

Technical Information

Solitrend MMP40

Material moisture measurement



TDR moisture sensors for measuring bulk solids, emulsions, liquids and media with higher material densities and conductivity values up to 20 mS/cm

Application

- Measuring range 0 to 100 % vol. water content
- Material conductivity range 0 to 20 mS/cm
- Process temperature 0 to 70 °C (32 to 158 °F)
- Process pressure -1 to 10 bar (-14.50 to 145.03 psi), depending on installation
- IP67 degree of protection
- Accuracy: up to ± 0.1 %

Your benefits

- Moisture measurement of high-conductivity materials, such as special bulk solids, fresh concrete, emulsions and liquids.
- Up to 15 different material calibration curves are saved directly in the device
- 2 × analog output 0/4 to 20 mA for moisture and conductivity/temperature
- No measured value drift due to wear thanks to special sensor design

Table of contents

About this document	3	Mounting frame Ø108 mm	17
Symbols	3	Design of rectangular sensor	18
Function and system design	4	Design of rod sensor	19
Measuring principle	4	Mounting flange Ø55 mm (2.17 in)	19
Calibration	4	Certificates and approvals	20
Operating mode	4	CE mark	20
Communication	4	Pressure equipment with allowable pressure ≤ 200 bar (2 900 psi)	20
Input	5	RoHS	20
Measured variable	5	Ordering information	20
Measuring range	5	Accessories	21
Output	5	Device-specific accessories	21
Analog	5	Documentation	24
Digital	5	Operating Instructions (BA)	24
Linearization	5		
Power supply	5		
Terminal assignment	5		
Supply voltage	5		
Power consumption	5		
Power supply failure	6		
Electrical connection - example, sensor cable with 10-pin socket (sensor side) and ferrules at the end of the cable	6		
Potential equalization	6		
Cable specification	6		
Performance characteristics	7		
Reference operating conditions	7		
Measured value resolution	7		
Installation	7		
Installation conditions	7		
Mounting location for round sensor, short / medium version	7		
Mounting location for round sensor, long version	8		
Mounting location for rectangular sensor	8		
Mounting location for rod sensor	8		
Installation instructions	9		
Environment	13		
Ambient temperature range	13		
Storage temperature	13		
Operating altitude	13		
Degree of protection	13		
Process	14		
Process temperature range	14		
Mechanical construction	14		
Design	14		
Design of round sensor, short version	14		
Design of round sensor, medium version	15		
Mounting flange Ø108 mm	15		
Design of round sensor, long version	16		

About this document

Symbols

Safety symbols



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



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



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



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

Symbols for certain types of information and graphics



Tip

Indicates additional information



Reference to graphic

1, 2, 3, ...

Item numbers

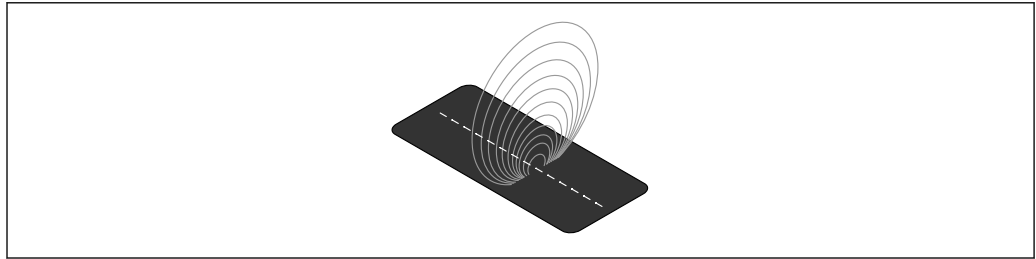
A, B, C, ...

Views


Function and system design

Measuring principle

Time-domain reflectometry (TDR) is a radar-based dielectric measurement method where the transit time of electromagnetic pulses is determined to measure the dielectric constant, and therefore the water content. The devices consist of a stainless steel housing with a ceramic window. A transmitter is integrated in the housing. The high-frequency TDR pulse generated in the transmitter travels along wave guides, creating an electromagnetic field around these guides and therefore also in the material around the sensor. Using a patented measurement method, the transit time of this pulse is measured with a resolution of one picosecond (1×10^{-12}) in order to determine the moisture and conductivity.



