous solutions ▪ Alcohols ▪ Ammonia	▪ One-piece: 4 m (13 ft) ▪ Separable: 10 m (33 ft)	45 m (148 ft)	6 m (20 ft)

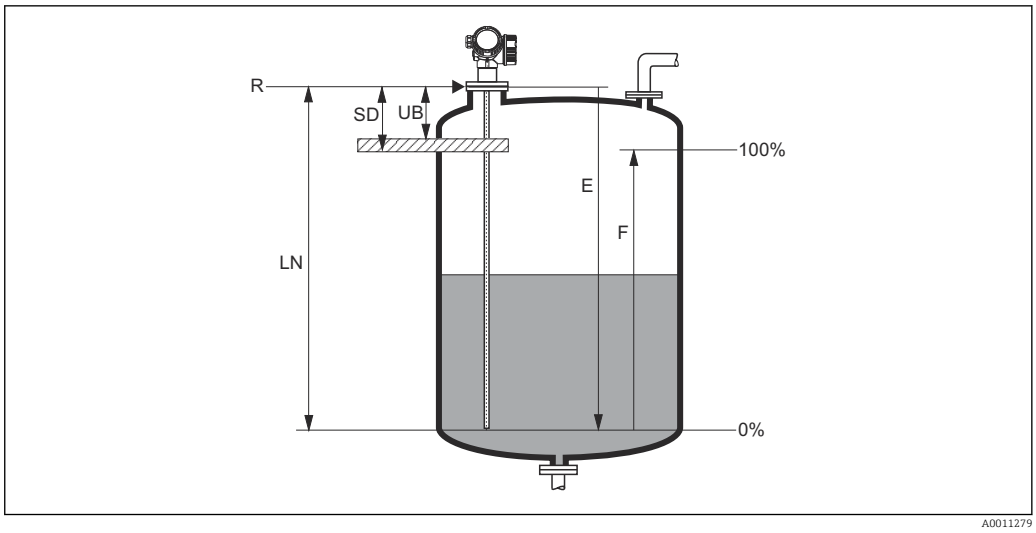
1) The measuring range for interface measurements is limited to 10 m (33 ft).

- The formation of buildup, particularly of moist products, can reduce the maximum possible measuring range.
- Due to the high rate of diffusion of ammonia, a gas-tight bushing [2] is recommended for measurements in this medium.

Blocking distance

The upper blocking distance (= UB) is the minimum distance from the reference point of the measurement (mounting flange) to the maximum level.

2) Optionally available for FMP51



3 *Definition of blocking distance and safety distance*

R Reference point of measurement
LN Probe length
UB Upper blocking distance
E Empty calibration (= zero)
F Full calibration (= span)
SD Safety distance

Blocking distance (factory setting):
- For coaxial probes: 0 mm (0 in)
- For rod and rope probes up to 8 m (26 ft): 200 mm (8 in)
- For rod and rope probes over 8 m (26 ft): 0.025 × probe length

The specified blocking distances are factory-preset on delivery. These settings can be changed depending on the application.

For rod and rope probes, the blocking distance can typically be reduced to 100 mm (4") for media with DC > 7 and generally for installation in a bypass/stilling well.

A reliable measurement cannot be guaranteed within the blocking distance.

A safety distance SD can be defined in addition to the blocking distance. The device generates a warning if the level rises to enter this safety distance.

Measuring frequency spectrum

100 MHz to 1.5 GHz

Output

Output signal

Modbus

Physical interface	RS485 in accordance with EIA/TIA-485 standard
Terminating resistor	Not integrated

Signal on alarm

Depending on the interface, failure information is displayed as follows:
- Local display
  - Status signal (as per NAMUR Recommendation NE 107)
  - Plain text display
- Operating tool via digital communication or service interface (CDI)
  - Status signal (as per NAMUR Recommendation NE 107)
  - Plain text display

Linearization

The device's linearization function allows the user to convert the measured value to any length or volume units. Linearization tables for calculating the volume in cylindrical vessels are preprogrammed into the device. Other tables of up to 32 value pairs can be entered manually or semi-automatically.

Galvanic isolation

All circuits for the outputs are galvanically isolated from each other.

Protocol-specific data

Modbus

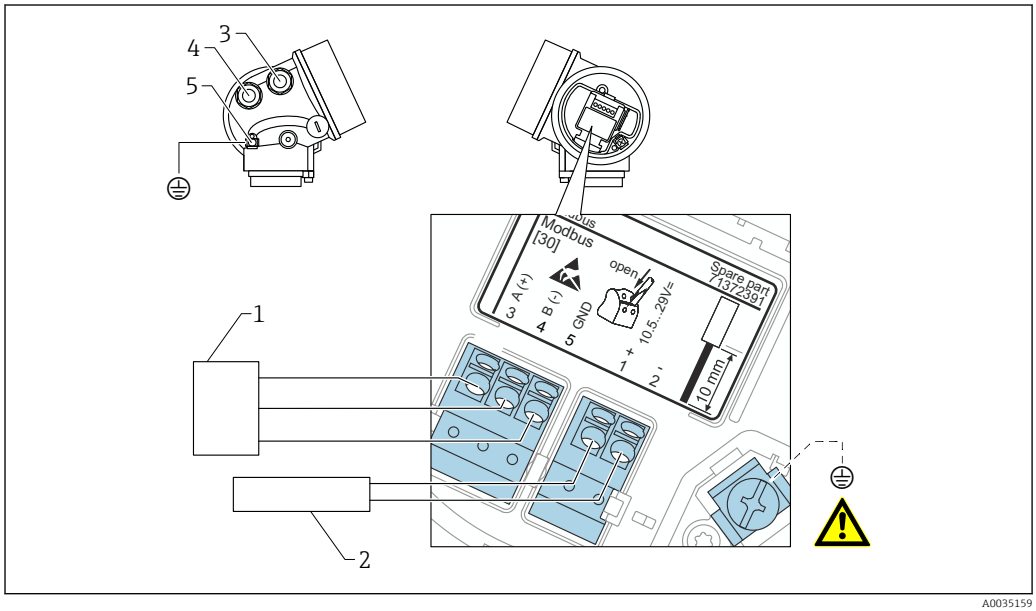
Protocol	▪ Modbus RTU ▪ Level Master
Response times	▪ Direct data access: typically 25 to 50 ms ▪ Auto-scan buffer (data range): typically 3 to 5 ms
Device type	Slave
Slave address range	1 to 63
Function codes	▪ 03: Read holding register ▪ 04: Read input register
Baud rate	Automatic baud rate detection
Parity	Automatic parity detection
Data transmission mode	RTU

Power supply

Terminal assignment

Modbus

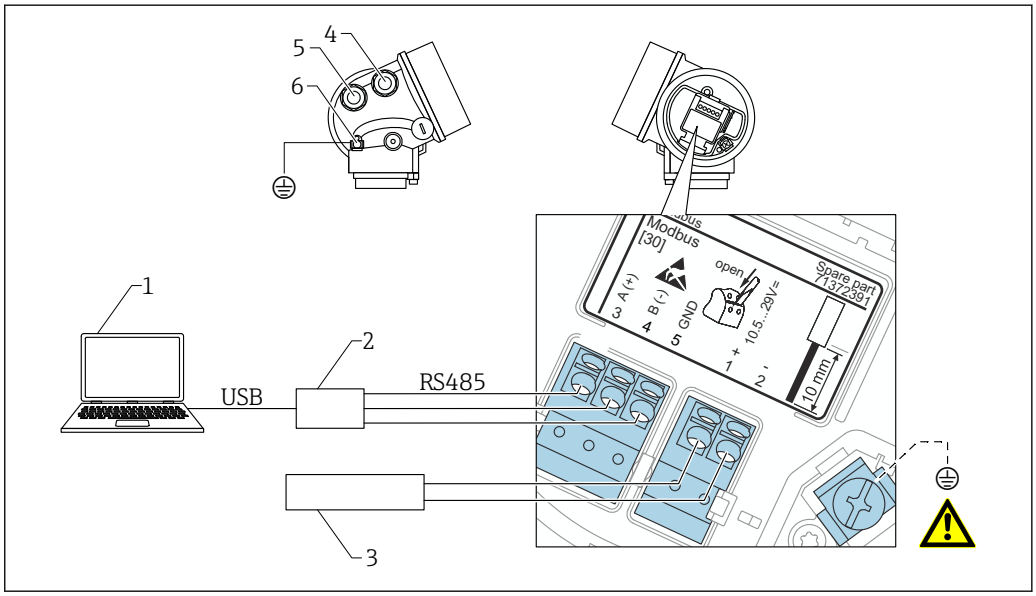
Connection to a Modbus master



1 Modbus master
2 Supply voltage
3 Cable entry for the Modbus connection
4 Cable entry for the supply voltage
5 Connection for protective ground

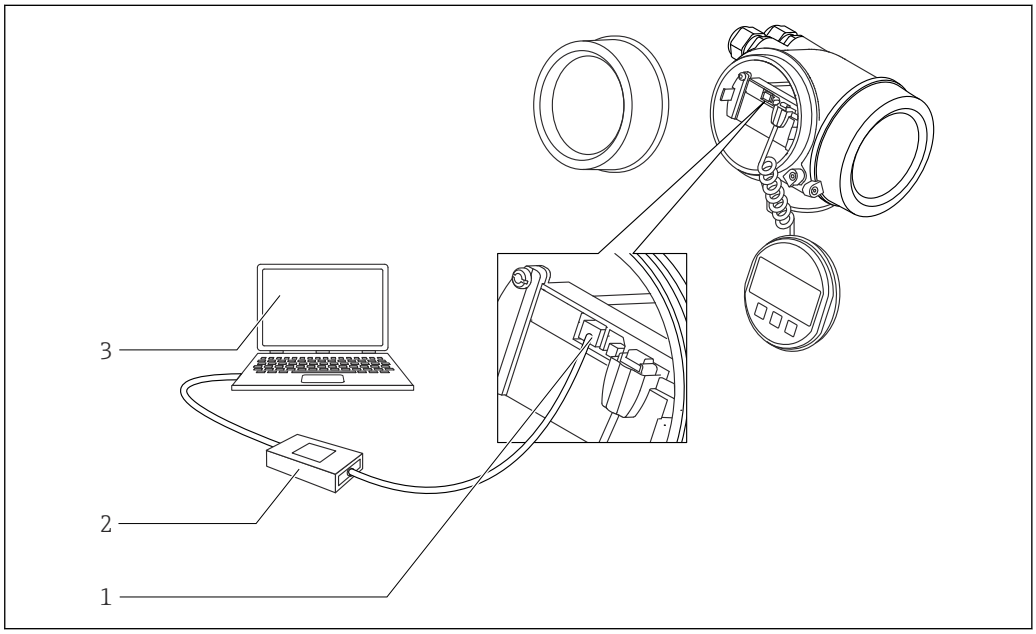
Connection to FieldCare/DeviceCare via RS485

For configuration via FieldCare or DeviceCare, it is advisable to disconnect the device from the bus and to connect it to the computer via a USB-to-RS485 interface.



1 *Computer with FieldCare/DeviceCare*
2 *USB-RS485 interface*
3 *Supply voltage*
4 *Cable entry for RS485*
5 *Cable entry for the supply voltage*
6 *Connection for protective ground*

Connection to DeviceCare/FieldCare via service interface



1 *Service interface (CDI) of the measuring device (= Endress+Hauser Common Data Interface)*
2 *Commubox FXA291*
3 *Computer with DeviceCare/FieldCare operating tool*

Supply voltage

Supply voltage	10.5 to 29 V_{DC}
Ripple	1 V_{SS} (< 100 Hz); 10 mV_{SS} (> 100 Hz)

Power consumption

Maximum	1 000 mW
Typical	400 mW

Power supply failure

- Configuration is retained in the HistoROM (EEPROM).
- Error messages (incl. value of operated hours counter) are stored.

Potential equalization

No special measures for potential equalization are required.

If the device is designed for hazardous areas, observe the information in the documentation "Safety Instructions" (XA).

Terminals

- **Supply voltage**
  Plug-in spring terminals for wire cross-sections 0.2 to 2.5 mm² (24 to 14 AWG)
- **Modbus**
  Plug-in spring terminals for wire cross-sections 0.2 to 1.5 mm² (24 to 16 AWG)

Cable entries

Connection of the power supply and signal cables

To be selected in feature 050 "Electrical connection":
- Coupling M20, material depends on approval:
  - For non-Ex, ATEX, IECEx, NEPSI Ex ia/ic:
    Plastic M20x1.5 for cable Ø5 to 10 mm (0.2 to 0.39 in)
  - For Dust-Ex, FM IS, CSA IS, CSA GP, Ex ec:
  - For Ex db:
    No cable gland available
- Thread
  - ½" NPT
  - G ½"
  - M20 × 1.5
- M12 plug / 7/8" plug
  Only available for non-Ex, Ex ic, Ex ia

Connection of remote display FHX50

Feature 030 "Display, operation"	Cable entry for connection of FHX50
L: "Prepared for display FHX50 + M12 connection"	M12 socket
M: "Prepared for display FHX50 + custom connection"	M12 cable gland

Cable specification

- Power line: Standard device cable
- Modbus connection : A shielded cable is recommended. Observe grounding concept of the plant.

Performance characteristics

Reference conditions

- Temperature = +24 °C (+75 °F) ±5 °C (±9 °F)
- Pressure = 960 mbar abs. (14 psia) ±100 mbar (±1.45 psi)
- Humidity = 60 % ±15 %
- Reflection factor ≥ 0.8 (water surface for coaxial probe, metal plate for rod and rope probe with min. 1 m (40 in) diameter)
- Flange for rod or rope probe ≥ 300 mm (12 in) diameter
- Distance to obstacles ≥ 1 m (40 in)
- For interface measurement:
  - Coaxial probe
  - DC of lower medium = 80 (water)
  - DC of upper medium = 2 (oil)

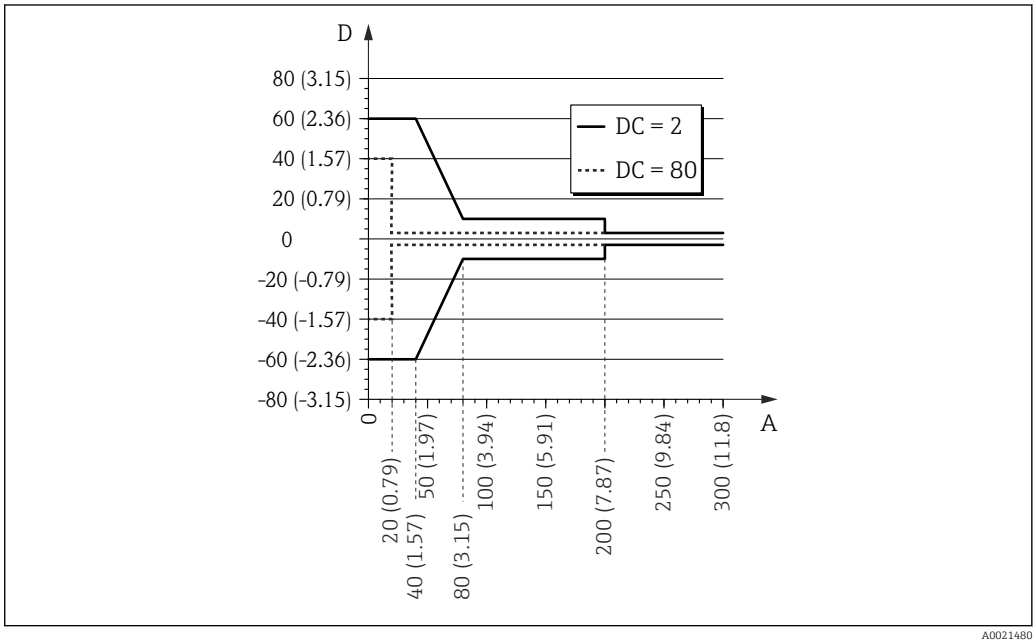
Reference accuracy

Typical data under reference operating conditions: DIN EN IEC 61298-2 / DIN EN IEC 60770-1; percentage values in relation to the span.

Output:	digital	analog [1]
Accuracy (sum of non-linearity, non-repeatability and hysteresis) [2]	**Level measurement:** ▪ Measuring distance up to 15 m (49 ft): ±2 mm (±0.08 in) [3] ▪ Measuring distance > 15 m (49 ft): ±10 mm (±0.39 in)	±0.02 %
	Interface measurement: ▪ Measuring distance up to 500 mm (19.7 in): ±20 mm (±0.79 in) ▪ Measuring distance > 500 mm (19.7 in): ±10 mm (±0.39 in) ▪ If thickness of upper medium < 100 mm (3.94 in): ±40 mm (±1.57 in)	
Non-repeatability [4]	≤ 1 mm (0.04 in)	

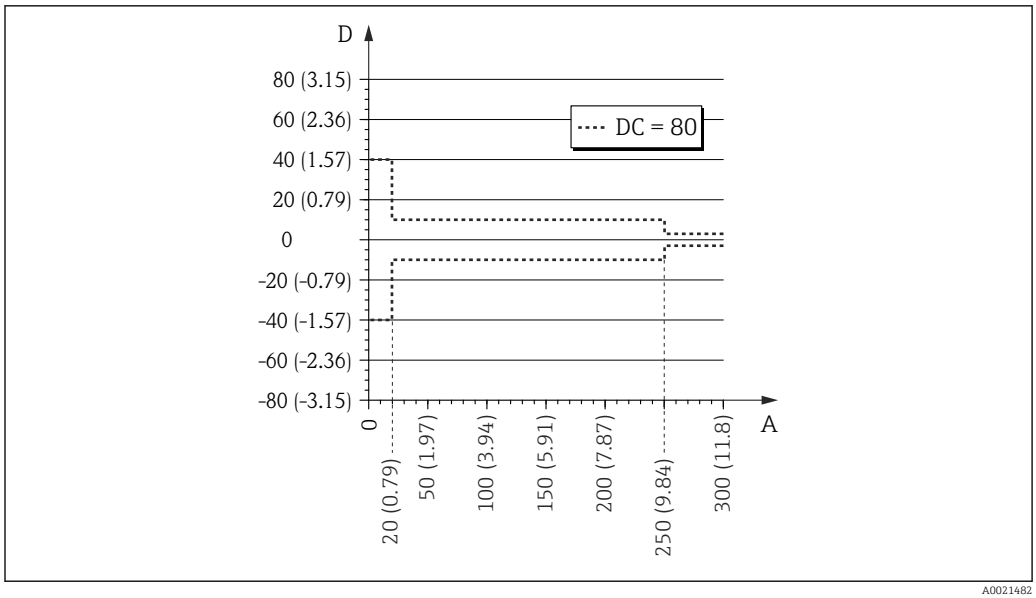
1) Add error of the analog value to the digital value.
2) If the reference conditions are not met, the offset/zero point resulting from the installation conditions can be up to ±16 mm (±0.63 in). This additional offset/zero point can be compensated for by entering a correction ("Level correction" parameter) during commissioning.
3) For probes with centering stars, the accuracy may deviate close to the centering stars.
4) The non-repeatability is already considered in the accuracy.

In the area of the lower probe end, the following measurement error applies specifically for level measurement:



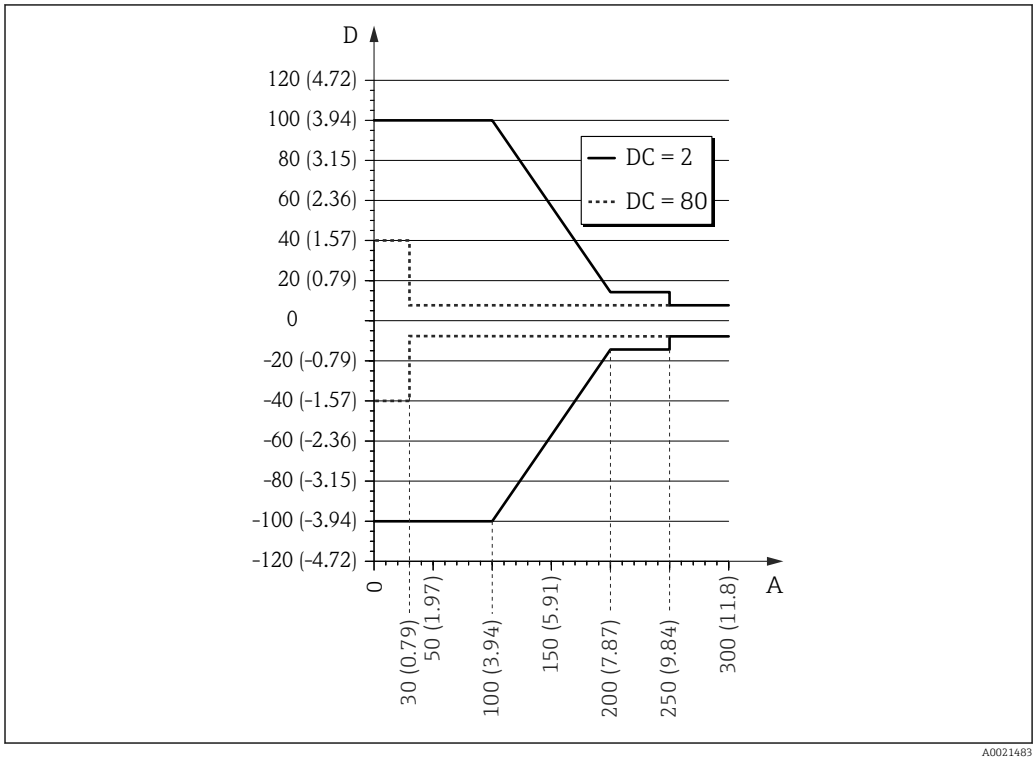
4 Measurement error at the probe end for rod and coaxial probes

A Distance from the probe end [mm(in)]
D Measurement error: Sum of non-linearity, non-repeatability and hysteresis



5 Measurement error at the probe end for rope probes

A Distance from the probe end [mm(in)]
D Measurement error: Sum of non-linearity, non-repeatability and hysteresis

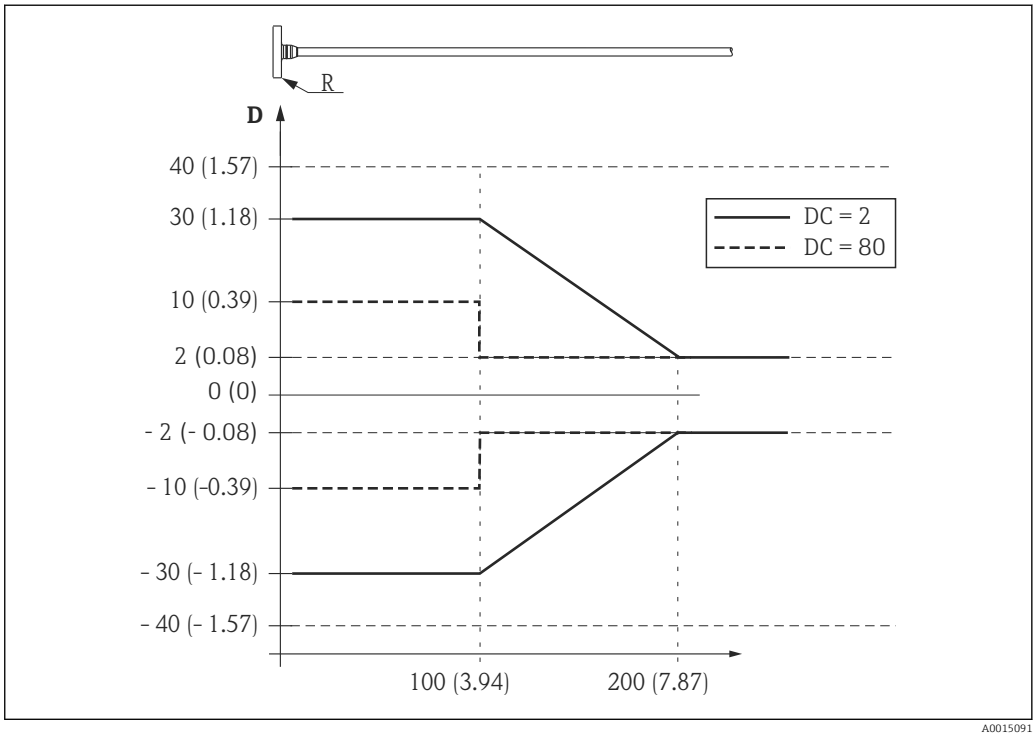


6 Measurement error at the probe end in the case of metal centering disks (product structure: feature 610 "Accessory mounted", version OA, OB or OC)

A Distance from the probe end [mm(in)]
D Measurement error: Sum of non-linearity, non-repeatability and hysteresis

If the DC is less than 7 in the case of rope probes, measurement is not possible in the area of the probe weight (0 to 250 mm from the probe end), (lower blocking distance).