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 1 Wave guide; sawtooth

The TDR method operates in the ideal frequency range between 600 MHz and 1.2 GHz.

The modular TDR technology enables special applications with little effort and can be adapted to many applications thanks to the variable sensor design.

Calibration

The sensor is calibrated upon delivery to suit the task the sensor is to perform. Up to 15 different calibrations are saved in the sensor. Zero point adjustment is only possible with the remote display.

Operating mode

The sensor is supplied from the factory with the CH mode for applications in the construction industry, and with the CA mode for general process applications. Six different operating modes are available in the C mode, depending on the application.

- **CS mode** (Cyclic-Successive)
For very short measurement cycles in the seconds range (e.g. 1 to 10 seconds) without averaging and without filter functions, and with up to 100 measurements per second internally and a cycle time of 250 ms at the analog output.
- **CA mode** (Cyclic Average Filter)
Standard averaging for relatively fast but continuous measurement processes, with simple filtering and an accuracy of up to 0.1 %. The CA operating mode is also used to record raw values without averaging and filtering to then be able to analyze the measured data and identify the best operating mode.
- **CF mode** (Cyclic Floating Average with Filter)
Floating average for very slow and continuous measurement processes, with simple filtering and an accuracy of up to 0.1 %. Suitable for applications on a conveyor belt etc.
- **CK mode** (Cyclic with Boost Filter)
For complex applications in mixers and dryers
- **CC mode** (Cyclic Cumulated)
With automatic totalization of moisture quantity measurements in one batch process if no PLC controller is used
- **CH mode** (Cyclic Hold)
Standard operating mode for applications in the construction industry. Similar to the CC mode, but with filtering and without totalization. The CH mode is ideal for very short batch times as low as 2 s if the sensor has been installed under the silo discharge hatch. The CH mode performs filtering automatically. This allows drip water that forms in the silo to be filtered out of the measured value, for example.


Communication

The serial interface enables the sensor to operate in a network. A data bus protocol for the connection of multiple sensors is implemented as standard.

Input

Measured variable	<ul style="list-style-type: none"> ▪ Channel 1 Material moisture in % (variable setting) ▪ Channel 2 Either conductivity 0 to 20 mS/cm or temperature 0 to 100 °C (32 to 212 °F).
Measuring range	<ul style="list-style-type: none"> ▪ Material moisture The material moisture can be determined with a water content ranging from 0 to 100 % ▪ Temperature sensor The temperature can be determined in the range from 0 to 100 °C (32 to 212 °F) ▪ Material conductivity Material conductivity can be determined up to a maximum value of 20 mS/cm

Output

Analog	<ul style="list-style-type: none"> ▪ Channel 1 (material moisture): 0 to 20 mA/ 4 to 20 mA ▪ Channel 2 (material conductivity or material temperature): 0 to 20 mA/4 to 20 mA <p> The analog outputs can be set differently to the following possible options:</p> <p>Moist, Temp Analog output 1 for moisture, output 2 for material temperature.</p> <p>Moist, Conduct Analog output 1 for moisture, output 2 for conductivity in the range from 0 to 20 mS/cm</p> <p>Moist, Temp/Conductivity Analog output 1 for moisture, output 2 for material temperature and conductivity with automatic window changeover.</p>
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Starting time

The first stable measured value is present at the analog output after approx. 1 s.