The following measurement error applies for level measurement in the area of the upper probe end (rod/rope only):



7 Measurement error at the upper probe end; unit: mm (in)

D Sum of non-linearity, non-repeatability and hysteresis
R Reference point of measurement
DC Dielectric constant

Resolution

- Digital: 1 mm
- Analog: 1 µA

Response time

The response time can be configured. The following step response times (in accordance with DIN EN IEC 61298-2 / DIN EN IEC 60770-1) [3] are when damping is switched off:

Level measurement		
Probe length	**Sampling rate**	**Response time**
< 10 m (33 ft)	3.6 measurements per second	< 0.8 s
< 40 m (131 ft)	≥ 2.7 measurements per second	< 1 s

Interface measurement		
Probe length	**Sampling rate**	**Response time**
< 10 m (33 ft)	≥ 1.1 measurements per second	< 2.2 s

Influence of ambient temperature

The measurements are performed according to DIN EN IEC 61298-3 / DIN EN IEC 60770-1

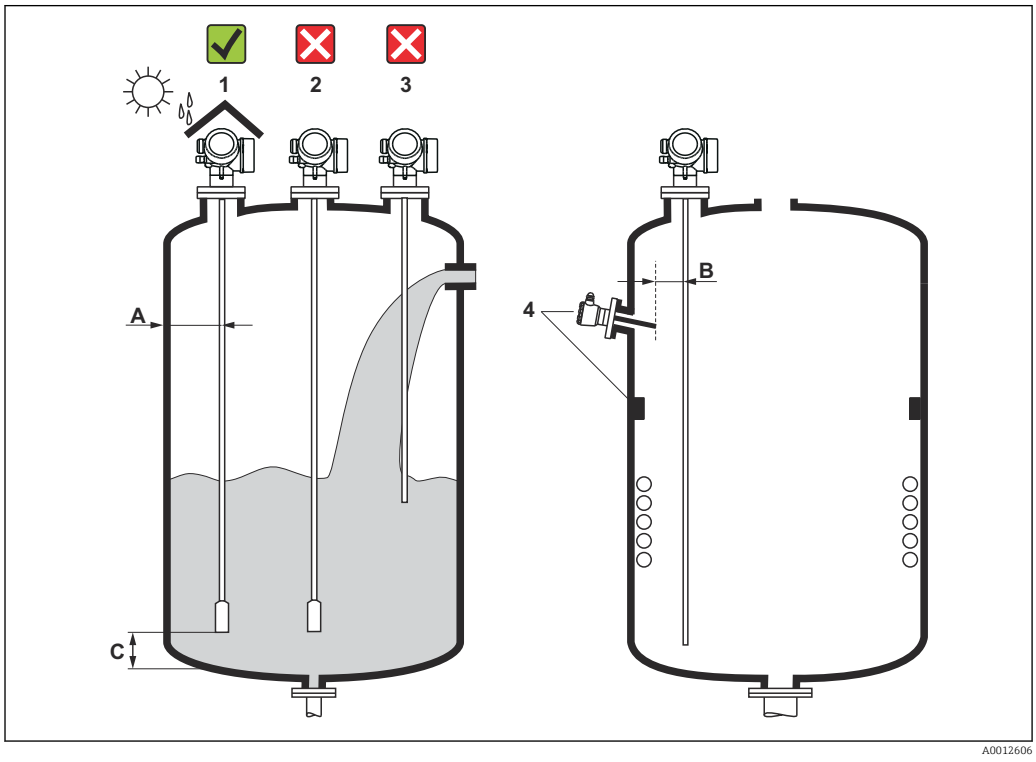
- Digital (HART, PROFIBUS PA, FOUNDATION Fieldbus, Modbus): average T_C = 0.6 mm/10 K
  For FMP51 and FMP52 with a remote sensor, [4] there is an additional offset error of ±0.3 mm/10K (±0.01 in/10K) per 1 m (3.3 ft) of the remote cable.
- Analog (current output):
  - Zero point (4 mA): average T_C = 0.02 %/10 K
  - Span (20 mA): average T_C = 0.05 %/10 K

3) According to DIN EN IEC 61298-2 / DIN EN IEC 60770-1, the step response time is the time that elapses after an abrupt change in the input signal until the change in the output signal has adopted 90% of the steady-state value for the first time.
4) Product structure: feature 600, version MB, MC or MD)

Installation

Mounting requirements

Suitable mounting position



8 *Installation positions*

Spacing requirements when mounting

- Distance (A) between the vessel wall and rod and rope probes:
  - For smooth metallic walls: > 50 mm (2 in)
  - For plastic walls: > 300 mm (12 in) to metallic parts outside the vessel
  - For concrete walls: > 500 mm (20 in), otherwise the permitted measuring range may be reduced.
- Distance (B) between rod probes and internal fittings (3): > 300 mm (12 in)
- When using more than one Levelflex:
  Minimum distance between the sensor axes: 100 mm (3.94 in)
- Distance (C) from the end of the probe to the bottom of the vessel:
  - Rope probe: > 150 mm (6 in)
  - Rod probe: > 10 mm (0.4 in)
  - Coaxial probe: > 10 mm (0.4 in)

Coaxial probes can be mounted at any distance to the wall and internal fixtures.

Additional mounting requirements

- When mounting outdoors, a weather protection cover (1) can be used to protect the device against extreme weather conditions.
- In metallic vessels, preferably do not mount the probe in the center of the vessel (2), as this would lead to increased interference echoes.
  If a central mounting position cannot be avoided, it is essential to perform interference echo suppression (mapping) after commissioning the device.
- Do not mount the probe in the filling curtain (3).
- Avoid buckling the rope probe during installation or operation (e.g. as a result of product movement against silo wall) by selecting a suitable mounting location.

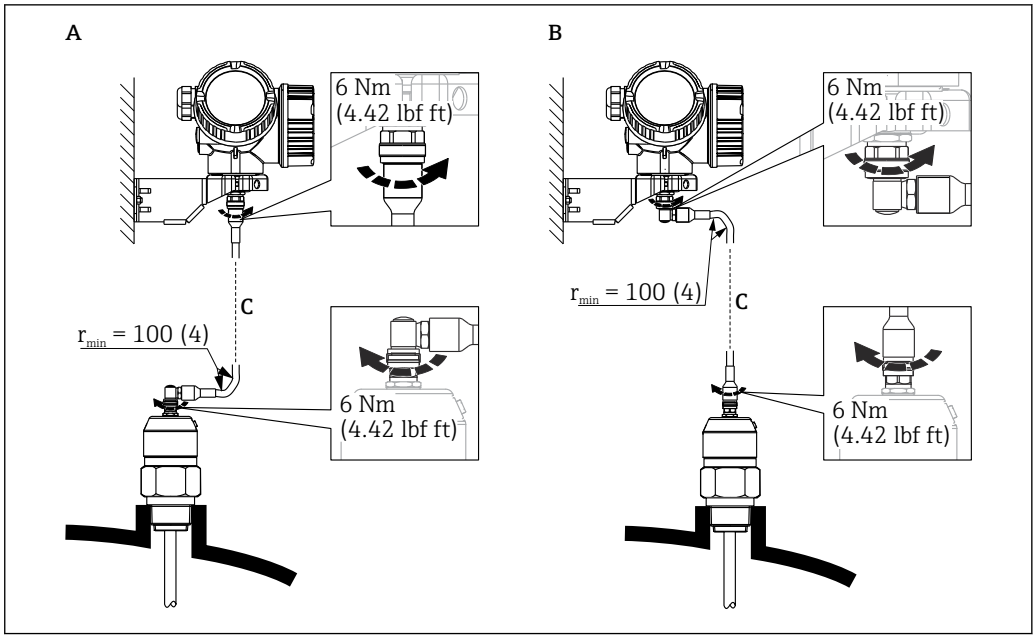
In the case of freely suspended rope probes (probe end not fixed at the bottom), the distance between the probe rope and internal fittings, which can change due to the movement of the product, must never be less than 300 mm (12 in). Occasional contact between the probe weight and the cone of the vessel, however, does not influence the measurement provided that the relative permittivity is at least $\varepsilon_r = 1.8$.

When mounting the housing in a recess (e.g. in a concrete ceiling), observe a minimum distance of 100 mm (4 in) between the cover of the connection compartment/electronics compartment and the wall. Otherwise the connection compartment/electronics compartment will not be accessible after installation.

Mounting under confined conditions

Mounting with remote probe

The device version with a remote probe is suitable for applications with restricted mounting space. In this case, the electronics housing is mounted at a separate position from the probe.

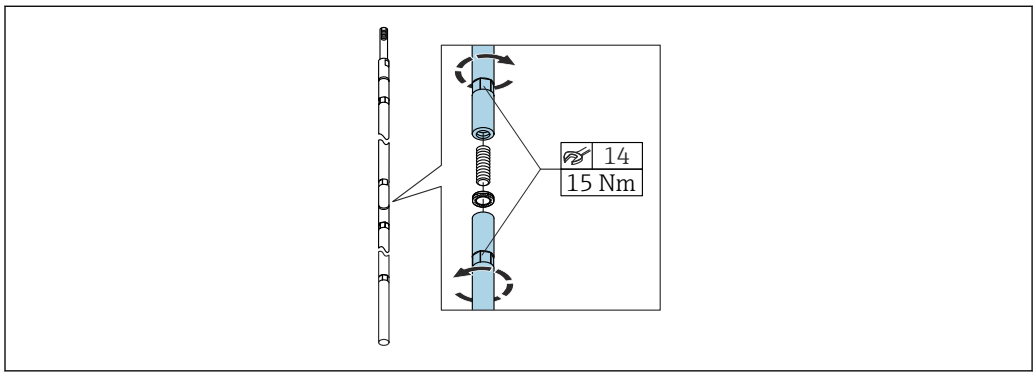


A Angled plug at the probe
B Angled plug at the electronics housing
C Length of the remote cable as ordered

- Product structure, feature 600 "Probe design":
  - Version MB "Remote sensor, 3 m cable"
  - Version MC "Remote sensor, 6 m cable"
  - Version MD "Remote sensor, 9 m cable"
- The connecting cable is included in the delivery with these versions.
  Minimum bending radius: 100 mm (4 inch)
- The mounting bracket for the electronics housing is included in the delivery with these versions.
  Mounting options:
  - Wall mounting
  - Mounting on DN32 to DN50 (1¼ to 2 inch) post or pipe
- The connecting cable has one straight plug and one plug angled at 90 °. Depending on the local conditions the angled plug can be connected at the probe or at the electronics housing.

The probe, electronics and connection cable are mutually compatible and bear a common serial number. Only components with the same serial number may be connected to one another.

Separable probes



A0021647

In confined mounting conditions (ceiling clearance), the use of separable rod probe (Ø 16 mm) is advisable.

- Max. probe length 10 m (394 in)
- Max. lateral loading capacity 30 Nm
- Probes can be separated several times, with the individual parts having the following lengths:
  - 500 mm (20 in)
  - 1 000 mm (40 in)

Notes on the mechanical load of the probe

Tensile loading capacity of rope probes

FMP51

Rope 4 mm (⅙ in) 316
Tensile loading capacity5 kN

Rope 4 mm (⅙ in) Alloy C
Tensile loading capacity5 kN

Rope 4 mm (⅙ in) PFA>316L
Tensile loading capacity 1 kN

Lateral loading capacity (flexural strength) of rod probes

FMP51

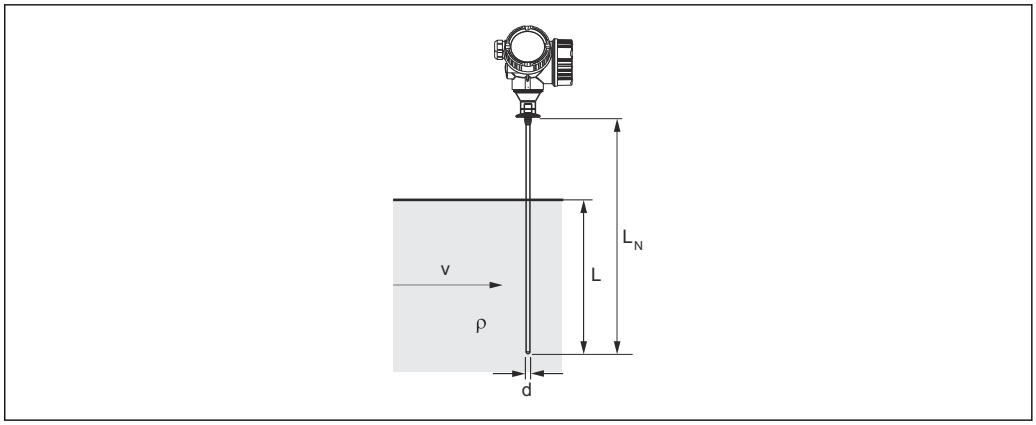
Rod 8 mm (⅓ in) 316L
10 Nm

Rod 12 mm (½ in) 316L
Flexural strength 30 Nm

Rod 12 mm (½ in) AlloyC
Flexural strength 30 Nm

Rod 16 mm (0.63 in) 316 L separable
Flexural strength 30 Nm

Lateral load (bending moment) from flow conditions



A0014175

ρ Density of the medium [kg/m³]
v Flow velocity [m/s] of the medium, perpendicular to the probe rod
d Diameter [m] of probe rod
L Level [m]
LN Probe length [m]

The formula for calculating the bending moment M acting on the probe:

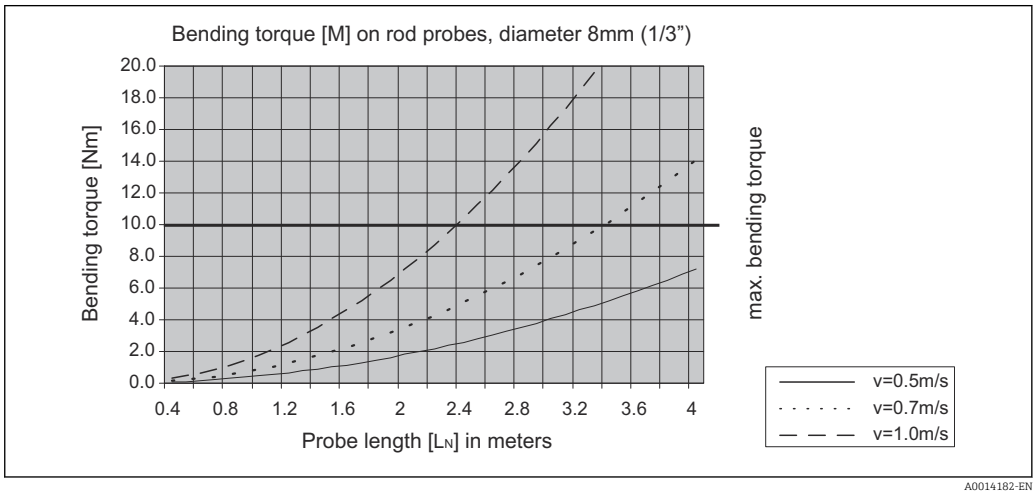
$M = c_w \times \rho/2 \times v^2 \times d \times L \times (L_N - 0.5 \times L)$

With:

c_w: coefficient of friction

Sample calculation

Coefficient of friction c_w	0.9 (assuming turbulent flow - high Reynolds number)
Density ρ [kg/m³]	1000 (e.g. water)
Probe diameter d [m]	0.008
$L = L_N$	(unfavorable conditions)



A0014182-EN

Lateral loading capacity (flexural strength) of coaxial probes

FMP51

Probe Ø21.3 mm316L
Flexural strength:60 Nm

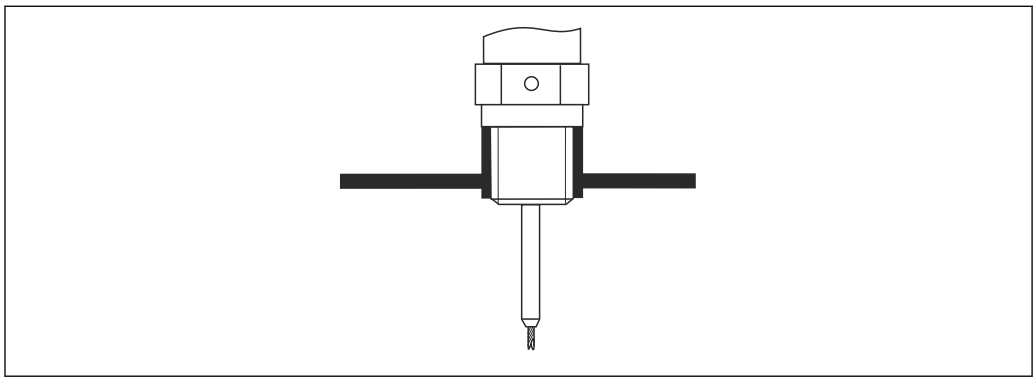
Probe Ø42.4 mm316L
Flexural strength:300 Nm

Probe Ø 42.4 mm AlloyC
Flexural strength:300 Nm

Information concerning the process connection

Probes are mounted on the process connection with threaded connections or flanges. If there is the danger with this installation that the probe end moves so much that it occasionally touches the vessel floor or cone, the probe may need to be shortened at the lower end and fixed in place.

Threaded connection



9 *Mounting with threaded connection; flush with the vessel ceiling*

Sealing

The thread and the type of seal comply with DIN3852 Part 2, screwed plug, form A.

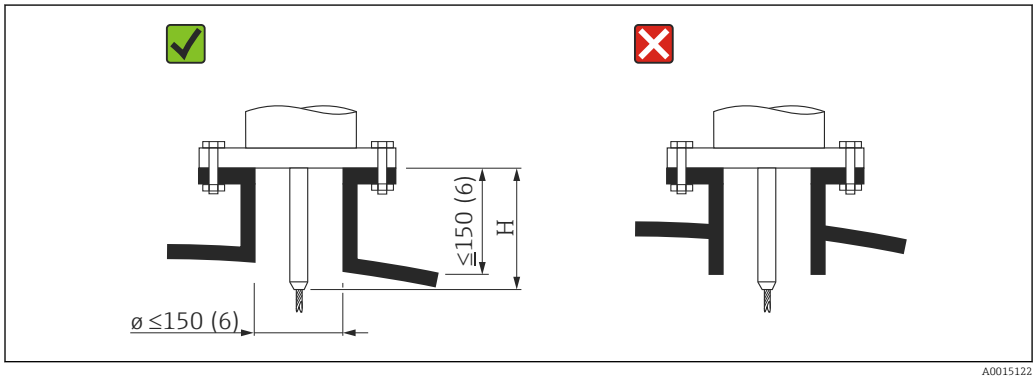
The following types of sealing ring can be used:

- For thread G¾": according to DIN7603 with dimensions 27 mm × 32 mm
- For thread G1½": according to DIN 7603 with dimensions 48 mm × 55 mm

Use a sealing ring according to this standard in form A, C or D and of a material that offers appropriate resistance for the application.

Refer to the dimensional drawing for the length of the screwed plug:

Nozzle installation



H Length of the centering rod or the rigid part of the rope probe

- Permissible nozzle diameter: ≤ 150 mm (6 in)
  For larger diameters, the near-range measuring capability may be reduced.
  For large nozzles, see the section "Mounting in nozzles ≥DN300"
- Permissible nozzle height: ≤ 150 mm (6 in)
  For larger heights, the near-range measuring capability may be reduced.
  Larger nozzle heights are possible in special cases (on request), see sections "Centering rod for FMP51 and FMP52" and "Rod extension/centering device HMP40 for FMP54".
- The end of the nozzle should be flush with the tank ceiling in order to avoid ringing effects.

In thermally insulated vessels, the nozzle should also be insulated in order to prevent condensate formation.

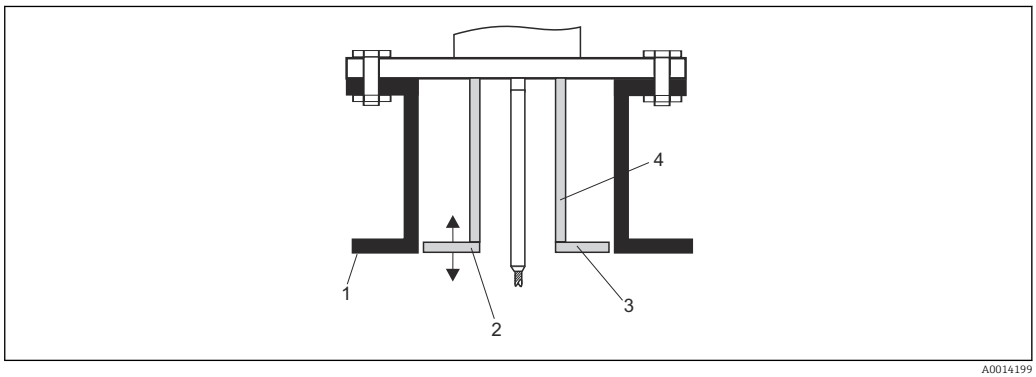
Centering rod

In the case of rope probes, it may be necessary to use a version with a centering rod so that the rope does not come in contact with the nozzle wall during the process.

The length of the optional centering rod determines the maximum nozzle height.

Mounting in nozzles ≥ DN300

If installation in nozzles ≥ 300 mm (12 in) is unavoidable, installation must be carried out in accordance with the following diagram in order to avoid interference signals in the near range.

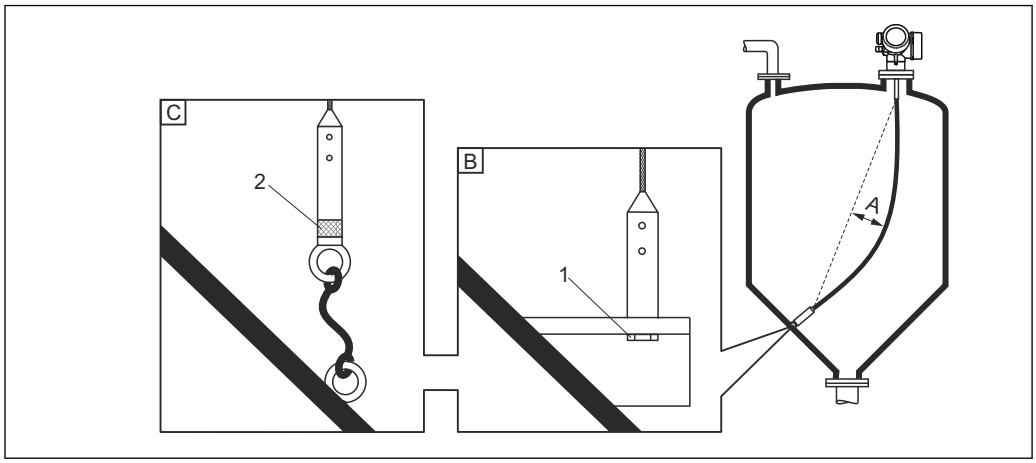


A0014199

1 Lower edge of the nozzle
2 Approximately flush with the lower edge of the nozzle (±50 mm)
3 Plate, nozzle Ø 300 mm (12 in) = plate Ø 280 mm (11 in); nozzle Ø ≥ 400 mm (16 in) = plate Ø ≥ 350 mm (14 in)
4 Pipe Ø 150 to 180 mm

Securing the probe

Securing rope probes



A0012609

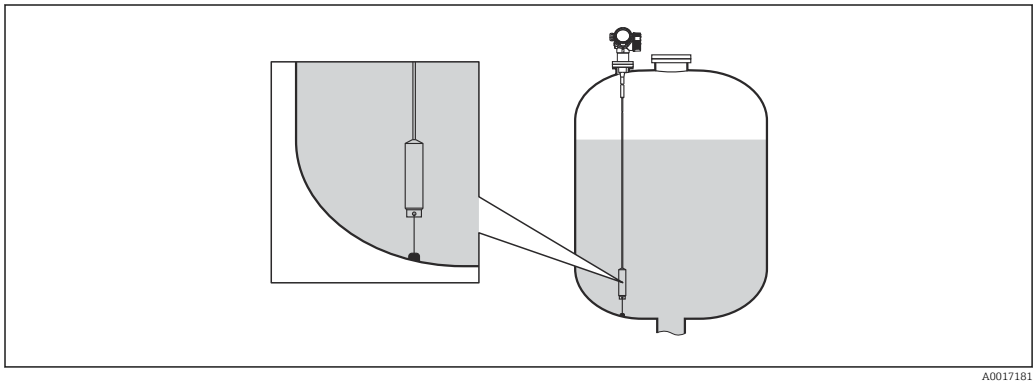
A Sag: ≥ 10 mm/m (0.12 in/ft) probe length
B Reliably grounded end of probe
C Reliably insulated end of probe
1 Fastener in female thread of probe weight
2 Insulated fastening kit

- The end of the rope probe must be secured or fixed down under the following conditions:
  If the probe temporarily comes into contact with the vessel wall, the cone, internal fittings/beams or another part of the installation
- A female thread is provided in the probe weight to secure the end of the probe:
  Rope 4 mm (⅙ in), 316: M 14
- When fixed down, the end of the probe must be reliably grounded or reliably insulated. If it is not otherwise possible to secure the probe with a reliably insulated connection, use the insulated fastening kit.
- To prevent an extremely high tensile load (e.g. due to thermal expansion) and the risk of the rope breaking, the rope must be slack. Required sag: ≥ 10 mm/m (0.12 in/ft) rope length.
  Pay attention to the tensile loading capacity of rope probes.