Digital	<ul style="list-style-type: none"> ▪ Serial interface, RS485 standard ▪ IMP-Bus <ul style="list-style-type: none"> ▪ Signal cable and operating voltage are galvanically isolated ▪ Data transmission rate 9 600 Bit/s
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Linearization	Up to 15 different calibration curves can be used in the sensor. Linear and non-linear curves with polynomials of up to degree 5 can be used. The calibration curve can be selected via the remote display.
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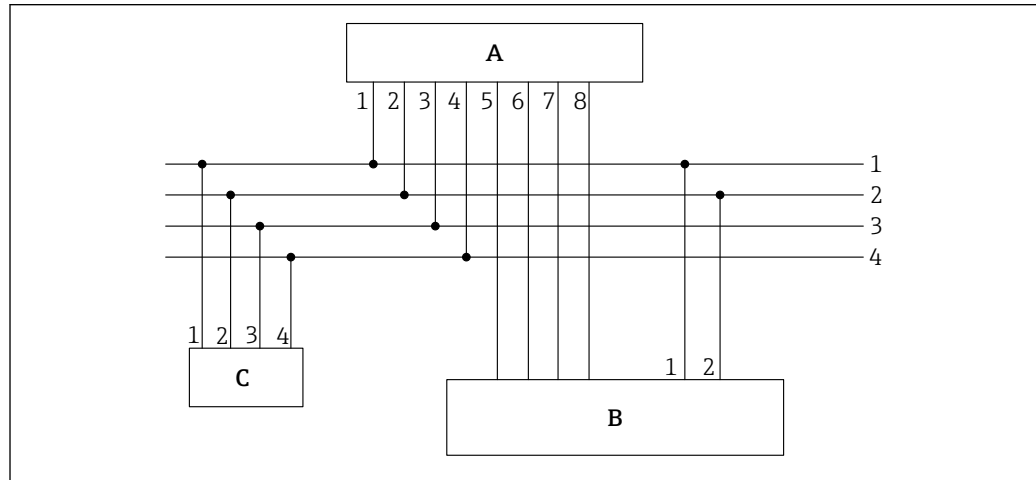
Power supply

Terminal assignment	<ul style="list-style-type: none"> ▪ Round and rod sensors: supplied as standard with a 10-pin plug, series 26482, with IP67 protection. ▪ Rectangular sensor: supplied as standard with a 5-meter long, 10-pin cable with ferrules.
Supply voltage	12 to 24 V _{DC}  CAUTION Overvoltage ► Only use stabilized power units
Power consumption	<3 W

Power supply failure

The configuration is retained in the sensor.

Electrical connection - example, sensor cable with 10-pin socket (sensor side) and ferrules at the end of the cable



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2 Connection example

- A Sensor
- B PLC / distribution box
- C Remote display (optional)
- 1 0 V_{DC} power supply
Wire color: blue (BU)
- 2 12 to 24 V_{DC} stabilized power supply
Wire color: red (RD)
- 3 IMP-Bus RT
Wire color: gray (GY) / pink (PK)
- 4 IMP-Bus COM
Wire color: blue (BU) / red (RD)
- 5 1st current output (+), analog
Wire color: green (GN)
- 6 1st current output (-), analog
Wire color: yellow (YE)
- 7 2nd current output (+), analog
Wire color: pink (PK)
- 8 2nd current output (-), analog
Wire color: gray (GY)

i The moisture content determined and the conductivity / temperature can either be fed directly into a PLC via analog outputs 0 to 20 mA/4 to 20 mA or queried via the serial interface (IMP-Bus).

Potential equalization

The shield is grounded at the sensor.

Cable specification

Connecting cables are available in different versions and lengths (depending on sensor design).

Round sensor, rod sensor

Connecting cables with a preassembled 10-pin socket on the sensor side are available in different standard lengths:

- 4 m (13 ft)
- 10 m (32 ft)
- 25 m (82 ft)

UNITRONIC PUR CP shielded cable, twisted pairs $6 \times 2 \times 0.25 \text{ mm}^2$, PUR sheath resistant to oils and chemicals.

Rectangular sensor

Standard lengths (fixed cable):


- 5 m (16 ft)
- Cable lengths of 1 to 100 m (3 to 328 ft) are possible upon request

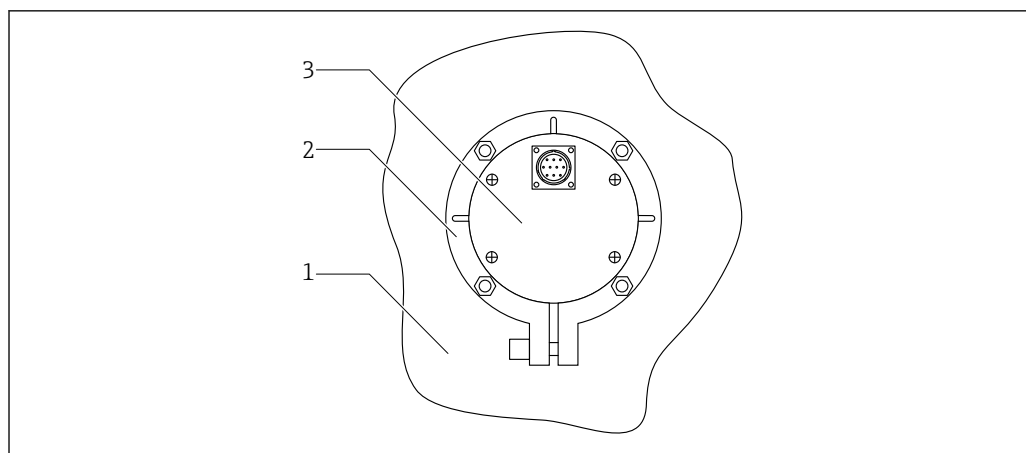
UNITRONIC PUR CP shielded cable, $10 \times 0.25 \text{ mm}^2$, PUR sheath resistant to oils and chemicals.