Securing rope probes

The end of the probe needs to be secured if the probe would otherwise temporarily touch the tank wall or another part in the tank. The anchor hole provided in the probe weight is intended for this purpose. Bracing can be conductive or insulating in relation to the tank wall.

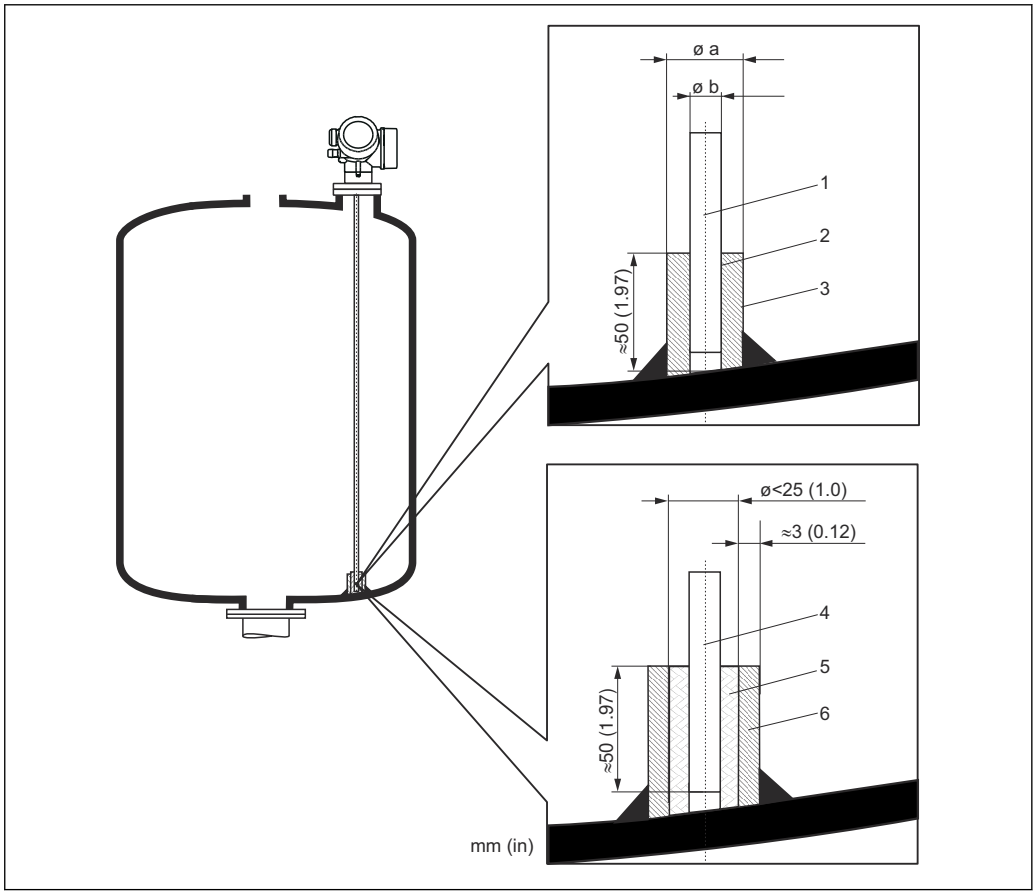
To avoid the risk of a high tensile load, the probe rope should be loose or guyed with a spring. Pay attention to the tensile loading capacity of rope probes.



A0017181

Securing rod probes

- In the case of WHG approval: a support is required for probe lengths ≥ 3 m (10 ft).
- In general, rod probes must be secured in the event of horizontal flow (e.g. from an agitator) or strong vibrations.
- Only secure rod probes directly at the end of the probe.



Unit of measurement mm (in)

1 *Probe rod, uncoated*
2 *Sleeve with narrow bore to ensure electrical contact between the sleeve and the rod.*
3 *Short metal pipe, e.g. welded in place*
4 *Probe rod, coated*
5 *Plastic sleeve, e.g. PTFE, PEEK, PPS*
6 *Short metal pipe, e.g. welded in place*

Probe Ø 8 mm (0.31 in)
- a < Ø 14 mm (0.55 in)
- b = Ø 8.5 mm (0.34 in)

Probe Ø 12 mm (0.47 in)
- a < Ø 20 mm (0.78 in)
- b = Ø 12.5 mm (0.52 in)

Probe Ø 16 mm (0.63 in)
- a < Ø 26 mm (1.02 in)
- b = Ø 16.5 mm (0.65 in)

NOTICE

Poor grounding of the probe end may cause incorrect measurements.

► Use a sleeve with a narrow bore to ensure good electrical contact between the sleeve and the probe rod.

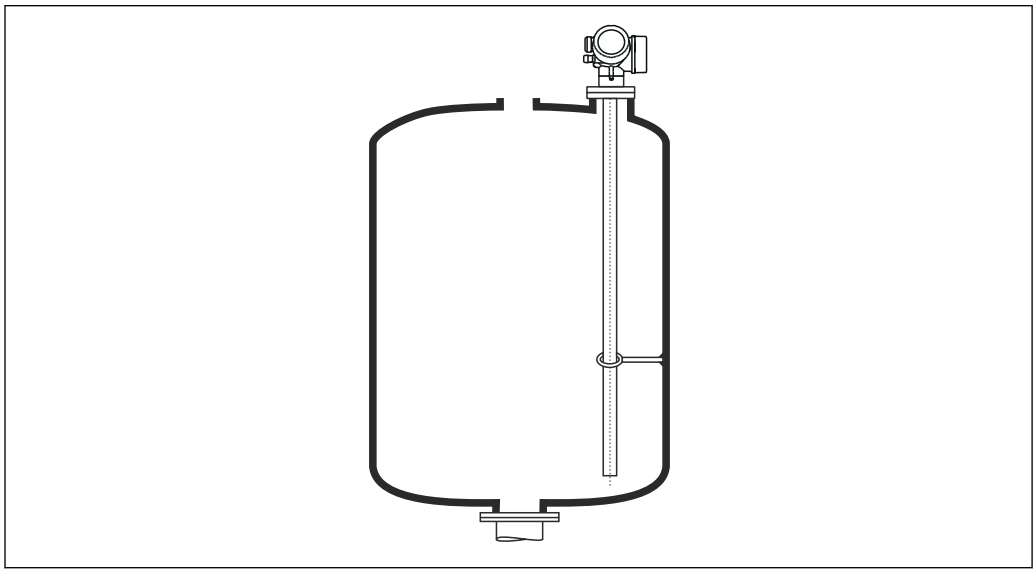
NOTICE

Welding can damage the main electronics module.

► Before welding: Ground the probe rod and remove the electronics.

Securing coaxial probes

For WHG approval: a support is required for probe lengths ≥ 3 m (10 ft).



A0012608

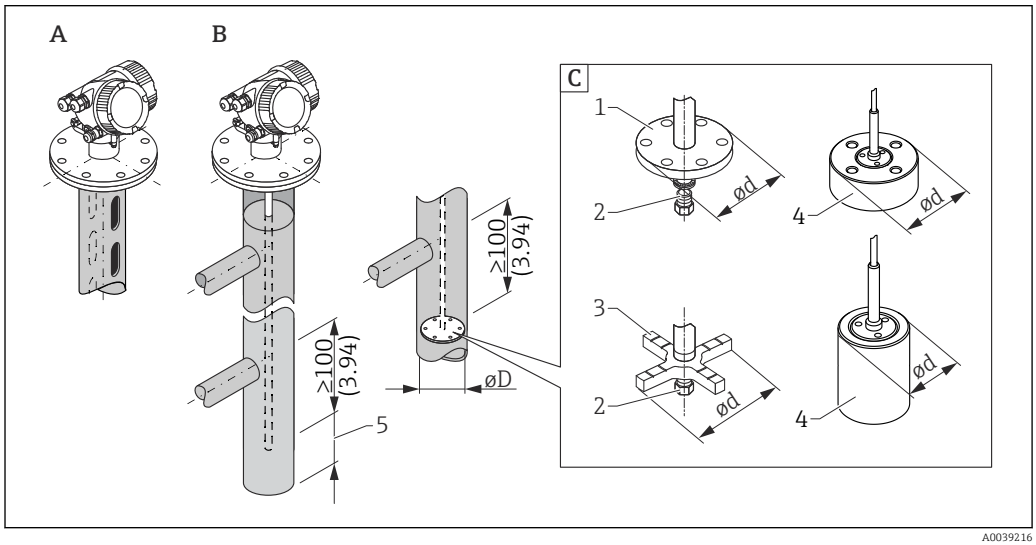
Coaxial probes can be secured (fixed) at any point in the ground tube.

Special installation situations

Bypasses and stilling wells

The use of centering disks/stars/weights (available as accessories) is recommended in bypass and stilling well applications.

Since the measuring signal permeates a large number of plastics, incorrect measurements can result when the device is installed in bypasses or stilling wells made of plastic. For this reason use a bypass or stilling well made of metal.



A0039216

10 *Unit: mm (in)*

A Mounting in stilling well
B Mounting in bypass
C Centering disk/centering star/centering weight
1 Metal centering disk (316L) for level measurement
2 Securing screw; torque: 25 Nm ± 5 Nm
3 Non-metal centering star (PEEK, PFA) preferred for interface measurement
4 Metal centering weight (316L) for level measurement
5 Minimum distance between probe end and lower edge of bypass 10 mm (0.4 in)

- Pipe diameter: > 40 mm (1.6 in) (for rod probes).
- A rod probe can be installed in pipes with a diameter of up to 150 mm (6 in). The use of a coaxial probe is recommended for larger pipe diameters.
- Side outlets, holes, slots and welds - with a maximum inward projection of 5 mm (0.2 in) - do not affect the measurement.
- There should not be any changes in the diameter of the pipe.
- The probe must be 100 mm (4 in) longer than the lower outlet.
- The probes must not touch the pipe wall within the measuring range. Support or brace the probe if necessary. All rope probes are prepared for bracing in vessels (probe weight with anchor hole).
- If a metal centering disk is mounted at the end of the probe rod, the signal for detecting the end of the probe is reliably defined.
  Note: The non-metal centering stars made of PEEK or PFA are recommended for interface measurements. When using metal centering disks, it is important to ensure that the lower medium covers the centering disk at all times. Otherwise, incorrect interface measurements can result.
- Coaxial probes can be used within any restrictions provided that the pipe diameter permits their installation.

For bypasses with condensate formation (water) and a medium with a low relative permittivity (e.g. hydrocarbons):

Over time, the bypass fills with condensate up to the lower outlet. When levels are low, the level echo is masked by the echo of the condensate as a result. In this range, the level of the condensate is output and the correct value is only output when levels are higher. For this reason, ensure that the lower outlet is 100 mm (4 in) below the lowest level to be measured and fit a metal centering disk at the level of the lower edge of the lower outlet.

In thermally insulated vessels, the bypass should also be insulated in order to prevent condensate formation.

Assignment of centering disk/centering star/centering weight to the pipe diameter

Metal centering disk (316L)

for level measurement

Rod centering disk (Ø d) 45 mm (1.77 in)
for pipe diameters (Ø D)
DN50/2" to DN65/2½"

Rod centering disk (Ø d) 75 mm (2.95 in)
for pipe diameters (Ø D)
DN80/3" to DN100/4"

Rope centering disk (Ø d) 75 mm (2.95 in)
for pipe diameters (Ø D)
DN80/3" to DN100/4"

Metal centering weight (316L)

for level measurement

Rope centering weight (Ø d) 45 mm (1.77 in), h 60 mm (2.36 in)
for pipe diameters (Ø D)
DN50/2"

Rope centering weight (Ø d) 75 mm (2.95 in), h 30 mm (1.81 in)
for pipe diameters (Ø D)
DN80/3"

Rope centering weight (Ø d) 95 mm (3.74 in), h 30 mm (1.81 in)
for pipe diameters (Ø D)
DN100/4"

Non-metal centering star (PEEK)

For level and interface measurement, operating temperature: −60 to +250 °C (−76 to 482 °F)

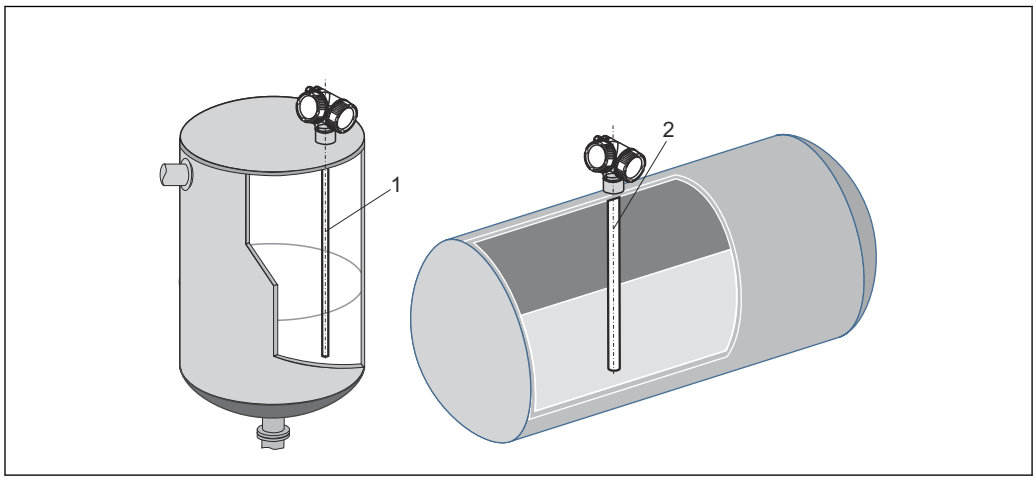
Rod centering star (Ø d) 48 to 95 mm (1.89 to 3.74 in)
for pipe diameters (Ø D)
≥ DN50/2"

Non-metal centering star (PFA)

for level and interface measurement, operating temperature: −200 to +250 °C (−328 to +482 °F)

Rod centering star (Ø d) 37 mm (1.46 in)
for pipe diameters (Ø D)
≥ 40 mm (1.57 in)

Horizontal cylindrical and vertical tanks

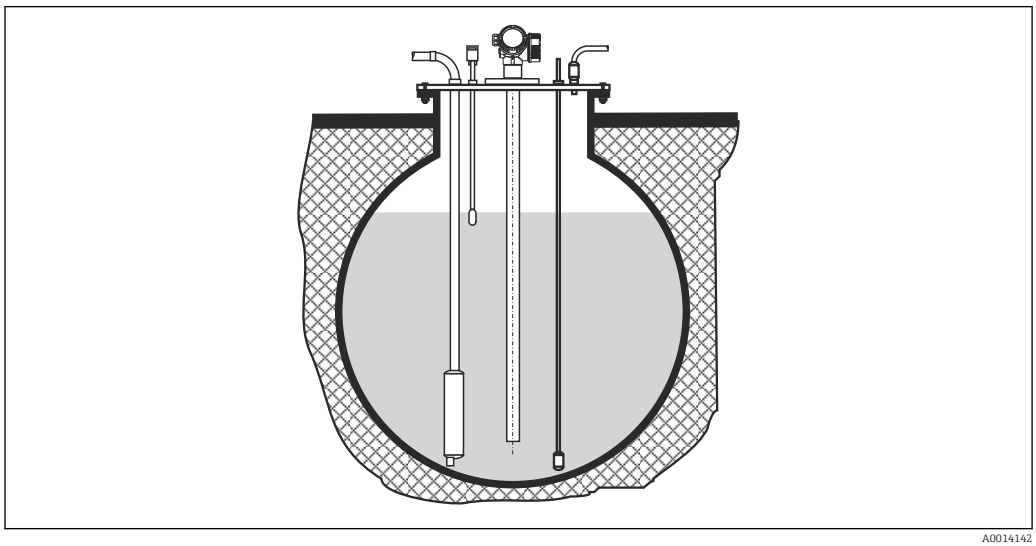


A0014141

1 Coaxial probe

- Any distance from wall provided occasional contact is avoided.
- Use a coaxial probe (1) if installing in tanks with many internal fixtures or internal fixtures located close to the probe.

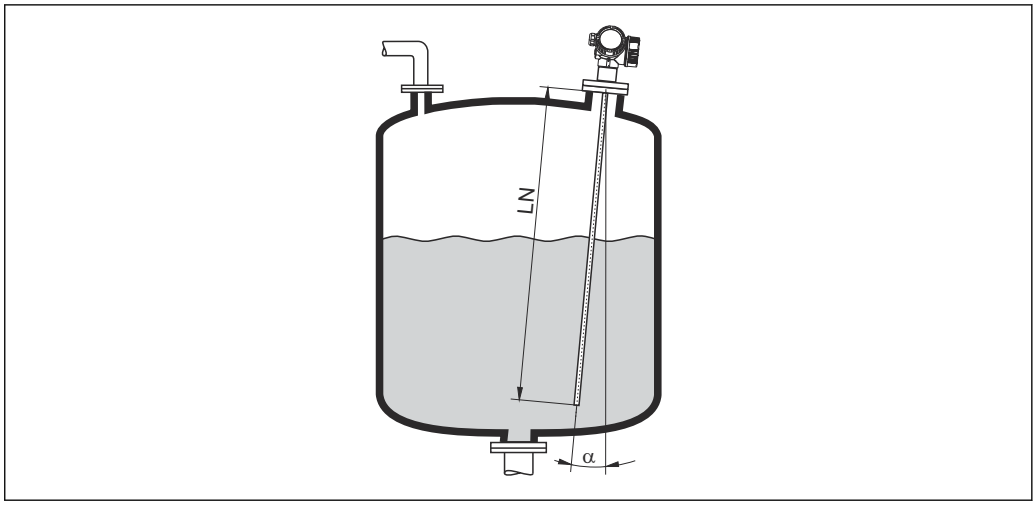
Underground tanks



A0014142

In the case of nozzles with large diameters, use a coaxial probe to avoid reflections at the nozzle wall.

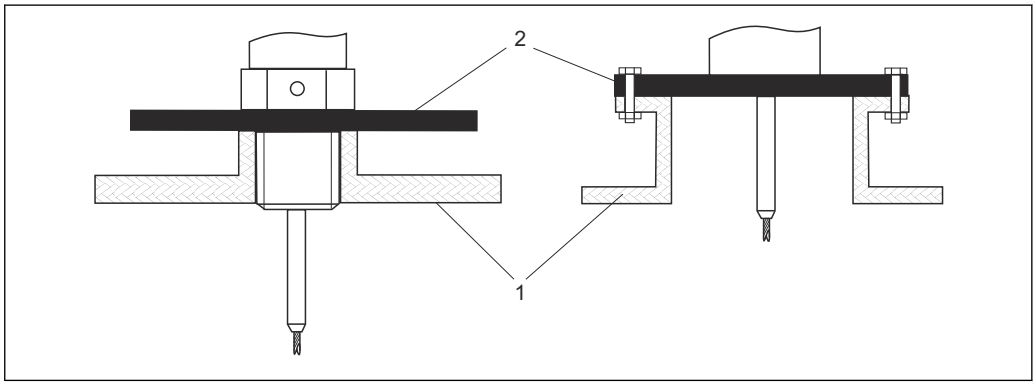
Mounting at an angle



A0014145

- For mechanical reasons, the probe should be installed as vertically as possible.
- If the probe is installed at an angle, the length of the probe must be reduced depending on the angle of installation.
  - α 5 °: $LN_{max.}$ 4 m (13.1 ft)
  - α 10 °: $LN_{max.}$ 2 m (6.6 ft)
  - α 30 °: $LN_{max.}$ 1 m (3.3 ft)

Non-metal vessels



A0012527

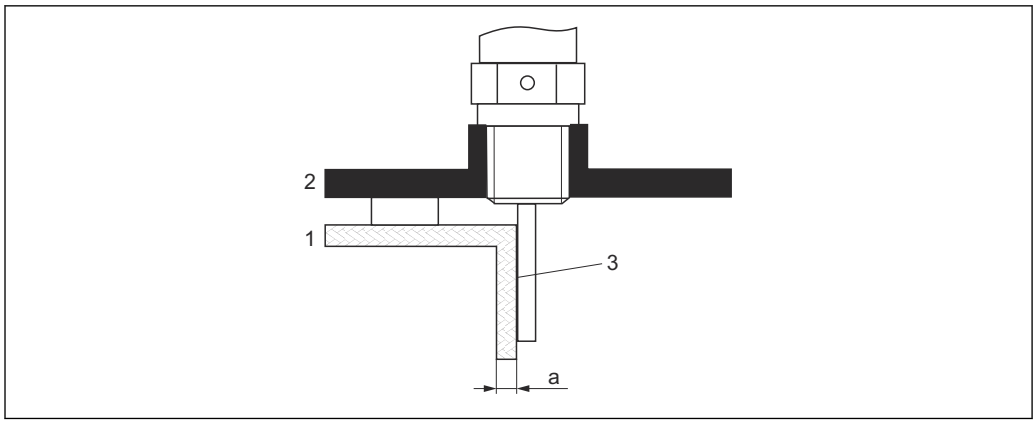
1 Non-metal vessel
2 Metal sheet or metal flange

To ensure good measurement results when mounting on non-metal vessels
- Use a device with a metal flange (minimum size DN50/2").
- Alternatively, mount a metal plate with a diameter of at least 200 mm (8 in) at a right angle to the probe at the process connection.

A metal surface is not required at the process connection in the case of coaxial probes.

Plastic and glass vessels: Mounting the probe on the outside wall

In the case of plastic and glass vessels, the probe can also be mounted on the outside wall under certain conditions.



A0014150

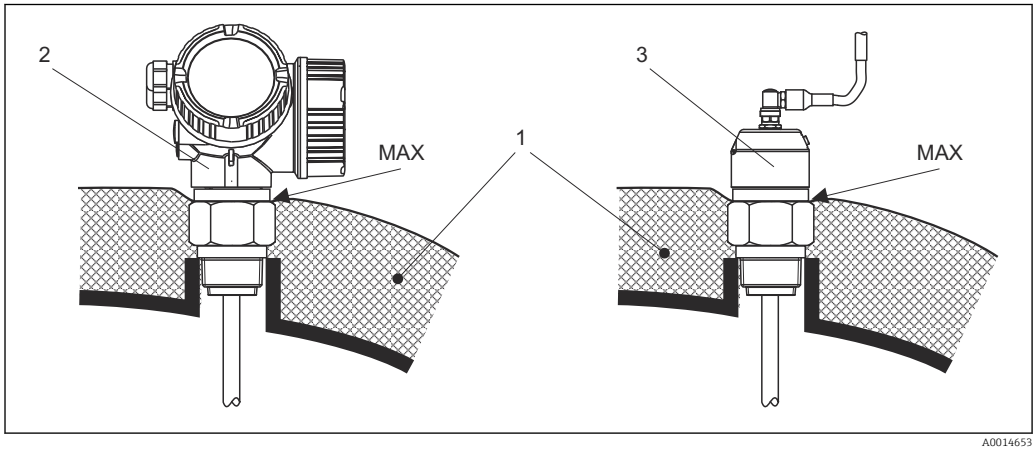
1 Plastic or glass vessel
2 Metal plate with screw-in sleeve
3 No space between vessel wall and probe!

Requirements
- Relative permittivity of medium: $\varepsilon_r > 7$
- Non-conductive vessel wall.
- Maximum wall thickness (a):
  - Plastic: < 15 mm (0.6 in)
  - Glass: < 10 mm (0.4 in)
- No metal reinforcements on the vessel

Note the following when mounting the device:
- Mount the probe directly on the tank wall without any clearance.
- To protect against interference with the measurement, fit a plastic half pipe with a minimum diameter of 200 mm (8 in) or a similar protective unit on the probe.
- If the vessel diameter is less than 300 mm (12 in):
  On the opposite side of the vessel, fit a grounding plate that is conductively connected to the process connection and covers around half of the vessel's circumference.
- If the vessel diameter is 300 mm (12 in) or higher:
  At the process connection, fit a metal plate with a diameter of at least 200 mm (8 in) at a right angle to the probe (see above).

Vessel with thermal insulation

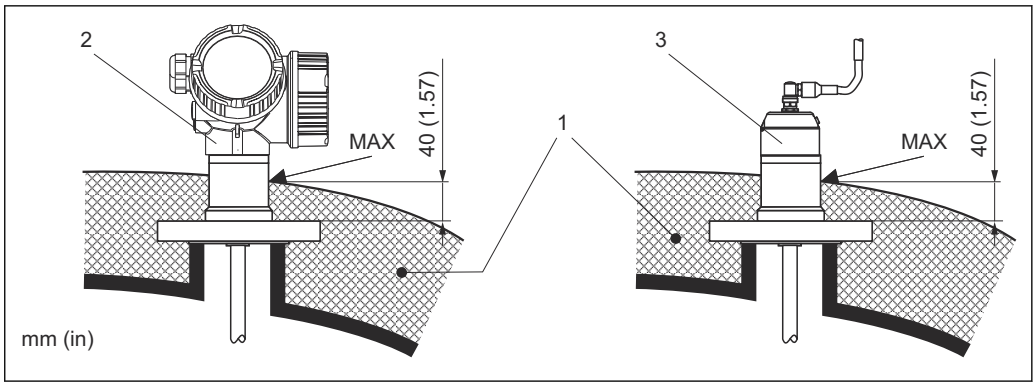
If process temperatures are high, the device must be included in normal vessel insulation (1) in order to prevent the electronics heating up as a result of thermal radiation or convection. The insulation may not go beyond the points labeled "MAX" in the drawings.



A0014653

11 Process connection with thread

1 Vessel insulation
2 Compact device
3 Sensor, remote



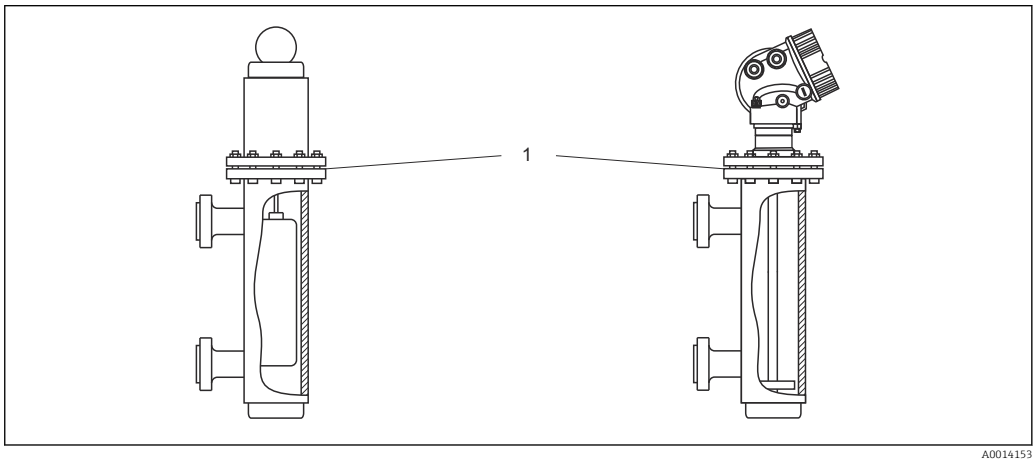
12 *Process connection with flange*

1 Vessel insulation
2 Compact device
3 Sensor, remote

Replacing a displacer system in an existing displacer chamber

FMP51 and FMP54 are a perfect replacement for a conventional displacer system in an existing displacer chamber. Flanges that suit Fisher and Masoneilan displacer chambers are available for this purpose (special product for FMP51; feature 100 of the product structure, options LNJ, LPJ, LQJ for FMP54). Thanks to menu-guided local operation, commissioning the Levelflex only takes a few minutes. Replacement is also possible when partially filled, and wet calibration is not required.

Your benefits:
- No moving parts, therefore zero-maintenance operation.
- Not affected by process influences such as temperature, density, turbulence and vibrations.
- The rod probes can be easily shortened or replaced. Therefore, the probe can also be easily adjusted on site.



1 Flange of the displacer chamber

Planning instructions:
- In normal cases, use a rod probe. When installing into a metal displacer chamber up to 150 mm (5.91 in), you have all the advantages of a coaxial probe.
- Contact between the probe and the side wall must be avoided. Where necessary, use a centering disk or centering star at the bottom end of the probe.
- The centering disk or centering star must be adapted as accurately as possible to the internal diameter of the displacer chamber to also ensure correct operation around the probe end.

Additional information regarding interface measurement
- In the case of oil and water, the centering star should be positioned at the lower edge of the lower outlet (water level).
- There should not be any changes in the diameter of the pipe. Use the coaxial probe if necessary.
- It must be ensured that rod probes do not come into contact with the wall. Where necessary, use a centering star at the end of the probe.
- The non-metal centering stars made of PEEK or PFA are recommended for interface measurements. When using metal centering disks, it is important to ensure that the lower medium covers the centering disk at all times. Otherwise, incorrect interface measurements can result.

Environment

Ambient temperature

Device	−40 to +80 °C (−40 to +176 °F)
Device (option for FMP51 and FMP54)	−50 to +80 °C (−58 to +176 °F) [1]
Local display	−20 to +70 °C (−4 to +158 °F), the readability of the local display may be impaired at temperatures outside the temperature range.
Connecting cable (for "Sensor, remote" probe design)	−50 to +100 °C (−58 to +212 °F)
Remote display FHX50	−40 to 80 °C (−40 to 176 °F)
Remote display FHX50 (option)	−50 to 80 °C (−58 to 176 °F) [2]

1) This range applies if the option JN "Transmitter ambient temperature −50 °C (−58 °F)" has been selected in order code 580 "Test, certificate". If the temperature is permanently below −40 °C (−40 °F), higher failure rates can be expected.
2) This range applies if the option JN "Transmitter ambient temperature −50 °C (−58 °F)" has been selected in order code 580 "Test, certificate". If the temperature is permanently below −40 °C (−40 °F), higher failure rates can be expected.

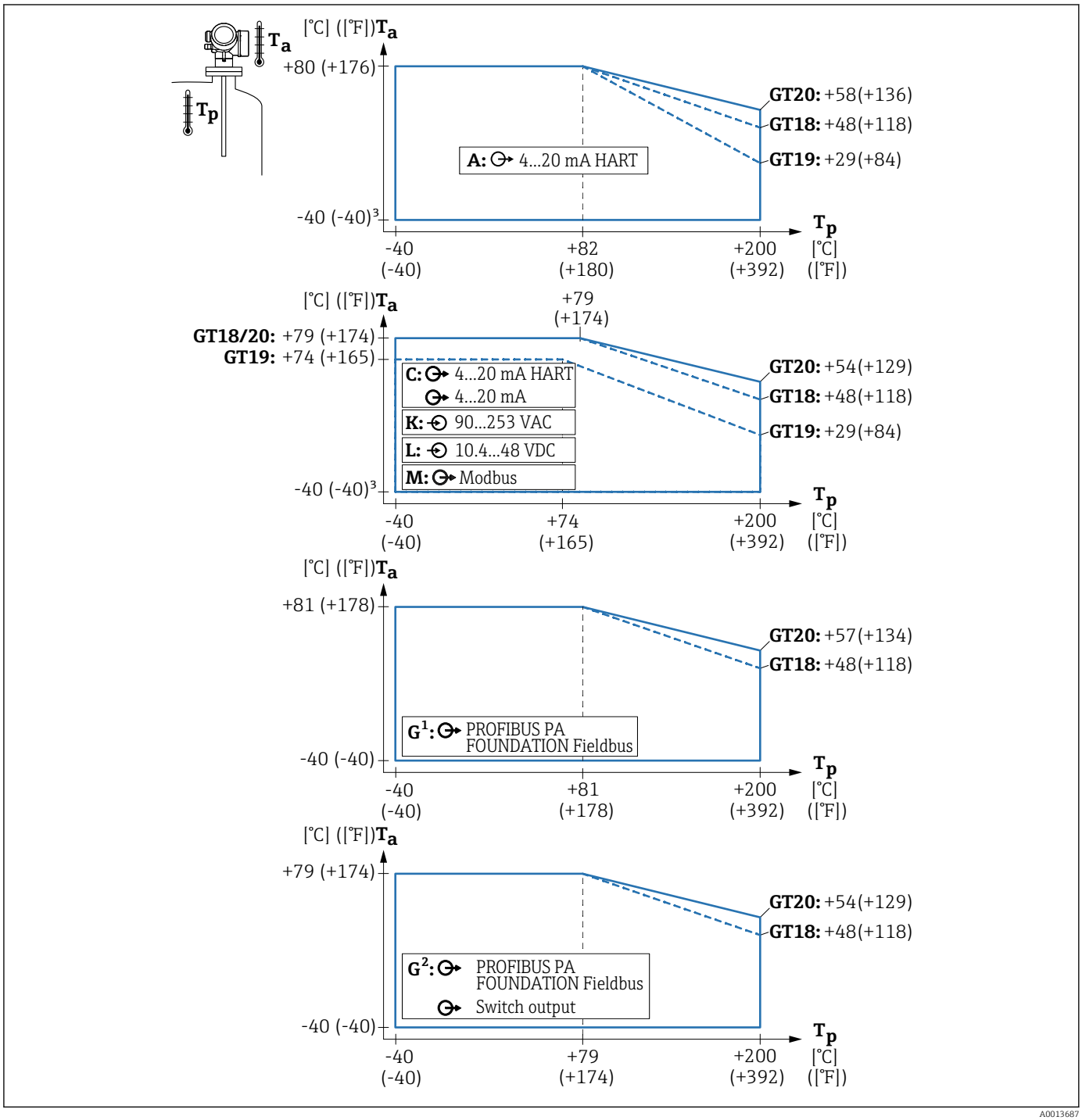
If operating outdoors in strong sunlight:
- Mount the device in the shade.
- Avoid direct sunlight, particularly in warm climatic regions.
- Use a weather protection cover (accessory).

Ambient temperature limits

The following diagrams only consider functional aspects. Additional restrictions may apply for certified device versions. See the separate Safety Instructions for more information.

In the event of temperature (T_p) at the process connection, the permitted ambient temperature (T_a) is reduced as indicated in the following diagram (temperature derating):

Temperature derating for FMP51 with threaded connection G¾ or NPT¾



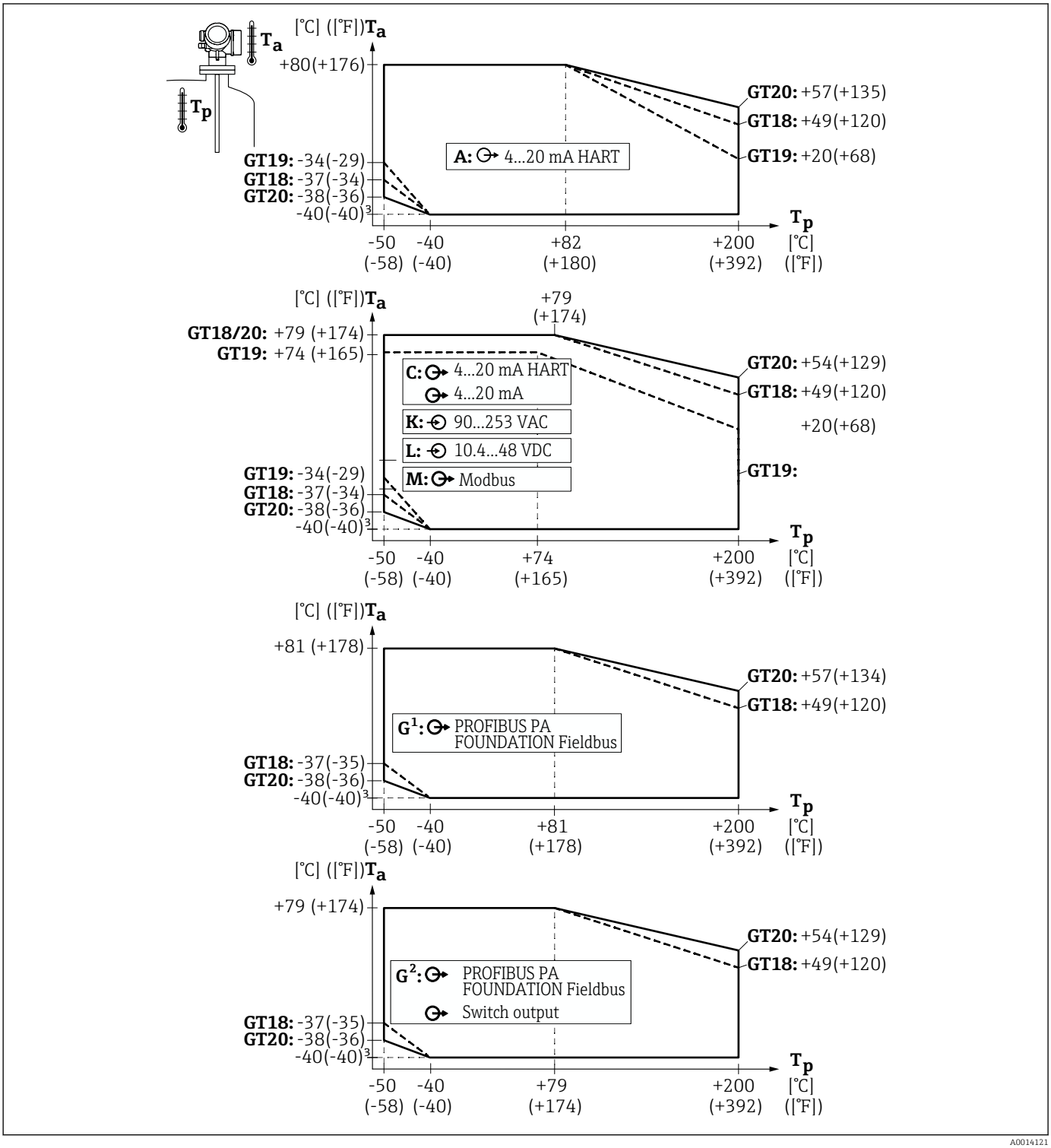
GT18 = Stainless steel housing
GT19 = Plastic housing
GT20 = Aluminum housing

A = 1 current output
C = 2 current outputs
G¹, G² = PROFIBUS PA [1) 2)]
K, L = 4-wire

T_a = Ambient temperature [3)]
T_p = Temperature at the process connection

1) G¹: Switch output not used
2) G²: Switch output used
3) T_a to −50 °C (−58 °F) for order code 580 "Test, certificate" = JN "Transmitter ambient temperature −50 °C (−58 °F)"; only available for 2-wire HART devices

Temperature derating for FMP51 with threaded connection G1½ or NPT1½



A0014121

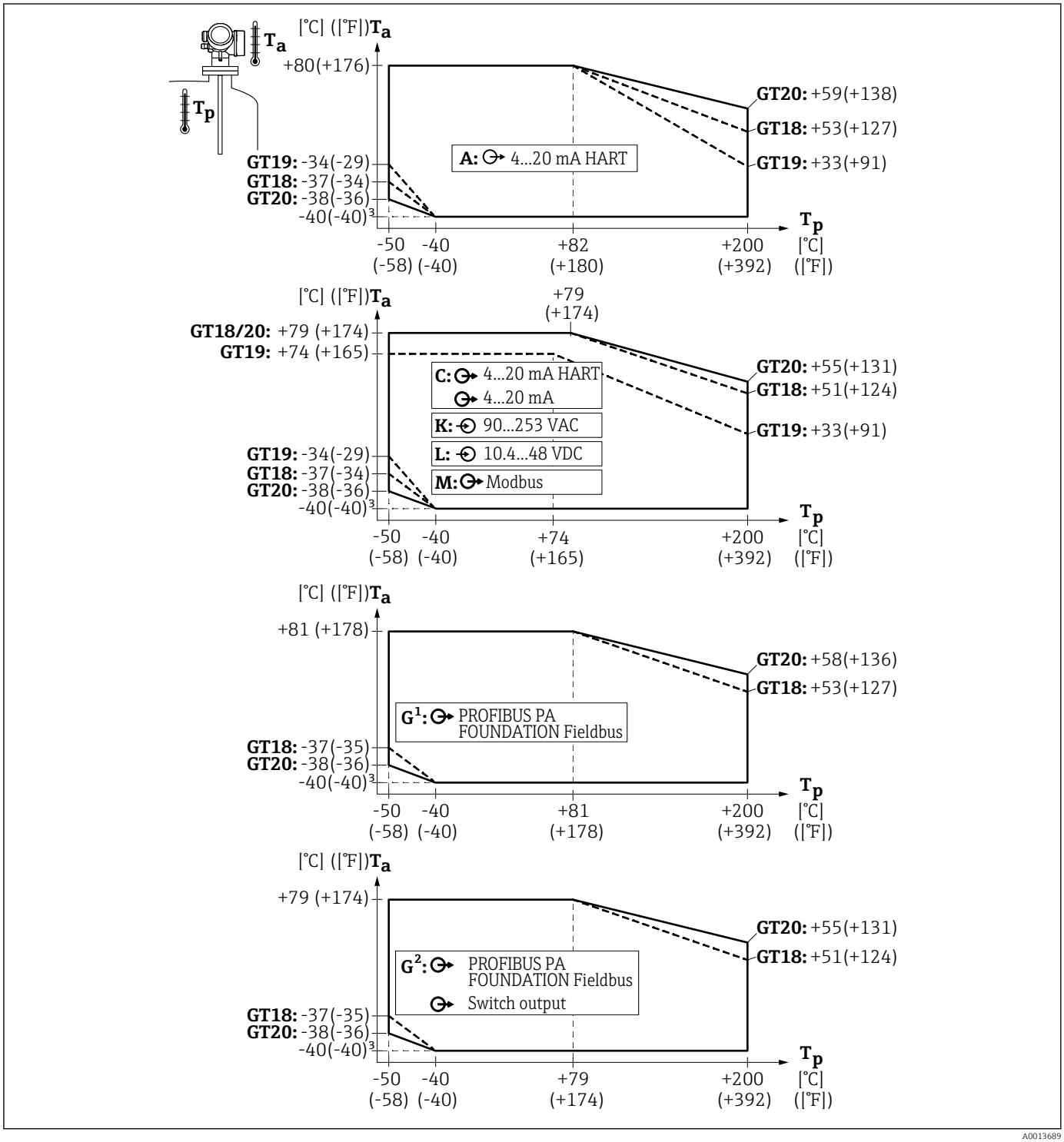
GT18 = Stainless steel housing
GT19 = Plastic housing
GT20 = Aluminum housing

A = 1 current output
C = 2 current outputs
G^1, G^2 = PROFIBUS PA [1) 2)]
K, L = 4-wire

T_a = Ambient temperature [3)]
T_p = Temperature at the process connection

1) G^1: Switch output not used
2) G^2: Switch output used
3) T_a to −50 °C (−58 °F) for order code 580 "Test, certificate" = JN "Transmitter ambient temperature −50 °C (−58 °F)"; only available for 2-wire HART devices

Temperature derating for FMP51 with flange



GT18 = Stainless steel housing
GT19 = Plastic housing
GT20 = Aluminum housing

A = 1 current output
C = 2 current outputs
G1, G2 = PROFIBUS PA [1) 2)]
K, L = 4-wire

T_a = Ambient temperature [3)]
T_p = Temperature at the process connection

1) G1: Switch output not used
2) G2: Switch output used
3) T_a to −50 °C (−58 °F) for order code 580 "Test, certificate" = JN "Transmitter ambient temperature −50 °C (−58 °F)"; only available for 2-wire HART devices

Storage temperature

- Permitted storage temperature: −40 to +80 °C (−40 to +176 °F)
- Use original packaging.
- Option for FMP51 and FMP54: −50 to +80 °C (−58 to +176 °F)
  This range applies if the option JN "Transmitter ambient temperature" −50 °C (−58 °F) was selected in order code 580 "Test, Certificate". If the temperature is permanently below −40 °C (−40 °F), higher failure rates can be expected.

Climate class

DIN EN 60068-2-38 (test Z/AD)

Operating height

- Generally up to 2 000 m (6 600 ft) above sea level.
- Over 2 000 m (6 600 ft) under the following conditions:
  - Order code 020 "Power supply; output "= A, B, C, E or G (2-wire versions)
  - Supply voltage U < 35 V
  - Power supply, overvoltage category 1

Degree of protection

Tested according to:

- With housing closed: IP68, NEMA6P (24 h at 1.83 m (6 ft) under water)
  (also applies for the "Remote sensor" version)
  - For housing: GT19 dual compartment, PBT plastic in combination with display, operation: SD02 or SD03: IP68 (24 h at 1 m (3.28 ft) under water)
  - IP66, NEMA4X
- With housing open: IP20, NEMA1
- Display module: IP22, NEMA2
- For M12 plug: IP68 NEMA6P, only if the cable is plugged in and also specified according to IP68 NEMA6P

Vibration resistance

DIN EN 60068-2-64 / IEC 60068-2-64: 20 to 2 000 Hz, 1 $(m/s^2)^2/Hz$

Cleaning the probe

Dirt or buildup may form on the probe depending on the application. A thin, even layer has little impact on the measurement. Thick layers can dampen the signal and reduce the measuring range. Very uneven deposit formation or caking (e.g. due to crystallization) can result in incorrect measurements. In such cases, use a non-contact measuring principle, or regularly inspect the probe for contamination.

Cleaning with sodium hydroxide solution (e.g. in CIP procedures): if the coupling is wetted, larger measurement errors can occur than under reference operating conditions. Wetting can cause temporary incorrect measurements.

Electromagnetic compatibility (EMC)

Electromagnetic compatibility in accordance with all the relevant requirements outlined in the EN 61326 series and NAMUR Recommendation EMC (NE 21). For details, refer to the Declaration of Conformity.

Download from www.endress.com.

Use a shielded cable for signal transmission.

Maximum measurement error during EMC testing: < 0.5 % of the span.

When the probes are installed in metal and concrete vessels and when a coaxial probe is used:

- Interference emission according to EN 61326-x series, Class B equipment.
- Interference immunity according to EN 61326-x series, requirements for industry and NAMUR Recommendation NE 21 (EMC)

When probes are installed without a shielding/metal wall, e.g. installation in plastic or wooden silos, or when the "Remote sensor" device version is used, strong electromagnetic fields can affect the measured value.

- Interference emission according to EN 61326-x series, Class A equipment.
- Interference immunity: the effect of strong electromagnetic fields can influence the measured value.

Process

Process temperature range

The maximum temperature permitted at the process connection is determined by the O-ring version ordered:

Device	O-ring material	Process temperature	Approval
FMP51	FKM (Viton GLT)	−30 to +150 °C (−22 to +302 °F)	FDA
		−40 to +150 °C (−40 to +302 °F) Only in conjunction with feature 610 "Accessory mounted", feature version NC "Gas-tight gland"	
	EPDM (70C4 pW FKN or E7515)	−40 to +120 °C (−40 to +248 °F)	FDA
	FFKM (Kalrez 6375) [1]	−20 to +200 °C (−4 to +392 °F) [2].	
	FVMQ (FVMQ 70C79)	−50 to 130 °C (−58 to 260 °F)	

1) Recommended for water vapor applications.
2) Not recommended for saturated steam over +150 °C (+302 °F); use FMP54 instead

With uncoated probes, the medium temperature may be higher provided that the process temperature specified in the table is not exceeded at the process connection.

When using rope probes, the stability of the probe rope is reduced by structural changes at temperatures above 350 °C (662 °F), however.

Process pressure range

Device	Process pressure
FMP51	−1 to 40 bar (−14.5 to 580 psi)

The range indicated can be reduced by the choice of process connection. The maximum working pressure (MWP) indicated on the nameplate refers to a reference temperature of 20 °C, and of 100 °F for ASME flanges. Observe pressure-temperature dependency.