Performance characteristics

Reference operating conditions	<p>The following reference conditions apply to the performance characteristics:</p> <p>Ambient temperature: 24 °C (75 °F) \pm5 °C (9 °F)</p>
Measured value resolution	<p>Measuring field propagation \geq 25 mm (0.98 in) depending on the material and moisture</p> <p>Material moisture Measuring range up to 100 % vol.</p> <p>Conductivity</p> <ul style="list-style-type: none"> ■ The device delivers a characteristic value depending on the mineral concentration ■ The conductivity range is reduced in moisture measurement ranges >50 % ■ The conductivity value determined is uncalibrated and is primarily used to characterize the material being measured <p>Temperature Measuring range: 0 to 100 °C (32 to 212 °F) The temperature is measured 3 mm below the sensor surface in the housing and can be output at analog output 2. As the electronics use approx. 3 W of power, the housing heats up slightly. Therefore the precise measurement of the material temperature is only possible to a certain degree. The material temperature can be determined following an external calibration and compensation of the sensor's internal heating.</p> <p>Maximum measured error The measured error depends on the operating mode and on the flow of material over the measurement surface. The longer the averaging time and the more stable the material density over the measurement surface, the lower the measured error. Measured errors of up to maximum ± 0.1 % are possible. Heterogeneous materials such as fresh concrete or bulk solids with varying grain size require a continuous flow of material over the surface of the sensor.</p>

Installation

Installation conditions	<ul style="list-style-type: none"> ■ The device must be installed at a point in the process in such a way that ensures a relatively constant material density, as the material density is directly related to the measured value/reading. Where necessary, a bypass should be created or structural measures may be needed at the place of installation to ensure that the material flow, and therefore the material density, over the sensor is relatively constant. ■ The measuring cell should be completely surrounded by material. For this type of device, the minimum layer of material covering the cell must be ≥ 35 mm (moisture-dependent). ■ The flow of material over the surface of the sensor should be relatively continuous. Depending on the operating mode, the electronics module offers ways to automatically detect and bridge gaps in material in intervals of seconds. ■ No material deposits or buildup may form on the sensor surface, as this would falsify the readings. <p> Longer averaging times increase measurement accuracy.</p>
Mounting location for round sensor, short / medium version	<p>The short / medium round sensor can be installed using a mounting flange.</p>



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 3 Round sensor mounted, rear view

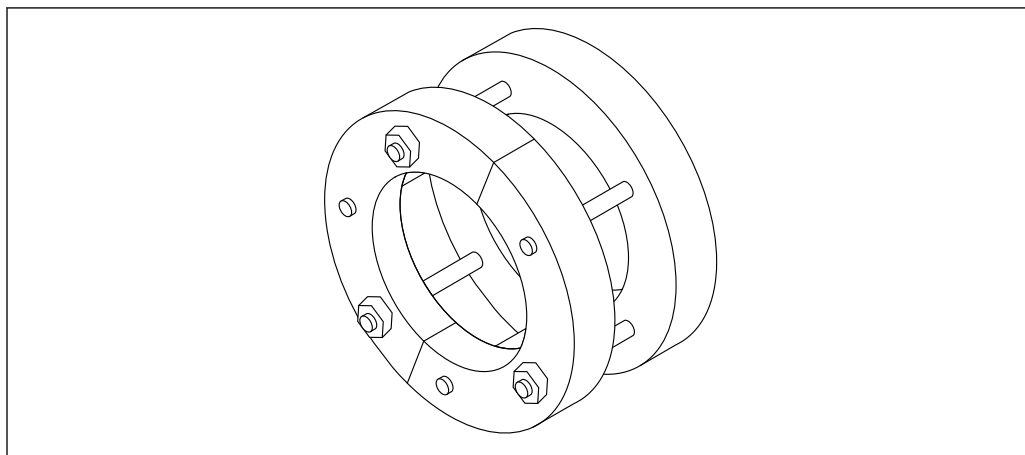
- 1 Vessel wall
- 2 Mounting flange
- 3 Round sensor

Mounting location for round sensor, long version

The long round sensor can be installed using a mounting frame.