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

- EN 1092-1: 2007 Tab. G.4.1-x
  With regard to their stability-temperature property, the materials 1.4435 and 1.4404 are grouped together under 13E0 in EN 1092-1: 2007 Tab. G.3.1-1. The chemical composition of the two materials can be identical.
- ASME B 16.5a - 2013 Tab. 2-2.2 F316
- ASME B 16.5a - 2013 Tab. 2.3.8 N10276
- JIS B 2220

Dielectric constant

- With coaxial probe: $\varepsilon_r \geq 1.4$
- Rod and rope probe: $\varepsilon_r \geq 1.6$ (when installed in pipes DN ≤ 150 mm (6 in): $\varepsilon_r \geq 1.4$)

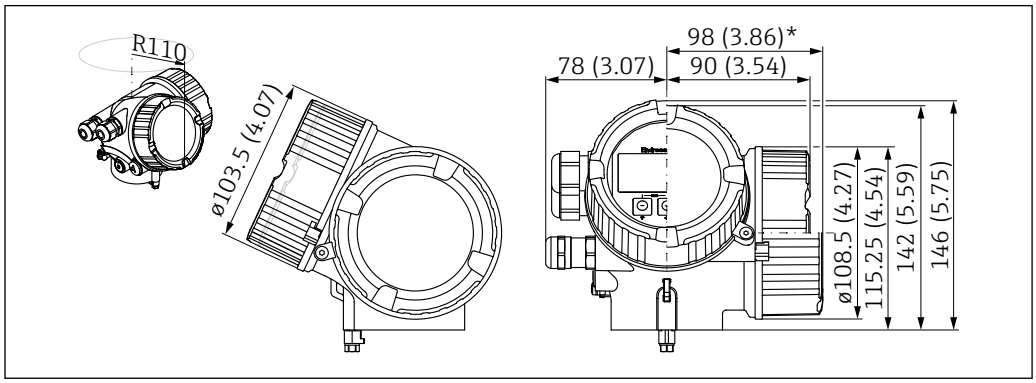
Extension of the rope probe

Extension of the rope probes due to temperature
Elongation due to temperature increase from 30 °C (86 °F) to 150 °C (302 °F): 2 mm/m (0.08 in/ft) rope length

Mechanical construction

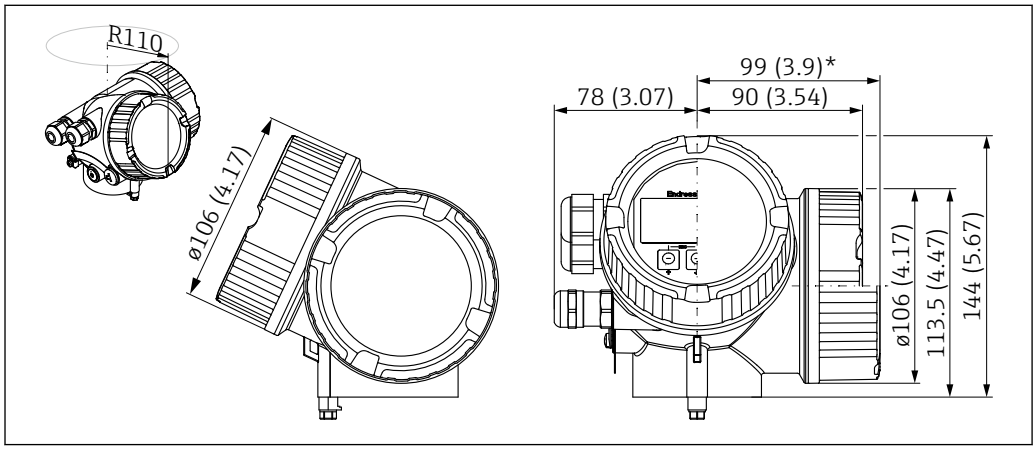
Dimensions

Dimensions of the electronics housing



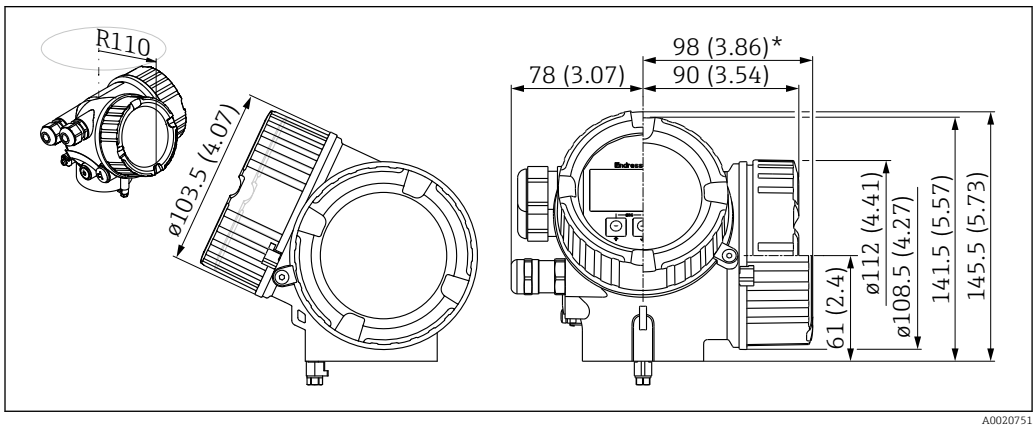
13 *Housing GT18 (316L). Unit of measurement mm (in)*

**For devices with integrated overvoltage protection.*



14 *GT19 housing (plastic PBT). Unit of measurement mm (in)*

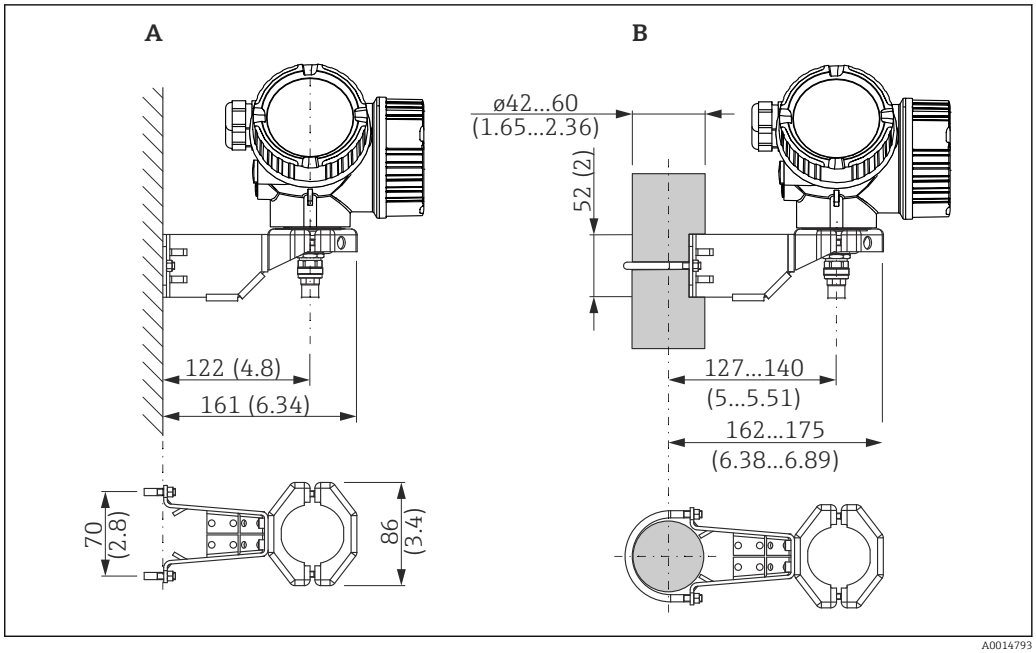
**For devices with integrated overvoltage protection.*



15 *Housing GT20 (aluminum coated). Unit of measurement mm (in)*

**For devices with integrated overvoltage protection.*

Mounting bracket dimensions

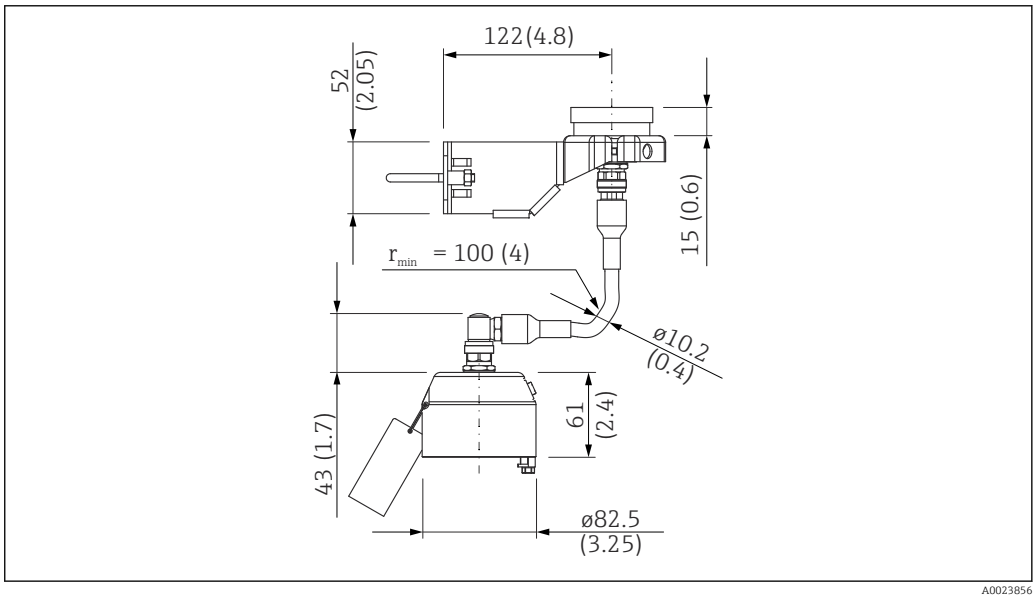


16 *Mounting bracket for electronics housing. Unit of measurement mm (in)*

A Wall mounting
B Post mounting

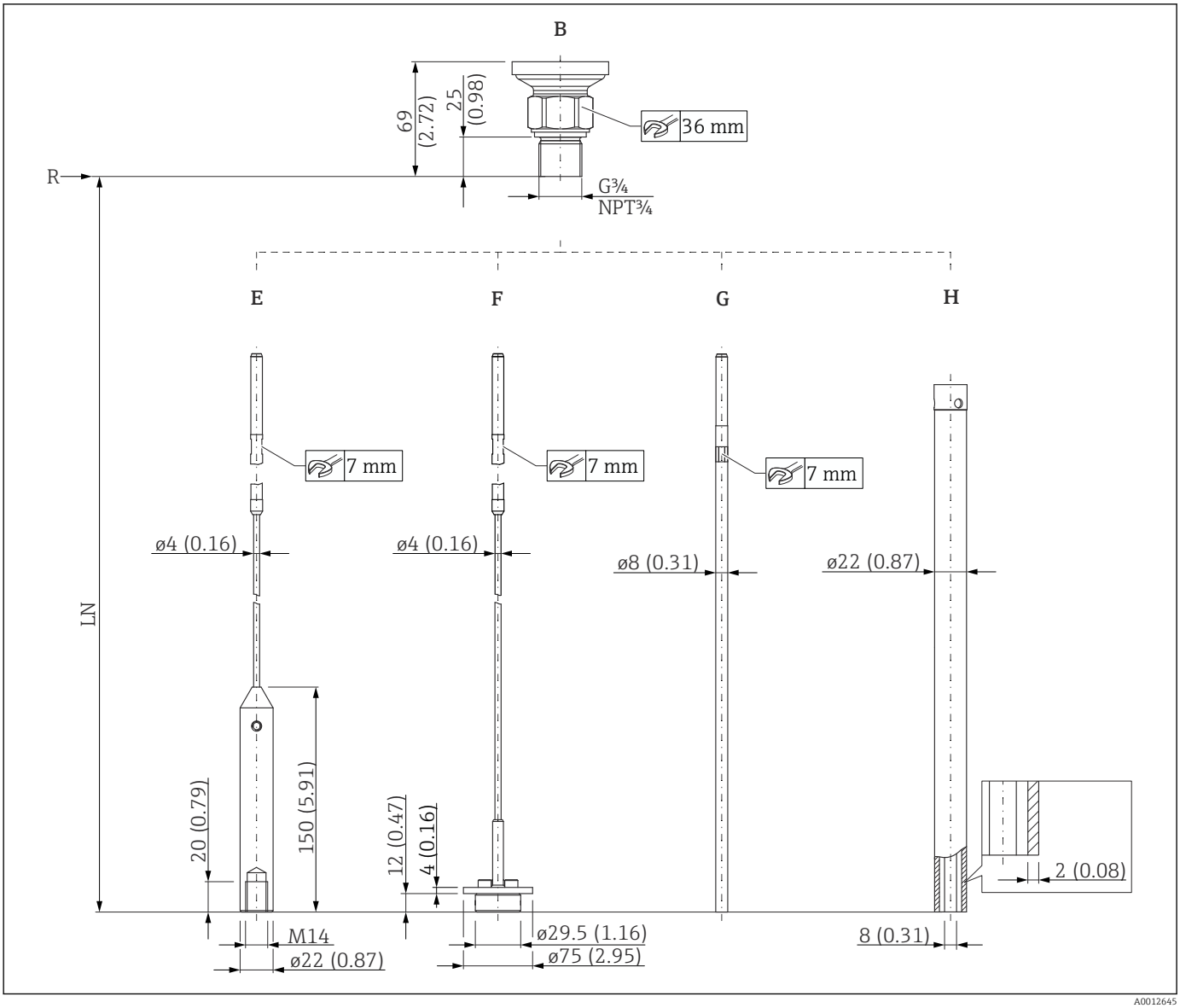
With "remote sensor" device versions (see feature 060 in the product structure), the mounting bracket is included in the scope of delivery. However, it can also be ordered separately as an accessory (order number: 71102216).

Dimensions of connection piece for remote probe



17 *Connection piece for remote probe; length of connecting cable: as per order. Unit of measurement mm (in)*

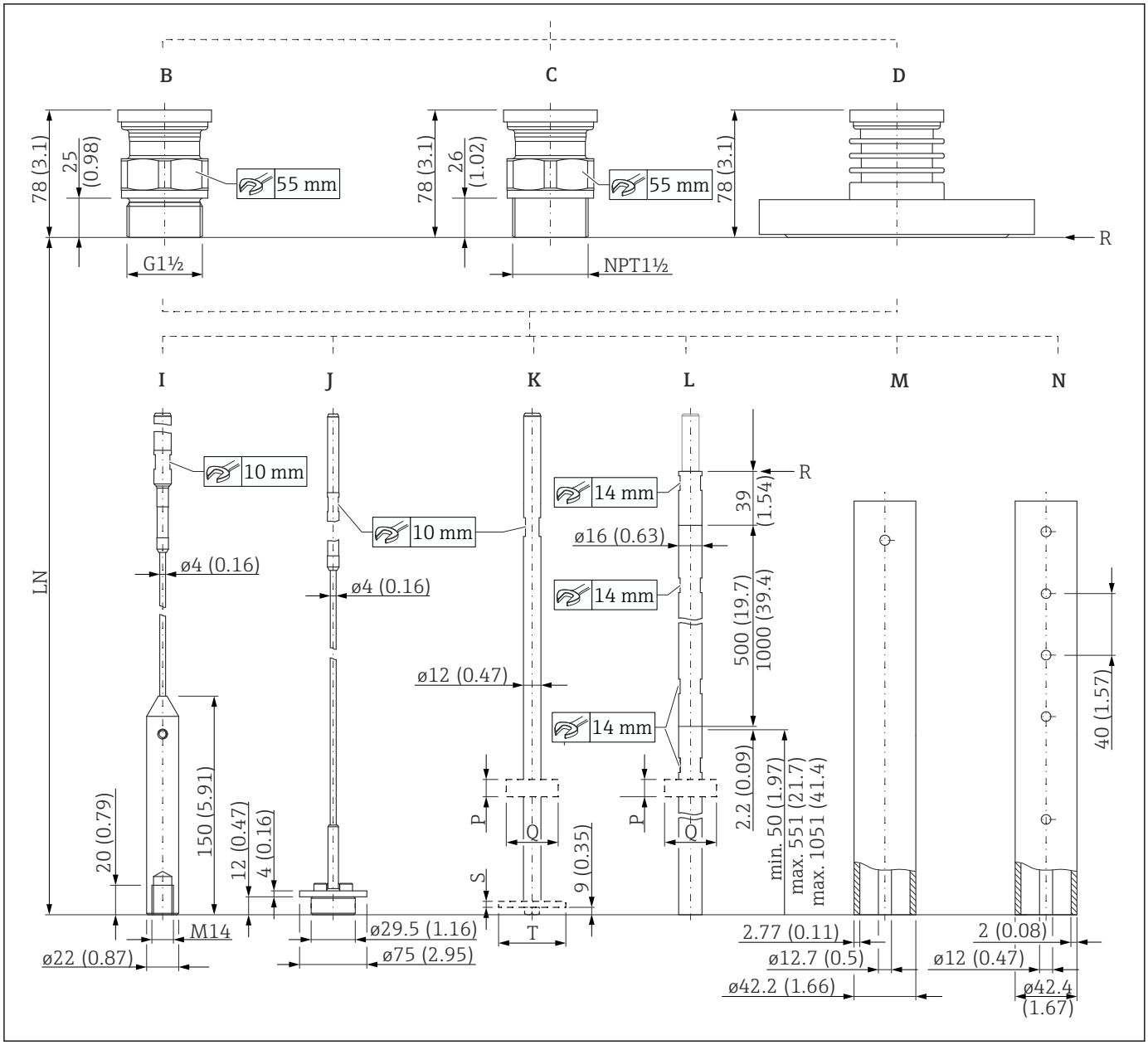
FMP51: Dimensions of process connection (G¾,NPT¾)/probe



18 *FMP51: Process connection / probe. Unit of measurement mm (in)*

B Thread ISO228 G¾ or ANSI MNPT¾ (feature 100)
E Rope probe 4 mm or ⅙" (feature 060)
F Rope probe 4 mm or ⅙" (feature 060), optional centering disk (feature 610)
G Rod probe 8 mm or ⅓" (feature 060)
H Coaxial probe (feature 060); with vent opening Ø approx. 6 mm (0.24 in)
LN Length of probe
R Reference point of measurement

FMP51: Dimensions of process connection (G1½,NPT1½, flange)/probe



19 *FMP51: Process connection / probe. Unit of measurement mm (in)*

- *B Thread ISO228 G1½ (feature 100)*
- *C Thread ANSI MNPT1½ (feature 100)*
- *D Flange ANSI B16.5, EN1092-1, JIS B2220 (feature 100)*
- *I Rope probe 4 mm or ⅛" (feature 060)*
- *J Rope probe 4 mm or ⅛"; optional centering disk (feature 060 and 610)*
- *K Rod probe 12 mm or ½"; optional centering disk; see table below (features 060 and 610)*
- *L Rod probe 16 mm (0.63 in), 500 mm (20 in) or 1000 mm (40 in) separable; centering disk optional; see table below (feature 060 and 610)*
- *M Coaxial probe; AlloyC (feature 060); with vent opening Ø approx. 8 mm (0.3 in)*
- *N Coaxial probe; 316 L (feature 060); with vent openings Ø approx. 10 mm (0.4 in)*
- *LN Length of probe*
- *P Thickness of centering star; for table of values, see below*
- *Q Diameter of centering star; for table of values, see below*
- *R Reference point of measurement*
- *S Thickness of centering disk or centering star; for table of values, see below*
- *T Diameter of centering disk or centering star: for table of values, see below*

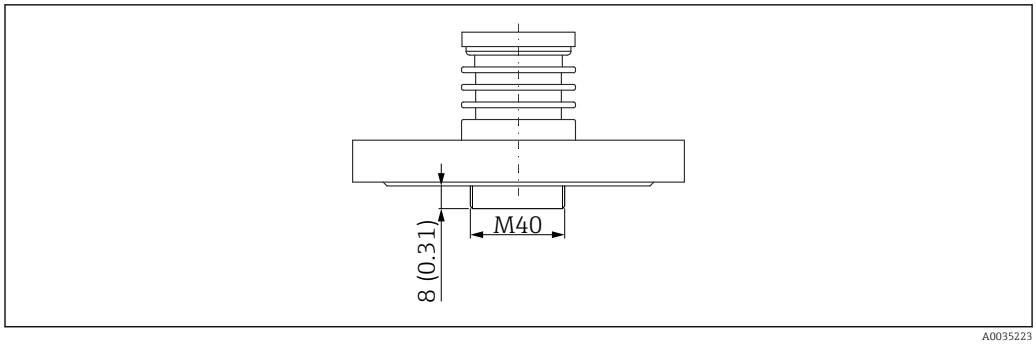
Centering disk / centering star / centering weight

Order code 610 "Accessory mounted"	Meaning	Thickness	Diameter
OA	Rod centering disk 316L; pipe diameter DN 80 (3") + DN 100 (4")	S = 4 mm (0.16 in)	T = 75 mm (2.95 in)
OB	Rod centering disk 316L; pipe diameter DN 50 (2") + DN 65 (2½")	S = 4 mm (0.16 in)	T = 45 mm (1.77 in)
OC	Rope centering disk 316L; pipe diameter DN 80 (3")+ DN 100 (4")	S = 4 mm (0.16 in)	T = 75 mm (2.95 in)
OD	Rod centering star PEEK; interface measurement; pipe diameter DN 50 (2") + DN 100 (4")	S =7 mm (0.28 in)	T = 48 to 95 mm (1.9 to 3.7 in)
OE	Rod centering star PFA; interface measurement; pipe diameter DN 40 (1½") + DN 50 (2")	P = 10 mm (0.39 in)	Q = 37 mm (1.46 in)
OK	Rope centering weight 316 L for DN 50 (2")	60 mm (2.4 in)	45 mm (1.77 in)
OL	Rope centering weight 316 L for DN 80 (3")	30 mm (1.18 in)	75 mm (2.95 in)
OM	Rope centering weight 316 L for DN 100 (4")	30 mm (1.18 in)	95 mm (3.7 in)

Note on AlloyC flanges

AlloyC flanges always have an additional thread, even if they are not used with a coaxial probe.

Options for order feature 100 for "Process connection" that are affected: AEM, AFM, AGM, AQM, ARM, ASM, ATM, CEM, CFM, CGM, CQM, CRM, CSM, CTM.



20 Dimensions of AlloyC flanges. Unit of measurement mm (in)

Probe length tolerances

Rod and coaxial probes
Permitted tolerance depending on the probe length:
- < 1 m (3.3 ft) = −5 mm (−0.2 in)
- 1 to 3 m (3.3 to 9.8 ft) = −10 mm (−0.39 in)
- 3 to 6 m (9.8 to 20 ft) = −20 mm (−0.79 in)
- > 6 m (20 ft) = −30 mm (−1.18 in)

Rope probes
Permitted tolerance depending on the probe length:
- < 1 m (3.3 ft) = −10 mm (−0.39 in)
- 1 to 3 m (3.3 to 9.8 ft) = −20 mm (−0.79 in)
- 3 to 6 m (9.8 to 20 ft) = −30 mm (−1.18 in)
- > 6 m (20 ft) = −40 mm (−1.57 in)

Surface roughness

Surface roughness of AlloyC coated flanges
Ra = 3.2 µm (126 µin); lower surface roughness available on request.

This value applies to flanges with "AlloyC>316/316L"; see product structure, feature 100 "Process connection". For other flanges, the surface roughness corresponds to the relevant flange standard.

Shortening probes

If necessary, probes can be shortened by observing the following instructions:

Shortening rod probes

Rod probes must be shortened if the distance to the vessel floor or outlet cone is less than 10 mm (0.4 in). To shorten, saw off the bottom end of the rod probe.

It is **not** possible to shorten FMP52 rod probes due to their coating.

Shortening rope probes

Rope probes must be shortened if the distance to the vessel floor or outlet cone is less than 150 mm (6 in).

It is **not** possible to shorten FMP52 rope probes due to their coating.

Shortening coaxial probes

Coaxial probes must be shortened if the distance to the vessel floor or outlet cone is less than 10 mm (0.4 in).

Coaxial probes can be shortened by a maximum of 80 mm (3.2 in) from below. They have centering devices on the inside to secure the rod centrally in the pipe. A raised edge holds the centering devices in place on the rod. It is possible to shorten the probe up to approx. 10 mm (0.4 in) below the centering device.

Weight

The weights of the individual components must be added together for the total weight.

Housing

Weight including electronics and display.