Mounting frame

A mounting frame is available for the long version of the round sensor. The frame can be welded onto the floor or side wall of the vessel. At the clamping ring, the sensor can be adjusted to the correct height or position using adjusting screws and nuts.



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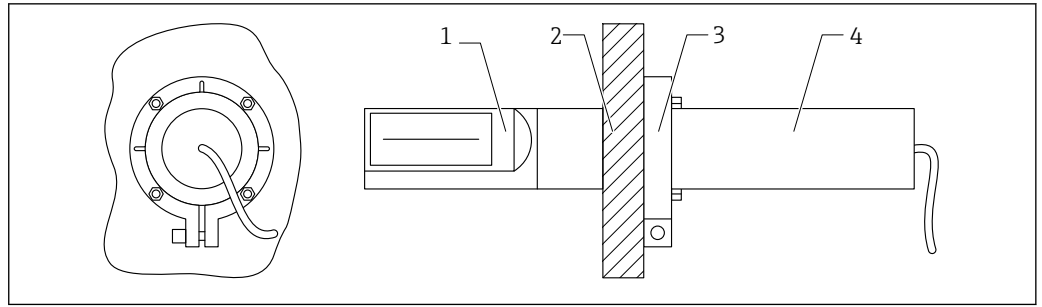
 4 Mounting frame with clamping ring for round sensor, long version

Mounting location for rectangular sensor


The rectangular sensor can be installed with four screws (M8).

Mounting location for rod sensor

The rod sensor can be installed using a mounting flange and a 0.2 m-long installation pipe (additional mounting accessories are optionally available).



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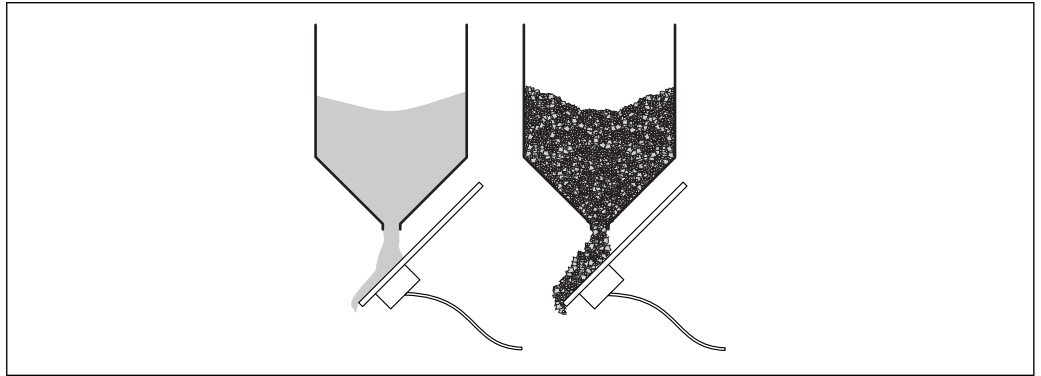
 5 Installation of the rod sensor with a mounting flange

- 1 Sensor
- 2 Silo or vessel wall
- 3 Mounting flange - is mounted on item 4 (installation pipe)
- 4 Installation pipe for rod sensor (0.2 m - accessory mounted or 1.0 m - accessory enclosed)


Installation instructions

Installation of the round sensor for sand moisture measurement

The installation conditions depend greatly on the specific plant conditions. The optimum mounting location must be determined individually on a case-by-case basis. Ideally, the round sensor for the measurement of sand and gravel is installed under the silo.



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 6 Installation of the round sensor for the measurement of sand and gravel under silo discharge hatches

Thanks to the device's rugged design, it can be installed directly under the opening hatch of a silo without any difficulties.