GT18 housing (stainless steel, corrosion-resistant)
4.5 kg (9.92 lb)

GT19 housing (plastic)
1.2 kg (2.65 lb)

GT20 housing (die-cast aluminum, powder-coated)
Approx.1.9 kg (4.19 lb)

Antenna and process connection adapter

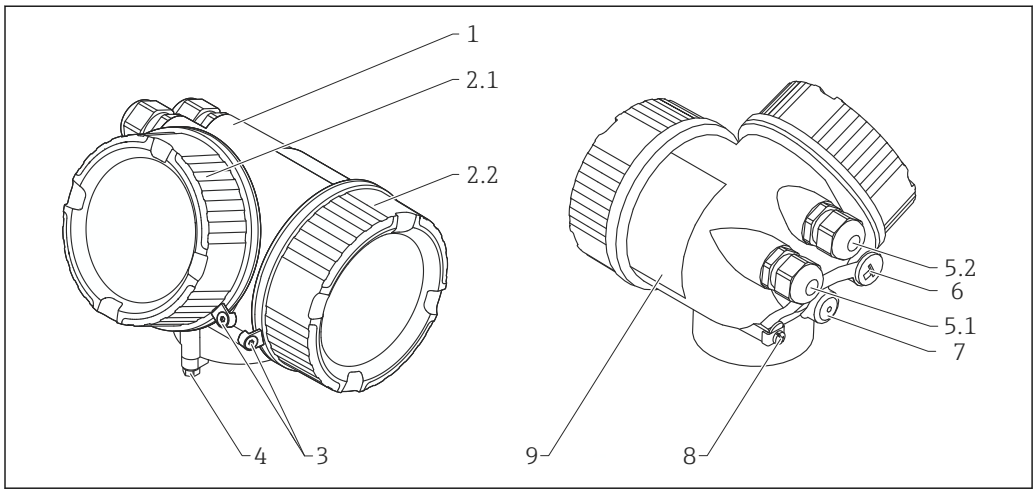
FMP51 with threaded connection G¾ or NPT¾
The weights of the individual components must be added together for the total weight.
- Sensor
  Approx.0.8 kg (1.76 lb)
- Rope probe 4 mm or ⅙"
  Approx. 0.10 kg/m (0.22 lb/in) probe length
- Rod probe 8 mm or ¾"
  Approx. 0.40 kg/m (0.88 lb/in) probe length
- Coaxial probe
  Approx. 1.20 kg/m (2.65 lb/in) probe length

FMP51 with threaded connection G1½/NPT1½ or flange
The weights of the individual components must be added together for the total weight.
- Sensor
  Approx. 1.20 kg/m (2.65 lb/in) + flange weight
- Rope probe 4 mm or ⅙"
  Approx. 0.10 kg/m (0.22 lb/in) probe length
- Rod probe 12 mm or ½"
  Approx. 0.90 kg/m (1.98 lb/in) probe length
- Rod probe 16 mm (0.63 in)
  Approx. 1.10 kg/m (2.43 lb/in) probe length
- Coaxial probe
  Approx. 3.00 kg/m (6.61 lb/in) probe length

Materials

Materials not in contact with process

GT18 housing (stainless steel, corrosion-resistant)

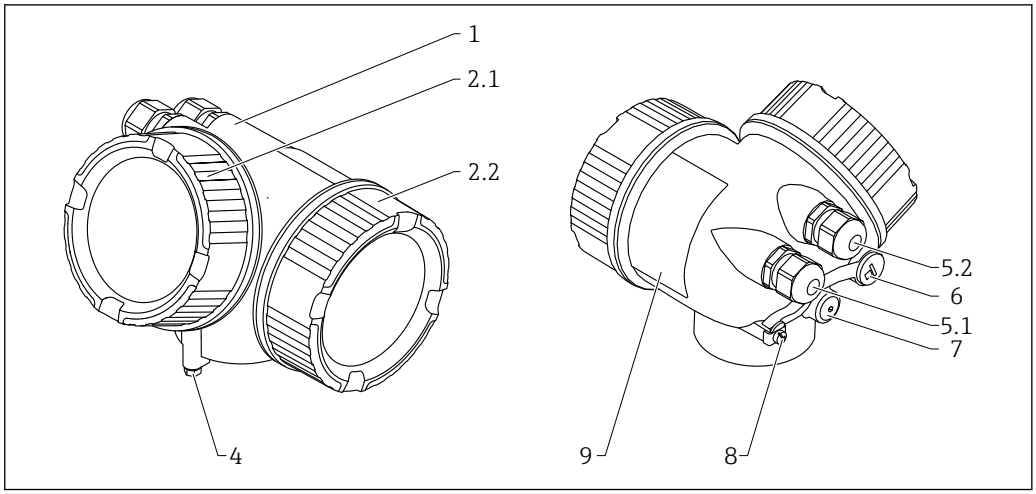


A0036037

21 Material; GT18 housing

1 Housing; CF3M (similar to 316L/ 1.4404)
2.1 Electronics compartment cover; CF3M (similar to 316L/ 1.4404), seals; NBR, window; glass, thread coating; graphite-based lubricant varnish
2.2 Connection compartment cover; CF3M (similar to 316L/ 1.4404), seal; NBR, thread coating; graphite-based lubricant varnish
3 Cover lock; 316L (1.4404), A4
4 Lock at the housing neck; 316L (1.4404), A4-70
5.1 Dummy plug, gland, adapter or plug (depending on the device version); 316L (1.4404), NBR, Viton, EPDM, PE, PBT-GF, nickel-plated brass (CuZn)
5.2 Dummy plug, gland, adapter or plug (depending on the device version); 316L (1.4404), NBR
6 Dummy plug or M12 socket (depending on the device version); 316L (1.4404)
7 Pressure relief plug; 316L (1.4404)
8 Ground terminal; 316L (1.4404), A4 (1.4571)
9 Nameplate; 316L (1.4404), A4 (1.4571)

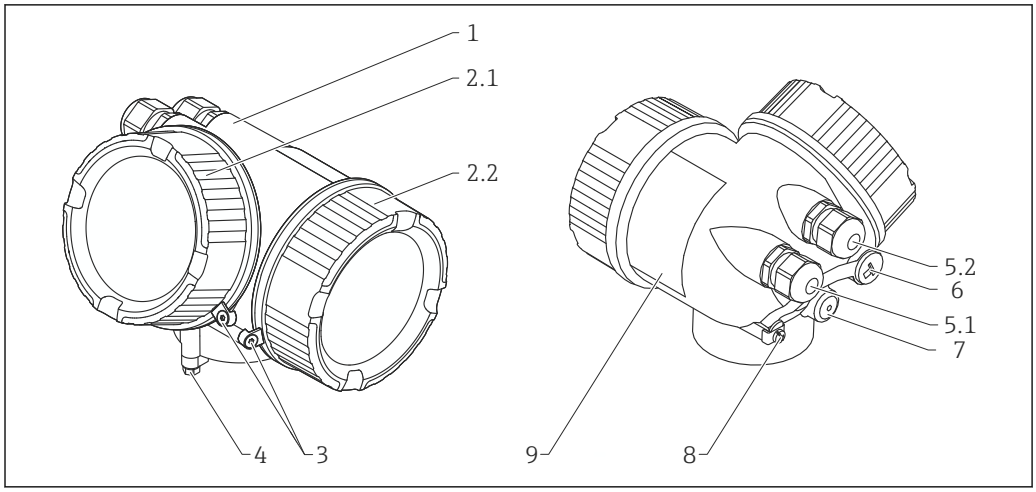
GT19 housing (plastic)



22 Material; GT19 housing

1 Housing; PBT
2.1 Electronics compartment cover; PBT-PC, seals; EPDM, window; PC, thread coating; graphite-based lubricant varnish
2.2 Connection compartment cover; PBT, seal; EPDM, thread coating; graphite-based lubricant varnish
4 Lock at the housing neck; 316L (1.4404), A4-70
5.1 Dummy plug, gland, adapter or plug (depending on the device version); 316L (1.4404), EPDM, PE, PBT-GF, nickel-plated brass (CuZn), PA
5.2 Dummy plug, gland, adapter or plug (depending on the device version); 316L (1.4404), EPDM, PE, PBT-GF, galvanized steel, nickel-plated brass (CuZn), PA
6 Dummy plug; nickel-plated brass (CuZn), M12 socket; GD-Zn nickel-plated
7 Pressure relief plug; nickel-plated brass (CuZn)
8 Ground terminal; 316L (1.4404), A4 (1.4571)
9 Adhesive nameplate; plastic

GT20 housing (die-cast aluminum, powder-coated)



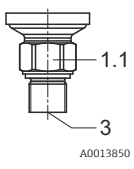
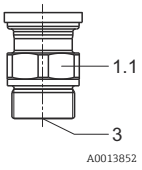
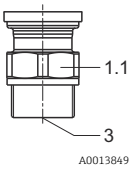
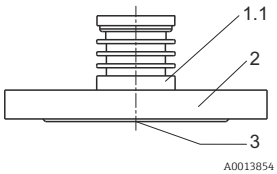
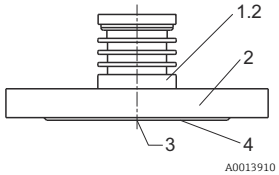
23 Material; GT20 housing

1 Housing RAL 5012 (blue); AlSi10Mg (<0.1% Cu), coating; polyester
2.1 Electronics compartment cover RAL 7035 (gray); AlSi10Mg (<0.1% Cu), seals; NBR, window; glass, thread coating; graphite-based lubricant varnish
2.2 Connection compartment cover RAL 7035 (gray); AlSi10Mg (<0.1% Cu), seals; NBR, thread coating; graphite-based lubricant varnish
3 Cover lock; 316L (1.4404), A4
4 Lock at the housing neck; 316L (1.4404), A4-70
5.1 Dummy plug, gland, adapter or plug (depending on the device version); 316L (1.4404), EPDM, PE, PBT-GF, nickel-plated brass (CuZn), PA
5.2 Dummy plug, gland, adapter or plug (depending on the device version); 316L (1.4404), EPDM, PE, PBT-GF, galvanized steel, nickel-plated brass (CuZn), PA
6 Dummy plug; nickel-plated brass (CuZn), M12 socket; GD-Zn nickel-plated
7 Pressure relief plug; nickel-plated brass (CuZn)
8 Ground terminal; 316L (1.4404), A4 (1.4571)
9 Adhesive nameplate; plastic

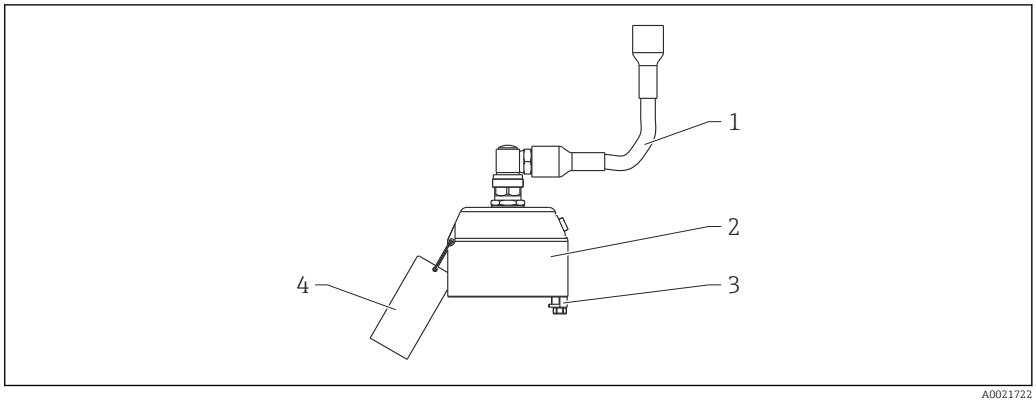
Materials in contact with the medium

Process connection

Endress+Hauser supplies DIN/EN flanges and process connections with threaded connection in stainless steel as per AISI 316L (DIN/ EN material number 1.4404 or 14435). With regard to their stability-temperature property, the materials 1.4404 and 1.4435 are grouped together under 13E0 in EN 1092-1: 2007 Tab. G.3.1-1. The chemical composition of the two materials can be identical.

Levelflex FMP51						
Threaded connection			Flange		No.	Material
G¾, NPT¾	*G1½*	*NPT1½*	*DN40 to DN200*	*DN40 to DN100*		
					1.1	316L (1.4404)
					1.2	Alloy C22 (2.4602)
					2	ASME: 316/316L EN: 316L (1.4404) JIS: 316L (1.4435)
					3	Ceramic Al_2O_3 99.7 %
					4	Cladding: Alloy C22 (2.4602)

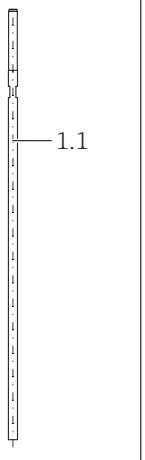
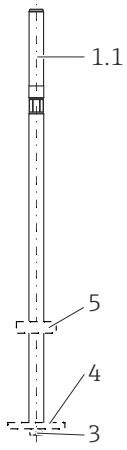
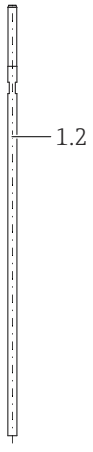
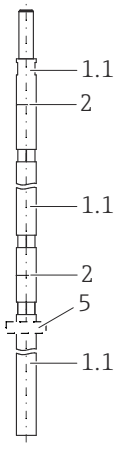
Adapter and cable for remote sensor



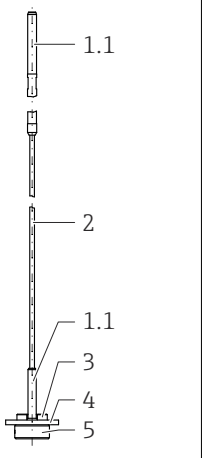
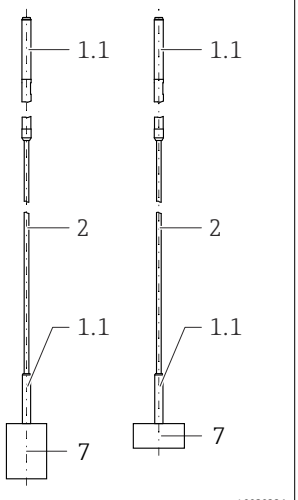
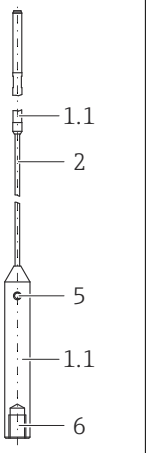
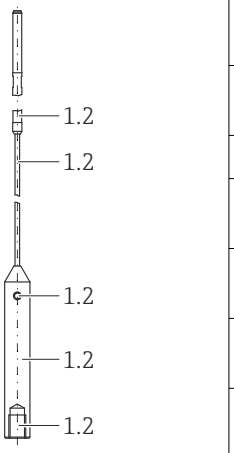
24 Materials: Adapter and cable for "Remote sensor" version

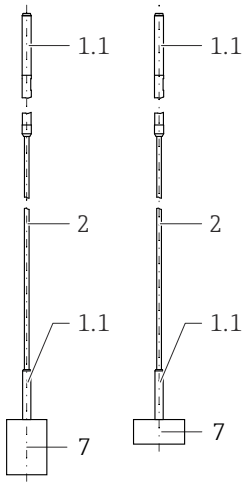
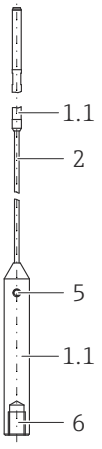
1 Cable, FRNC
2 Sensor adapter, 304 (1.4301)
3 Terminal, 316 L (1.4404); screw, A4-70
4 Strap, 316 (1.4401); crimp sleeve, aluminum; nameplate, 304 (1.4301)

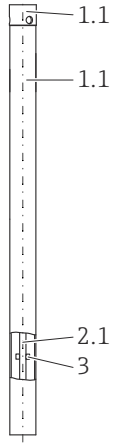
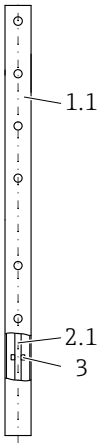
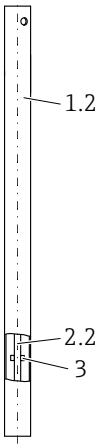
Probe

Levelflex FMP51: rod probes					
Feature 060 "Probe"				No.	Material
▪ AA: 8mm 316L ▪ AB: 1/3" 316L	▪ AC: 12mm 316L ▪ AD: 1/2" 316L	▪ AL: 12mm AlloyC ▪ AM: 1/2" AlloyC	▪ BA: 16mm 316L 500mm separable ▪ BB: 0.63in 316L 20inch separable ▪ BC: 16mm 316L 1000mm separable ▪ BD: 0.63in 316L 40inch separable		
				1.1	316L (1.4404)
				1.2	Alloy C22 (2.4602)
				2	Connecting bolts: Alloy C22 (2.4602)
					Nord-Lock washer: 1.4547
				3	Hexagonal-headed bolt: A4-70
					Nord-Lock washer: 1.4547
				4	Centering star, PEEK [1]
					Centering disk, 316L (1.4404) [2]
				5	Centering star, PFA [3]

1) Feature 610 "Accessory mounted" = OD "Rod centering star d=48-95mm, PEEK"
2) Feature 610 "Accessory mounted" = OA "Rod centering disk d=75mm" or OB "Rod centering disk d=45mm"
3) Feature 610 "Accessory mounted" = OE "Rod centering star d=37mm, PFA"

Levelflex FMP51: rope probes					
Feature 060 "Probe" ▪ LA: 4mm, 316L, max. 150mm nozzle ▪ LB: 1/6", 316L, max. 6in nozzle ▪ MB: 4mm, 316L, max. 300mm nozzle ▪ MD: 1/6", 316L, max. 12in nozzle			▪ LG: 4mm, AlloyC, max. 150mm nozzle ▪ LH: 1/6", AlloyC, max. 6in nozzle ▪ MG: 4mm, AlloyC, max. 300mm nozzle ▪ MH: 1/6", AlloyC, max. 12in nozzle	No.	Material
Feature 610 "Accessory mounted"					
OC: Centering disk d=75mm	▪ OK: Centering weight d=45mm ▪ OL: Centering weight d=75mm ▪ OM: Centering weight d=95mm	without option OC			
				1.1	316L (1.4404)
				1.2	Alloy C22 (2.4602)
				2	316 (1.4401)
				3	Cylinder screw: A4-80
				4	Disk: 316L (1.4404)
				5	Setscrew: A4-70
				6	Screw for tightening: A2-70
				7	Weight: 316L (1.4404)

Levelflex FMP51: rope probes				
Feature 060 "Probe" ▪ LE: 4mm, PFA>316, max. 150mm nozzle ▪ LF: 1/6", PFA>316, max. 6in nozzle ▪ ME: 4mm, PFA>316, max. 300mm nozzle ▪ MF: 1/6", PFA>316, max. 12in nozzle			No.	Material
Feature 610 "Accessory mounted"				
▪ OK: Centering weight d=45mm ▪ OL: Centering weight d=75mm ▪ OM: Centering weight d=95mm	without option OC			
		1.1	316L (1.4404)	
		2	Rope: 316 (1.4401)	
			Coating 0.75 mm (0.03 in): PFA	
		5	Setscrew: A4-70	
		6	Screw for tightening: A2-70	
		7	Weight: 316L (1.4404)	

Levelflex FMP51: coaxial probes				
Feature 060 "Probe" ▪ UA: ...mm, coax 316L ▪ UB: ...inch, coax 316L Feature 100 "Process connection" ▪ GDJ: thread ISO228 G3/4 ▪ RDJ: thread ANSI MNPT3/4	Feature 060 "Probe" ▪ UA: ...mm, coax 316L ▪ UB: ...inch, coax 316L Feature 100 "Process connection" all other options	Feature 060 "Probe" ▪ UC: ...mm, coax AlloyC ▪ UD: ...inch, coax AlloyC	No.	Material
 A0036590	 A0036591	 A0036592	1.1	316L (1.4404)
			1.2	Alloy C22 (2.4602)
			2.1	Rod: 316L (1.4404)
			2.2	Alloy C22 (2.4602)
			3	Spacer: PFA

Operability

Operation concept

Operator-oriented menu structure for user-specific tasks
- Commissioning
- Operation
- Diagnostics
- Expert level

Operating languages
- English
- Deutsch
- Français
- Español
- Italiano
- Nederlands
- Portuguesa
- Polski
- русский язык (Russian)
- Svenska
- Türkçe
- 中文 (Chinese)
- 日本語 (Japanese)
- 한국어 (Korean)
- Bahasa Indonesia
- tiếng Việt (Vietnamese)
- čeština (Czech)

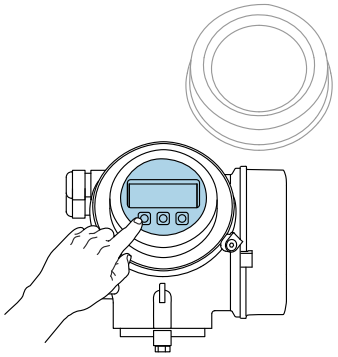
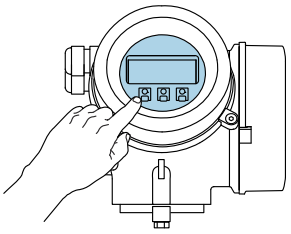
Feature 500 in the product structure determines which of these languages is preset on delivery.

Quick and safe commissioning
- Interactive wizard with graphical user interface for guided commissioning in FieldCare/DeviceCare
- Menu guidance with brief descriptions of the individual parameter functions
- Standardized operation at the device and in the operating tools

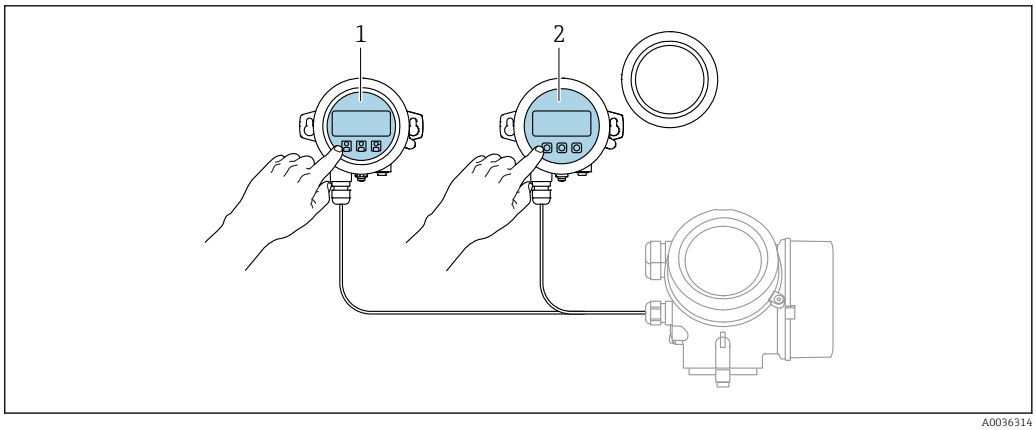
Integrated data memory (HistoROM)
- Adoption of data configuration when electronics modules are replaced
- Up to 100 event messages recorded in the device
- Data logging with up to 1000 logged values
- A reference signal curve is saved during commissioning for later use as a reference during operation.

Efficient diagnostics increase measurement availability.
- Remedial measures are integrated in plain text.
- Diverse simulation options and line recorder functions

Access to operating menu via local display

Operation with	*Pushbuttons*	*Touch control*
Order code for "Display; operation"	Option **C** "SD02"	Option **E** "SD03"
	 A0036312	 A0036313
Display elements	4-line display	4-line display White background lighting; switches to red in event of device errors
	Format for displaying measured variables and status variables can be individually configured	
	Permitted ambient temperature for the display: −20 to +70 °C (−4 to +158 °F) The readability of the display may be impaired at temperatures outside the temperature range.	
Operating elements	Onsite operation with 3 pushbuttons (⊞, ⊟, Ⓔ)	External operation via touch control; 3 optical keys: ⊞, ⊟, Ⓔ
	Operating elements also accessible in various hazardous areas	
Additional functionality	Data backup function The device configuration can be saved in the display module.	
	Data comparison function The device configuration saved in the display module can be compared to the current device configuration.	
	Data transfer function The transmitter configuration can be transmitted to another device using the display module.	

Operation with remote display and operating module FHX50



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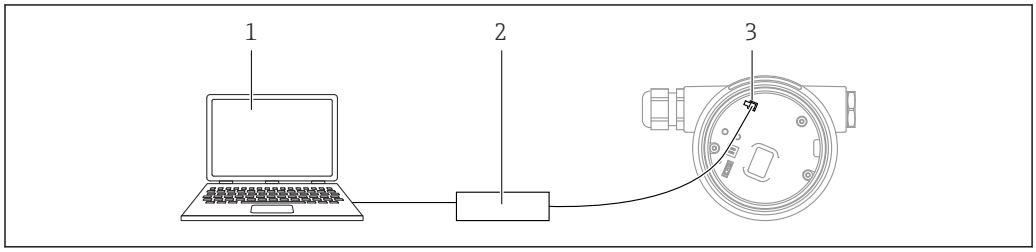
25 FHX50 operating options

1 Display and operating module SD03, optical keys; can be operated through the glass of the cover
2 Display and operating module SD02, push buttons; cover must be removed

Access to the operating menu via the operating tool

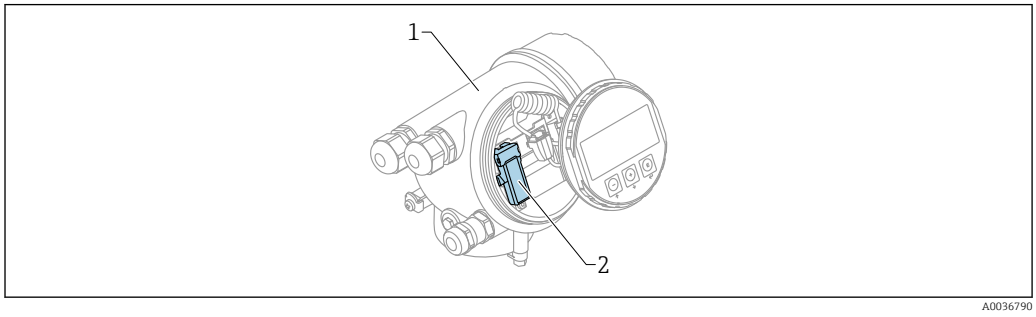
Via service interface (CDI)



1 Computer with FieldCare/DeviceCare operating tool
2 Commubox
3 Service interface (CDI) of the measuring instrument (= Endress+Hauser Common Data Interface)

Operation via Bluetooth® wireless technology

Requirements

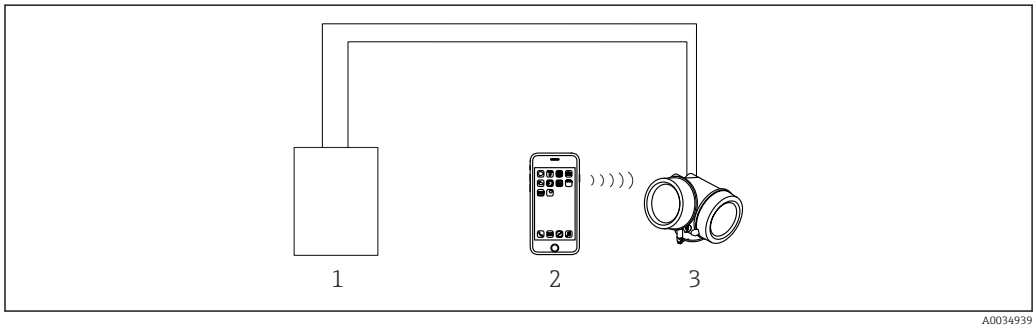


26 Device with Bluetooth module

1 Electronics housing of the device
2 Bluetooth module

This operation option is only available for devices with Bluetooth module. There are the following options:
- The device has been ordered with a Bluetooth module:
  Feature 610 "Accessory Mounted", option NF "Bluetooth"
- The Bluetooth module has been ordered as an accessory (ordering number: 71377355) and has been mounted. See Special Documentation SD02252F.

Operation via SmartBlue (app)



27 Operation via SmartBlue (app)

1 Transmitter power supply unit
2 Smartphone / tablet with SmartBlue (app)
3 Transmitter with Bluetooth module

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**.

CE mark

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

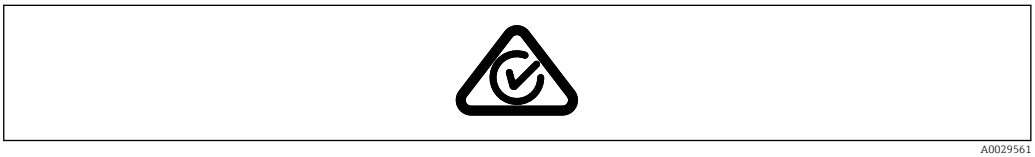
The manufacturer confirms successful testing of the device by affixing to it the CE mark.

RoHS

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

RCM marking

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



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Ex-approval

The devices are certified for use in hazardous areas and the relevant safety instructions are provided in the separate "Safety Instructions" (XA, ZD) document. Reference is made to this document on the nameplate.

The separate "Safety Instructions" documentation (XA) containing all the relevant explosion protection data is available from your Endress+Hauser sales organization.

Dual seal ANSI/ISA 12.27.01

The devices have been designed as dual seal devices in accordance with ANSI /ISA 12.27.01. This allows the user to forego the use of - and save the cost of installing - an external secondary process seal in the protection pipe as required in ANSI/NFPA 70 (NEC) and CSA 22.1 (CEC). These instruments comply with the North American installation practice and provide a very safe and cost-saving installation for pressurized applications with hazardous fluids.

Please refer to the Safety Instructions (XA) of the relevant device for further information.

Overfill protection

WHG

DIBt Z-65.16-501

AD2000

- For FMP51/FMP54:
  The wetted material 316L (1.4435/1.4404) corresponds to AD2000 - W2/W10.
- Declaration of Conformity: see the product structure, feature 580, version JF.

NACE MR 0175 / ISO 15156

For FMP51, FMP54:

- The wetted, metal materials (excluding ropes) meet the requirements of NACE MR 0175 / ISO 15156.
- Declaration of Conformity: see the product structure, feature 580, version JB

NACE MR 0103

For FMP51, FMP54:
- The wetted, metal materials (excluding ropes) meet the requirements of NACE MR 0103 / ISO 17495.
- The Declaration of Conformity is based on NACE MR 0175.
  The hardness and intergranular corrosion have been tested, and heat treatment (solution annealed) has been performed. The materials used therefore meet the requirements of NACE MR 0103 / ISO 17495.
- Declaration of Conformity: see the product structure, feature 580, version JE.

For FMP52:
- The pressure-bearing metal materials (excluding rope) comply with the requirements of NACE MR 0103/ISO 17495.
- The Declaration of Conformity is based on NACE MR 0175.
  The hardness and intergranular corrosion have been tested, and heat treatment (solution annealed) has been performed. The materials used therefore meet the requirements of NACE MR 0103 / ISO 17495.
- Declaration of Conformity: see the product structure, feature 580, version JE.

ASME B31.1 and B31.3

- The design, the material used, the pressure and temperature ranges and the labeling of the devices meet the requirements of ASME B31.1 and B31.3
- Declaration of Conformity: see the product structure, feature 580, version KV.

Pressure Equipment Directive

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

Pressure instruments with a process connection that does 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.

Radio approval

Satisfies "Part 15" of the FCC rules for an unintentional radiator. All probes meet the requirements for a Class A digital device.

In addition, coaxial probes and all probes in metal vessels meet the requirements for a Class B digital device.

CRN approval

Some device versions have CRN approval. Devices are CRN-approved if the following two conditions are met:

- The device has a CSA or FM approval (product structure: feature 010 "Approval")
- The device has a CRN-approved process connection according to the following table:

Feature 100 in the product structure	Approval
AEJ	NPS 1-1/2" Cl. 150 RF, 316/316l flange ASME B16.5
AEM	NPS 1-1/2" Cl. 150, AlloyC > 316/316l flange ASME B16.5
AFJ	NPS 2" Cl. 150 RF, 316/316l flange ASME B16.5
AFM	NPS 2" Cl.150, AlloyC>316/316L flange ASME B16.5
AGJ	NPS 3" Cl. 150 RF, 316/316l flange ASME B16.5
AGM	NPS 3" Cl.150, AlloyC>316/316L flange ASME B16.5
AHJ	NPS 4" Cl. 150 RF, 316/316l flange ASME B16.5
AJJ	NPS 6" Cl. 150 RF, 316/316l flange ASME B16.5
AKJ	NPS 8" Cl. 150 RF, 316/316l flange ASME B16.5
AQJ	NPS 1-1/2" Cl. 300 RF, 316/316l flange ASME B16.5
AQM	NPS 1-1/2" Cl. 300, AlloyC > 316/316l flange ASME B16.5
ARJ	NPS 2" Cl. 300 RF, 316/316l flange ASME B16.5

Feature 100 in the product structure	Approval
ARM	NPS 2" Cl.300, AlloyC>316/316L flange ASME B16.5
ASJ	NPS 3" Cl. 300 RF, 316/316l flange ASME B16.5
ASM	NPS 3" Cl.300, AlloyC>316/316L flange ASME B16.5
ATJ	NPS 4" Cl. 300 RF, 316/316l flange ASME B16.5
ATM	NPS 4" Cl.300, AlloyC>316/316L flange ASME B16.5
GGJ	Thread ISO228 G1-1/2, 316L
RGJ	Thread ANSI MNPT1-1/2, 316L

- Process connections that do not have CRN approval are not listed in this table.
- Please refer to the product structure to discover which process connections are available for a specific device type.
- CRN-approved devices are labeled with registration number 0F14480.5C on the nameplate.

Test, certificate

Feature 580 "Test, certificate"	Description	Approval
Yes	3.1 Material documentation, wetted metal parts, EN10204-3.1 inspection certificate	FMP51
JB	Declaration of Conformity NACE MR0175, wetted metal parts	FMP51
JE	Declaration of Conformity NACE MR0103, wetted metal parts	FMP51
JF	Declaration of Conformity AD2000, wetted metal parts: Material conformity for all metal wetted/pressurized parts according to AD2000 (data sheets W2, W9, W10)	FMP51
JN	Ambient temperature of transmitter −50 °C (−58 °F) Devices with this option are routine tested (start-up test at −50 °C (−58 °F)).	FMP51
KD	Helium leak test, internal procedure, inspection certificate	FMP51
KE	Pressure test, internal procedure, inspection certificate	FMP51
KG	3.1 material certificate+PMI test (XRF), internal procedure, wetted metal parts, EN10204-3.1 inspection certificate	FMP51
KP	Penetrant testing AD2000-HP5-3(PT), wetted/pressurized metal parts, inspection certificate	FMP51
KQ	Penetrant testing ISO23277-1 (PT), wetted/pressurized metal parts, inspection certificate	FMP51
KR	Penetrant testing ASME VIII-1 (PT), wetted/pressurized metal parts, inspection certificate	FMP51
KT	Welding documentation ISO, wetted/pressurized seams, declaration Consists of: ▪ Welding drawing ▪ WPQR (Welding Procedure Qualification Record) according to ISO 14613/ISO14614 ▪ WPS (Welding Procedure Specifications) ▪ WPQ (Manufacturer Declaration for Welding Professionals' Qualifications)	FMP51

Feature 580 "Test, certificate"	Description	Approval
KU	Welding documentation ASME, wetted/pressurized seams, declaration Consists of: ▪ Welding drawing ▪ WPQR (Welding Procedure Qualification Record) according to ASME BPVC Sect. IX ▪ WPS (Welding Procedure Specifications) ▪ WPQ (Manufacturer Declaration for Welding Professionals' Qualifications)	FMP51
KV	Declaration of Conformity ASME B31.3: The design, the material used, the pressure and temperature ranges and the labeling of the devices meet the requirements of ASME B31.3	FMP51

Test reports, declarations and inspection certificates are available in electronic format in the *W@M Device Viewer*:
Enter the serial number from the nameplate (www.endress.com/deviceviewer)

This concerns the options for the following order codes:
- 550 "Calibration"
- 580 "Test, certificate"

Product documentation on paper

A printed (hard copy) version of test reports, declarations and inspection certificates can optionally be ordered via order code 570 "Service", option I7 "Product documentation on paper". The documents are then supplied with the product.

External standards and guidelines

- EN 60529
  Degrees of protection provided by enclosures (IP code)
- EN 61010-1
  Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC/EN 61326
  "Emission in accordance with Class A requirements". Electromagnetic compatibility (EMC requirements)
- NAMUR NE 21
  Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment
- NAMUR NE 43
  Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53
  Software of field devices and signal-processing devices with digital electronics
- NAMUR NE 107
  Status classification as per NE107
- NAMUR NE 131
  Requirements for field devices for standard applications
- IEC61508
  Functional safety of safety-related electrical/electronic/programmable electronic systems

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:

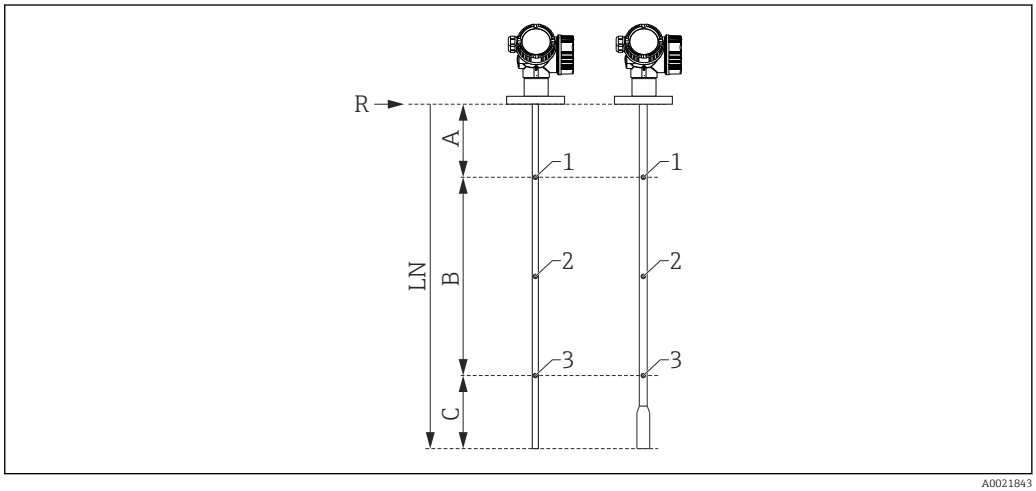
1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

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

3-point linearity protocol

The following points must be considered if the order option 3-point linearity protocol was selected under the Calibration feature.

The 3 points of the linearity protocol are defined as follows, depending on the selected probe:



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A Distance from the reference point R to the first measuring point
B Measuring range
C Distance from the probe end to the third measuring point
LN Probe length
R Reference point of measurement
1 First measuring point
2 Second measuring point (in the middle between the first and third measuring point)
3 Third measuring point

	Rod or coaxial probe LN ≤ 6 m (20 ft)	**Separable rod probe LN > 6 m (20 ft)**	**Rope probe LN ≤ 6 m (20 ft)**	**Rope probe LN > 6 m (20 ft)**
Position of 1st measuring point	▪ FMP51/FMP52/FMP54 without gas phase compensation/FMP55: A = 350 mm (13.8 in) ▪ FMP54 with gas phase compensation, L_{ref} = 300 mm (11 in): A = 600 mm (23.6 in) ▪ FMP54 with gas phase compensation, L_{ref} = 550 mm (21 in): A = 850 mm (33.5 in)		A = 350 mm (13.8 in)	A = 350 mm (13.8 in)
Position of 2nd measuring point	In the middle between the 1st and 3rd measuring point			
Position of 3rd measuring point	Measured from bottom: C = 250 mm (9.84 in)	Measured from top: A+B = 5 750 mm (226 in)	Measured from bottom: C = 500 mm (19.7 in)	Measured from top: A+B = 5 500 mm (217 in)
Minimum measuring range	B ≥ 400 mm (15.7 in)	B ≥ 400 mm (15.7 in)	B ≥ 400 mm (15.7 in)	B ≥ 400 mm (15.7 in)
Minimum probe length	LN ≥ 1 000 mm (39.4 in)	LN ≥ 1 000 mm (39.4 in)	LN ≥ 1 250 mm (49.2 in)	LN ≥ 1 250 mm (49.2 in)

The position of the measuring points can vary by ±1 cm (±0.04 in).

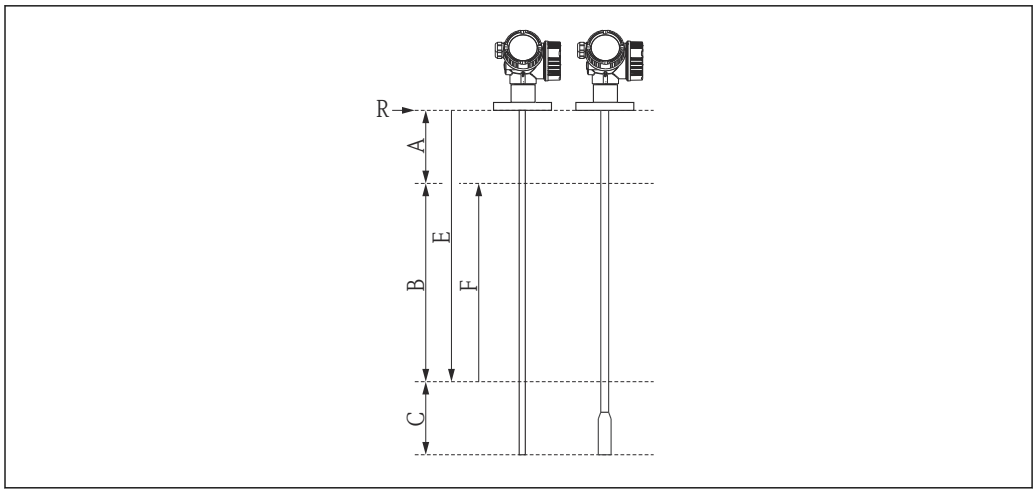
- In the case of rod and rope probes, the linearity check is performed with the entire device.
- For separable rod probes, a reference rod probe is used instead of the original probe.
- In the case of coaxial probes, the device electronics unit is mounted on a reference rod probe during the test and the linearity check is performed.
- The linearity check is performed under reference operating conditions.

5-point linearity protocol

The following points must be considered if the order option 5-point linearity protocol was selected under the Calibration feature.

The 5 points of the linearity protocol are evenly distributed over the measuring range (0% - 100%). The **Empty calibration** (E) and **Full calibration** (F) must be specified to define the measuring range. If this information is missing, probe-dependent default values are used instead.

The following restrictions must be considered when selecting E and F:



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A Distance from the reference point R to the 100% mark
B Measuring range
C Distance from the probe end to the 0% mark
E Empty calibration
F Full calibration
R Reference point of measurement

Sensor	Minimum distance between reference point R and 100% mark	Minimum measuring range
FMP51	A ≥ 250 mm (10 in)	B ≥ 100 mm (4 in)
FMP51 Rope probe ... mm (... in), 4 mm (⅙ in)PFA > 316, max 300 mm (12 in)nozzle height, centering rod	A ≥ 350 mm (14 in)	B ≥ 100 mm (4 in)

Probe type	Minimum distance from the probe end to the 0% mark	Maximum value for "Empty calibration"
Rod (non-separable)	C ≥ 100 mm (4 in)	E ≤ 3.9 m (12.8 ft)
▪ Coax ▪ Rod (separable)	C ≥ 100 mm (4 in)	E ≤ 5.9 m (19.4 ft)
Rope	C ≥ 1 000 mm (40 in)	E ≤ 23 m (75 ft)

- In the case of rod and rope probes, the linearity check is performed with the entire device.
- In the case of coaxial probes, the device electronics unit is mounted on a reference rod probe during the test and the linearity check is performed.
- The linearity check is performed under reference operating conditions.

The selected values for **Empty calibration** and **Full calibration** are only used to create the linearity protocol. Afterwards, the values are reset to the default values specific for the probe. If values other than the default values are required, they must be ordered as a customized parameterization.

Labeling (optional)

Various types of measuring point labeling can be selected in the Product Configurator.

This includes:
- Tag
- Adhesive label
- RFID TAG
- Labeling according to DIN91406, also with NFC.

Tag name
3 lines with a maximum of 18 characters per line

Labeling in the electronic nameplate (ENP)
The first 32 characters of the tag name

Labeling on the display module
The first 12 characters of the tag name

Accessories

The accessories currently available for the product can be selected at www.endress.com:

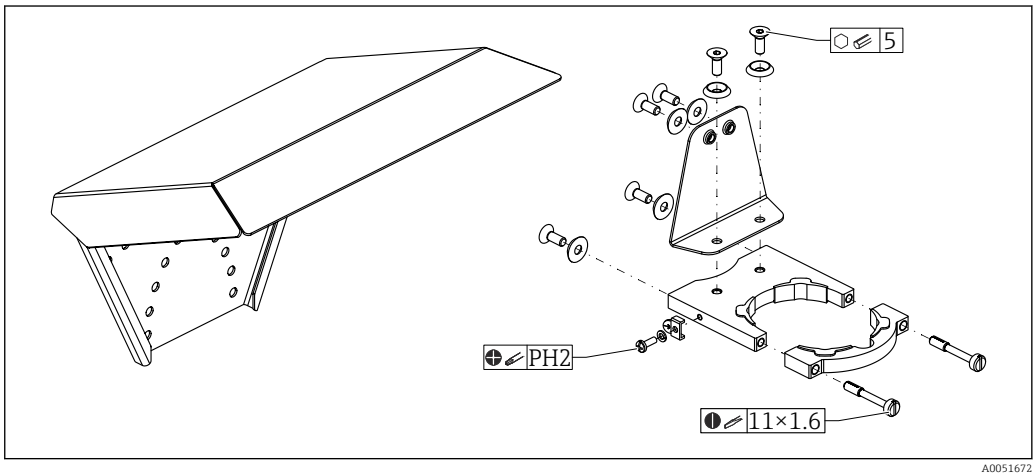
1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Spare parts & Accessories**.

Device-specific accessories

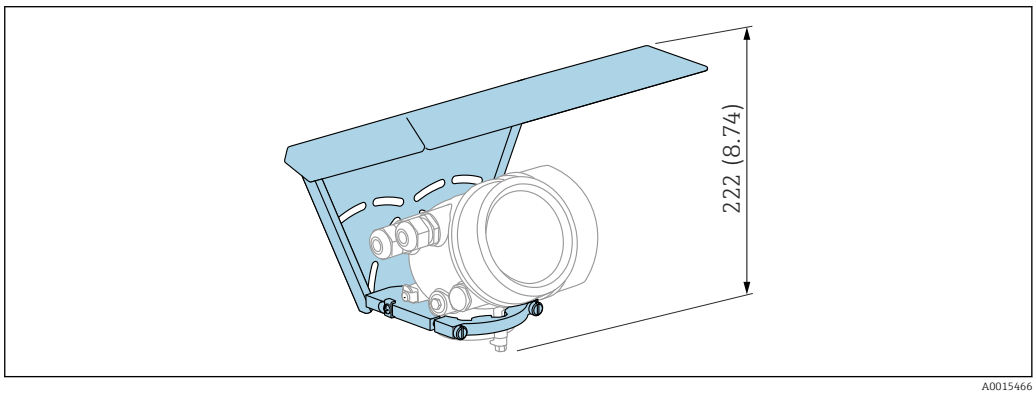
Weather protection cover

The weather protection cover can be ordered together with the device via the "Accessory enclosed" product structure.

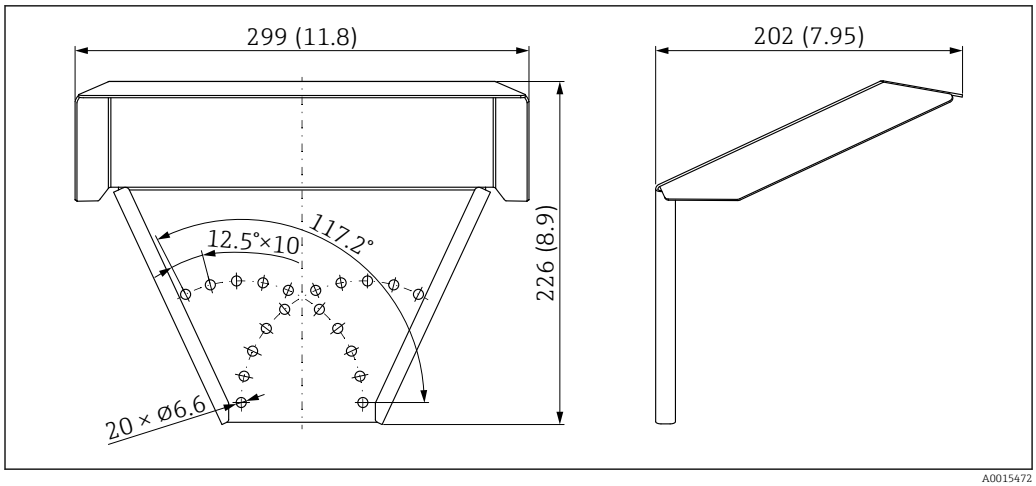
It is used to protect against direct sunlight, precipitation and ice.



28 *Overview*



29 *Height. Unit of measurement mm (in)*



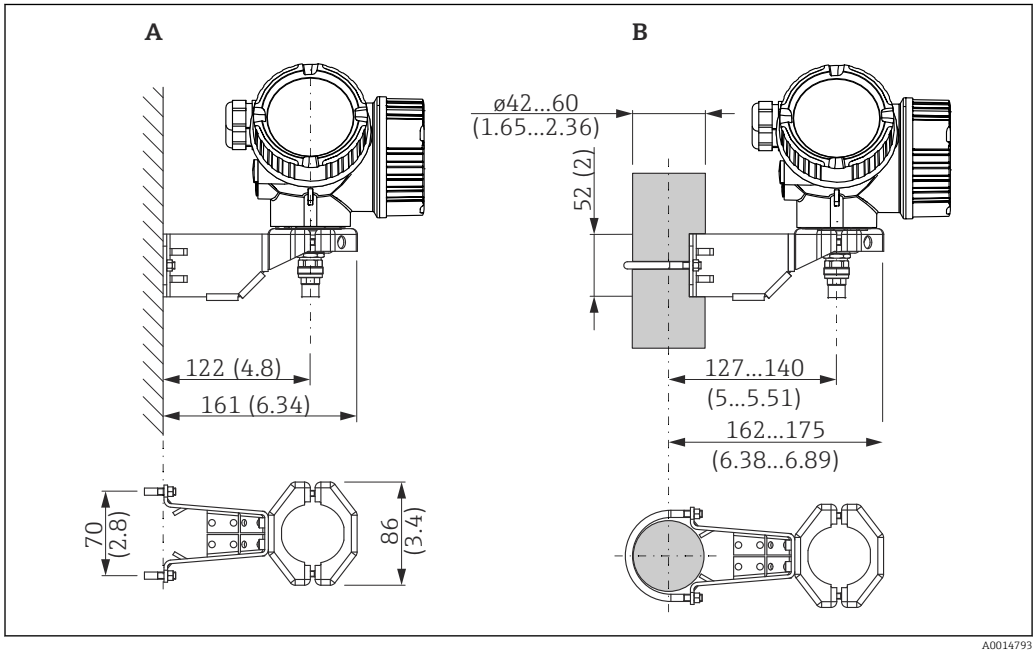
30 Dimensions. Unit of measurement mm (in)

Material
- Protection cap; 316L (1.4404)
- Bracket; 316L (1.4404)
- Angle bracket; 316L (1.4404)
- Clamping screw; 316L (1.4404) + carbon fiber
- Molded rubber part (4x); EPDM
- Screws; A4
- Disks; A4
- Ground terminal; A4, 316L (1.4404)

Order number for accessories:
71162242

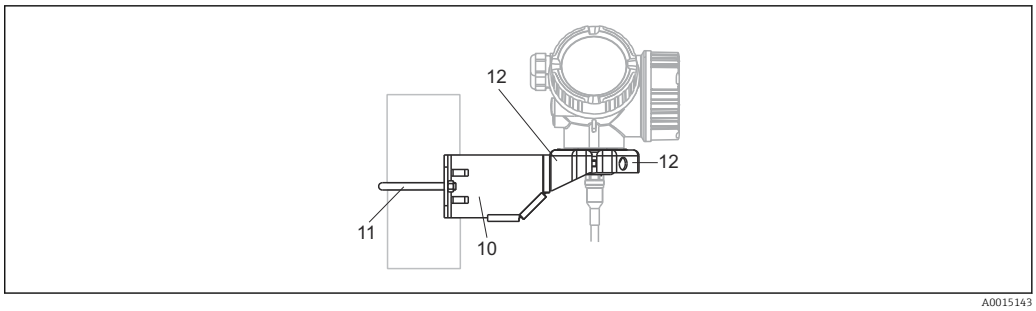
Mounting bracket for electronics housing

With "remote sensor" device versions (feature 060 in the product structure), the mounting bracket is included in the scope of delivery. It can be ordered as a separate accessory .



31 Mounting bracket for electronics housing; unit: mm (in)

A Wall mounting
B Post mounting



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32 *Material; mounting bracket*

10 Bracket, 316L (1.4404)
11 Round bracket, 316L (1.4404); screws/nuts, A4-70; distance sleeves, 316L (1.4404)
12 Half-shells, 316 L (1.4404)

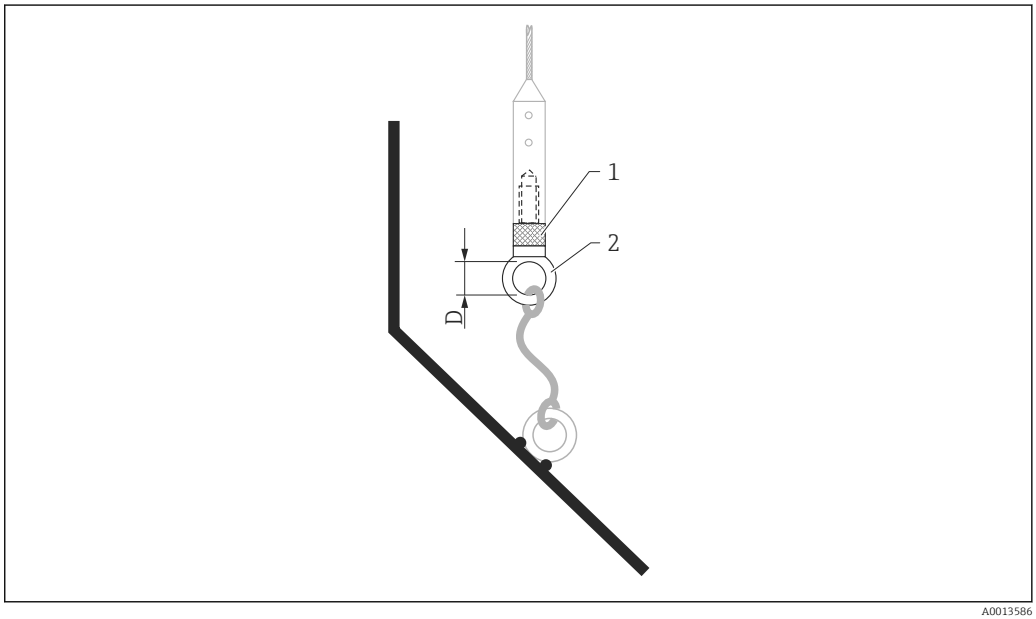
Order number for accessories:
71102216

Mounting kit, insulated

To secure rope probes so that they are reliably insulated.

Maximum process temperature: 150 °C (300 °F)

Mounting set, insulated, can be used for:
FMP51



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33 *Scope of delivery of mounting kit:*

1 Insulation sleeve
2 Ring bolt

For rope probes 4 mm (⅙ in) or 6 mm (¼ in) with PA > steel:
Diameter D = 20 mm (0.8 in)

Order number for accessories:
52014249

For rope probes 6 mm (¼ in) or 8 mm (⅓ in) with PA > steel:
Diameter D = 25 mm (1 in)

Order number for accessories:
52014250

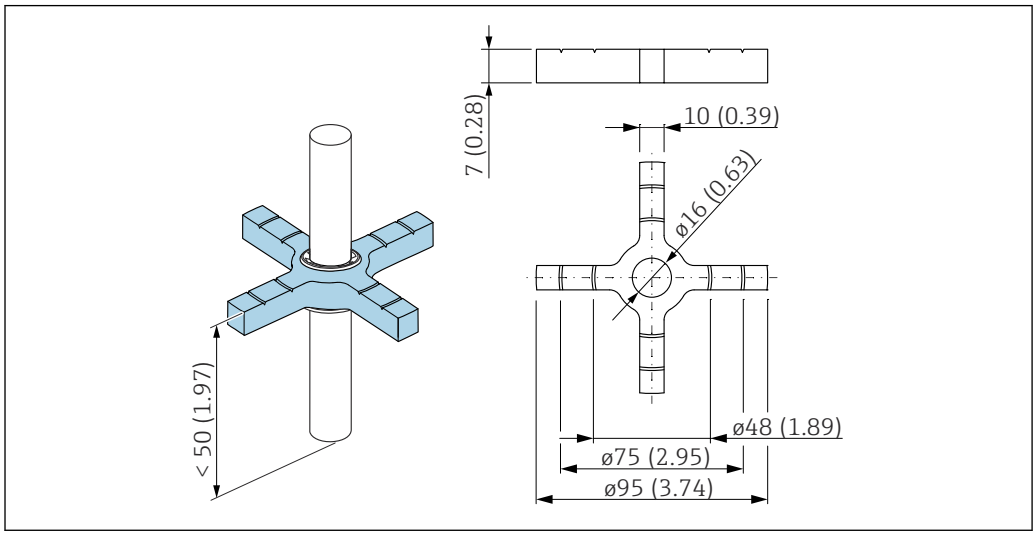
Due to the risk of electrostatic charge, the insulation sleeve is not suitable for use in hazardous areas! In this case, the probe must be secured so that it is reliably grounded.

The mounting kit can also be ordered directly with the device (Levelflex product structure, feature 620 "Accessory enclosed", version PG "mounting kit, insulated, rope").

Centering star

Centering star PEEK, Ø 48 to 95 mm (1.89 to 3.74 in)

Suitable for:
- FMP51
-



34 *Dimensions; centering star PEEK Ø 48 to 95 mm (1.89 to 3.74 in)*

The centering star is suitable for probes with a rod diameter of 16 mm (0.6 in) and can be used in pipes from DN50 to DN100. The markings make it easer to cut to size, ensuring that the centering star can be adjusted to the pipe diameter.

For details, see SD02316F.

- Material of centering star: PEEK
- Material of retaining rings: PH15-7Mo (UNS S15700)
- Permitted process temperature range: −60 to +250 °C (−76 to +482 °F)

Order number for accessories:
71069064

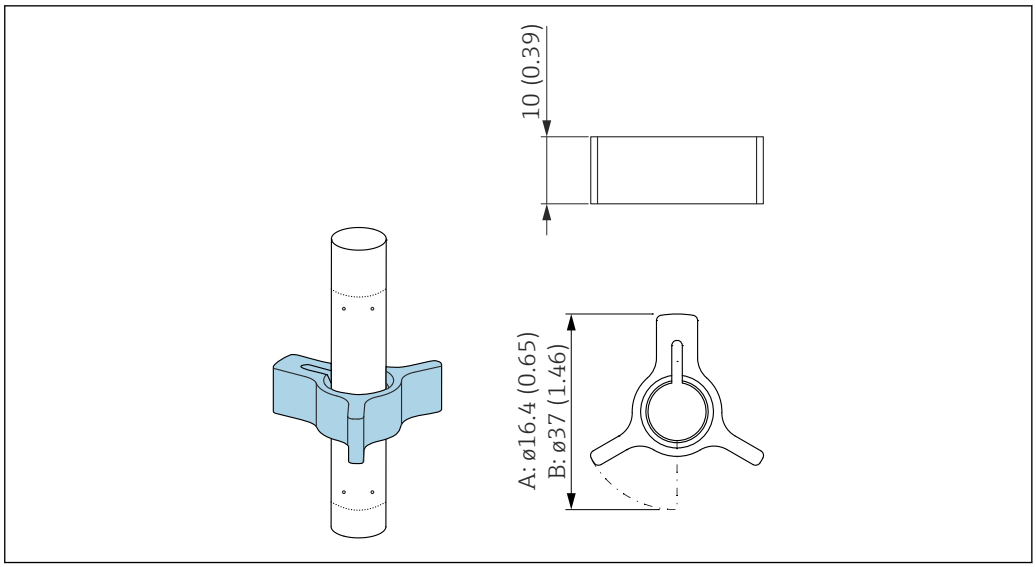
If the centering star is used in a bypass, it must be positioned below the lower bypass outlet. This must be taken into account when choosing the probe length. In general, the centering star should not be mounted more than 50 mm (1.97") above the probe tip. It is advised not to use the PEEK centering star in the measuring range of the rod probe.

The PEEK centering star can also be ordered directly with the device (Levelflex product structure, feature 610 "Accessory mounted", option OD). In this case, it is not secured to the rod using the retaining rings, but instead is secured using a hexagonal-headed bolt (A4-70) and a Nord Lock washer (1.4547) at the tip of the probe rod.

Centering star PFA

Suitable for:
FMP51

Available versions:
- Ø 16.4 mm (0.65 in)
- Ø 37 mm (1.46 in)



A For probe 8 mm (0.3 in)
B For probes 12 mm (0.47 in) and 16 mm (0.63 in)

The centering star is suitable for probes with a rod diameter of 8 mm (0.3 in), 12 mm (0.47 in) and 16 mm (0.63 in) (including coated rod probes) and can be used in pipes from DN40 to DN50.

For details, see BA00378F.

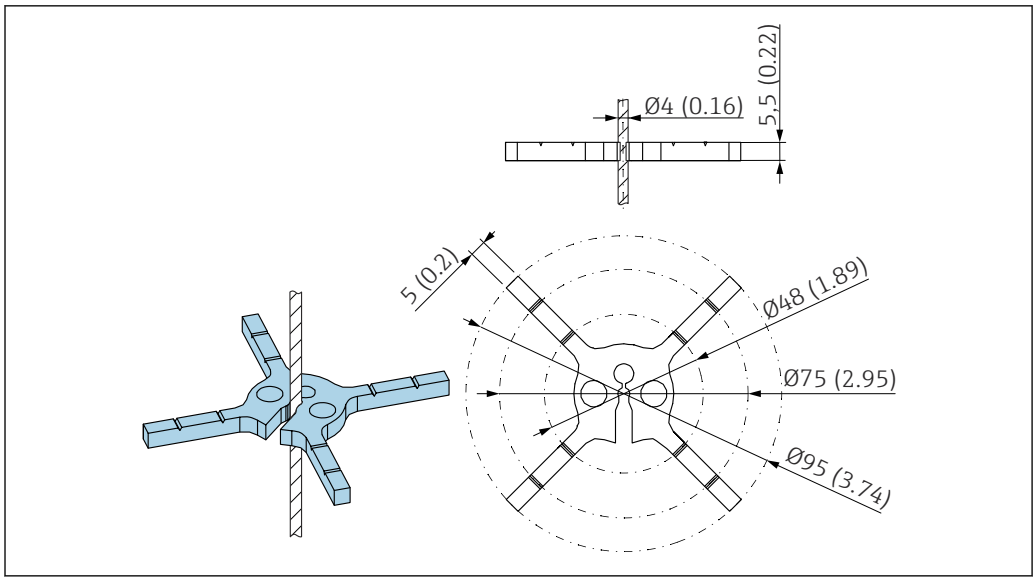
- Material: PFA
- Permitted process temperature range: −200 to +250 °C (−328 to +482 °F)

Order number for accessories:
- Probe 8 mm (0.3 in)
  71162453
- Probe 12 mm (0.47 in)
  71157270
- Probe 16 mm (0.63 in)
  71069065

The PFA centering star can also be ordered directly with the device (Levelflex product structure, feature 610 "Accessory mounted", option OE).

Centering star PEEK, Ø 48 to 95 mm (1.9 to 3.7 in)

Suitable for:
FMP51



The centering star is suitable for probes with a rope diameter of 4 mm (⅙ in) (including coated rope probes).

For details, see SD01961F.

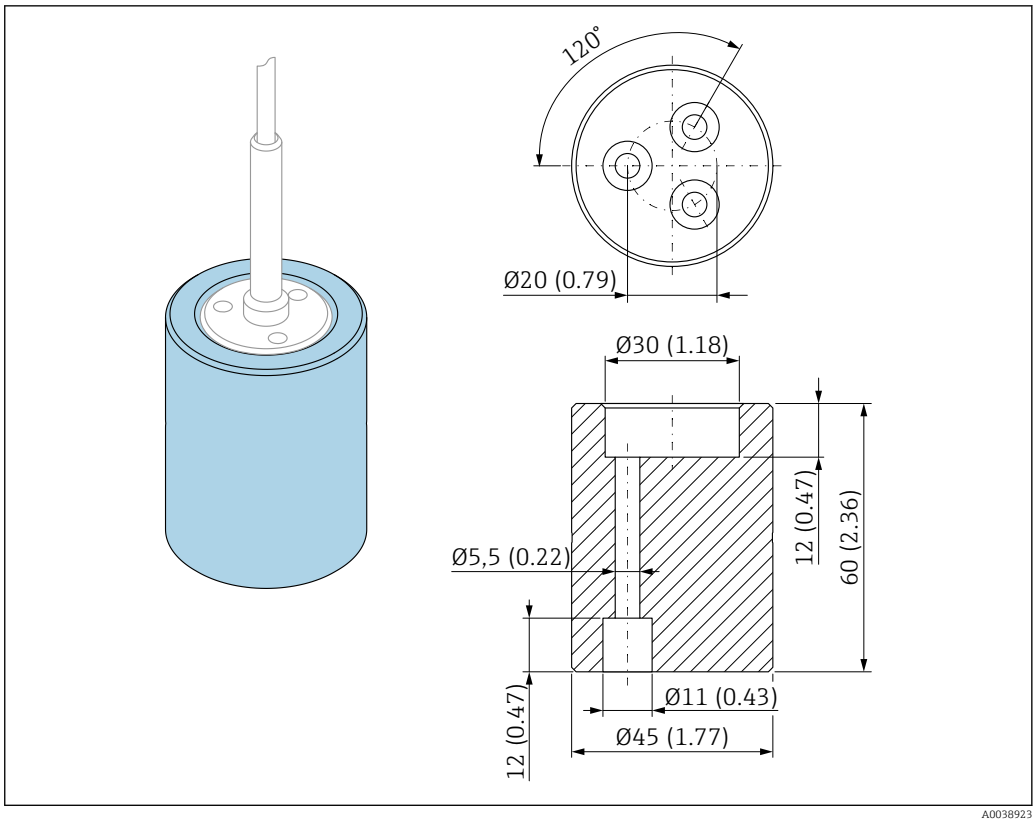
- Material: PEEK
- Permitted process temperature range: −60 to +250 °C (−76 to +482 °F)

Order number for accessories:
- 71373490 (1x)
- 71373492 (5x)

Centering weight

Centering weight 316 L for DN50/2" pipes

Suitable for:
- FMP51
-



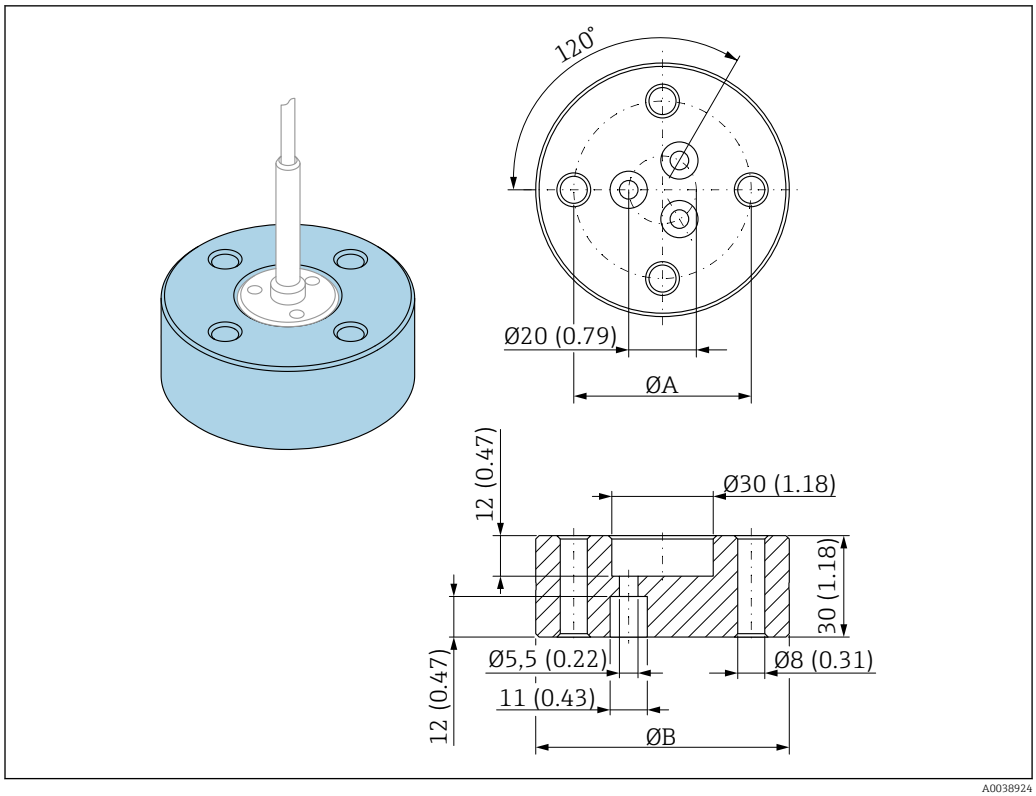
The centering weight is suitable for probes with a rope diameter of 4 mm (⅙ in) and can be used in DN50/2" pipes.

The centering weight can be ordered directly with the device (product structure Levelflex) or as a probe without a process connection (product structure XPF0005-) using feature 610 "Accessory mounted", version **OK** (for pipe DN50/2").

Centering weight 316 L for pipes ≥ DN80/3"

Suitable for:
- FMP51
-

Available versions:
- Ø 75 mm (2.95 in)
- Ø 95 mm (3.7 in)



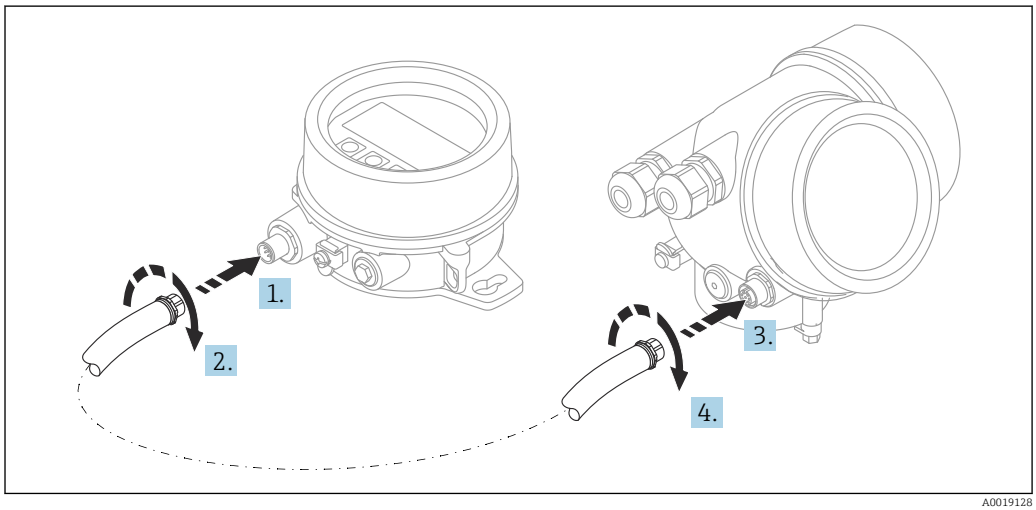
A0038924

ø A = 52.5 mm (2.07 in) for DN80/3" pipe
= 62.5 mm (2.47 in) for DN100/4" pipe
ø B = 75 mm (2.95 in) for DN80/3" pipe
= 95 mm (3.7 in) for DN100/4" pipe

The centering weight is suitable for probes with a rope diameter of 4 mm (⅙ in) and can be used in DN80/3" or DN100/4" pipes.

The centering weight can be ordered directly with the device (product structure Levelflex) or as a probe without a process connection (product structure XPF0005-) using feature 610 "Accessory mounted", version **OL** (for pipe DN80/3") or **OM** (for pipe DN100/4").

Remote display FHX50



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Technical data
- Material:
  - Plastic PBT
  - 316L/1.4404
  - Aluminum
- Degree of protection: IP68 / NEMA 6P and IP66 / NEMA 4x
- Suitable for display modules:
  - SD02 (push buttons)
  - SD03 (touch control)
- Connecting cable:
  - Cable supplied with device up to 30 m (98 ft)
  - Standard cable provided by customer onsite up to 60 m (196 ft)
- Ambient temperature: −40 to 80 °C (−40 to 176 °F)
- Ambient temperature, optionally available for order. −50 to 80 °C (−58 to 176 °F)
  NOTICE If the temperature is permanently below −40 °C (−40 °F), higher failure rates can be expected.

Ordering information
- If the remote display is to be used, the device version "Prepared for display FHX50" must be ordered.
  For FHX50, the option "Prepared for display FHX50" must be selected under "Measuring device version".
- If a measuring instrument has not been ordered with the version "Prepared for display FHX50" and is to be retrofitted with an FHX50, the version "Not prepared for display FHX50" must be ordered for the FHX50 under "Measuring device version". In this case, a retrofit kit for the device is supplied with the FHX50. The kit can be used to prepare the device so that the FHX50 can be used.

Use of the FHX50 may be restricted for transmitters with an approval. A device can only be retrofitted with the FHX50 if the option "Prepared for FHX50" is listed under *Basic specifications*, "Display, operation" in the Safety instructions (XA) for the device.

Also refer to the Safety Instructions (XA) of the FHX50.

Retrofitting is not possible on transmitters with:
- An approval for use in areas with flammable dust (dust ignition-proof approval)
- Type of protection Ex nA

For details, see "Special Documentation" document SD01007F.

Communication-specific accessories

Commubox FXA291
Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop
Order number: 51516983

For details, see "Technical Information" TI00405C

System components

Memograph M RSG45

The Advanced Data Manager is a flexible and powerful system for organizing process values.

The Memograph M is used for electronic acquisition, display, recording, analysis, remote transmission and archiving of analog and digital input signals as well as calculated values.

Technical Information TI01180R and Operating Instructions BA01338R

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.

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

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid for your device** The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	**Guide that takes you quickly to the 1st measured value** The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	**Your reference document** These Operating Instructions contain all the information that is required in the various life cycle phases 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 a constituent part of the Operating Instructions. Information on the Safety Instructions (XA) that are relevant for 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 a constituent part of the device documentation.

www.addresses.endress.com

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