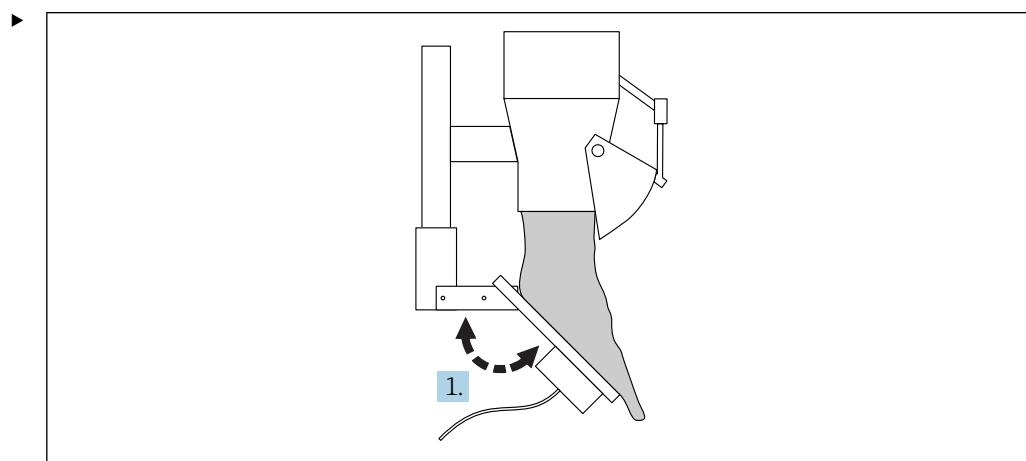
Advantages of mounting under the opening hatch of a silo:

- The flow of material, and therefore the material density, is constant during the measurement
- As a result of the pressure from the material, the sensor surface undergoes constant cleaning, which helps to prevent caking and incorrect measurements. Material caking and deposit buildup can be checked visually, which would not be possible inside the silo.
- The sensor can clearly detect the start and end of a batch. As a result, in the CH or CC operating mode (no switch signal) the sensor can automatically totalize moisture quantity measurements in one batch process. This makes precise and representative moisture measurements possible even with smaller volumes. PLC programming can be implemented more easily without a switch signal.

Installation of the round sensor under the silo discharge hatch

- Select the correct bracket angle to suit the material. The angle must not be too steep or too flat to ensure that no water can accumulate on the surface of the sensor.
- The flow of material should be directed at or "against" the sensor surface.
- When the material is flowing, the surface of the sensor should be covered completely by material. The layer of material should be at least 35 mm high (moisture-dependent).
- The opening hatch of the silo should be located just below the upper edge of the baffle plate to ensure that the sensor is completely covered by material, and not just partially covered.

Example: sand

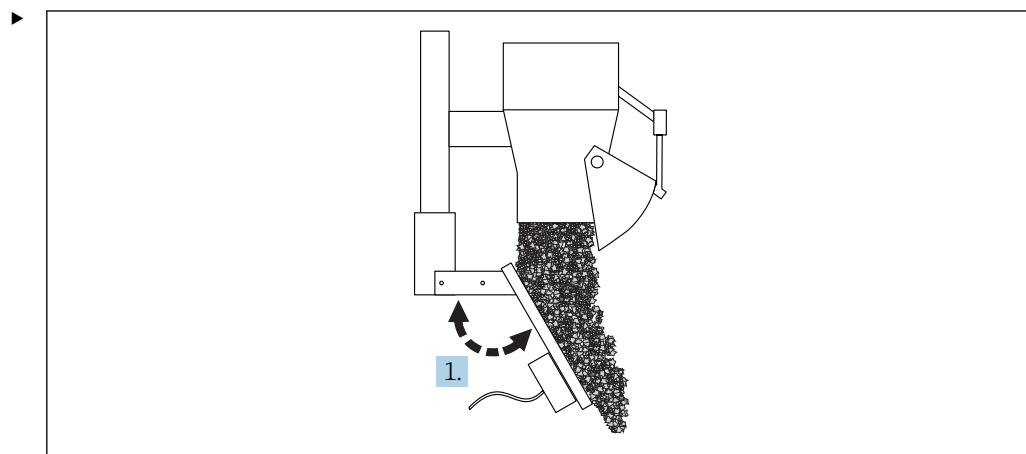


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7 Sand, position of the baffle plate - opening hatch

Set the installation angle 1. to 45 to 55 °.

Example: gravel or grit



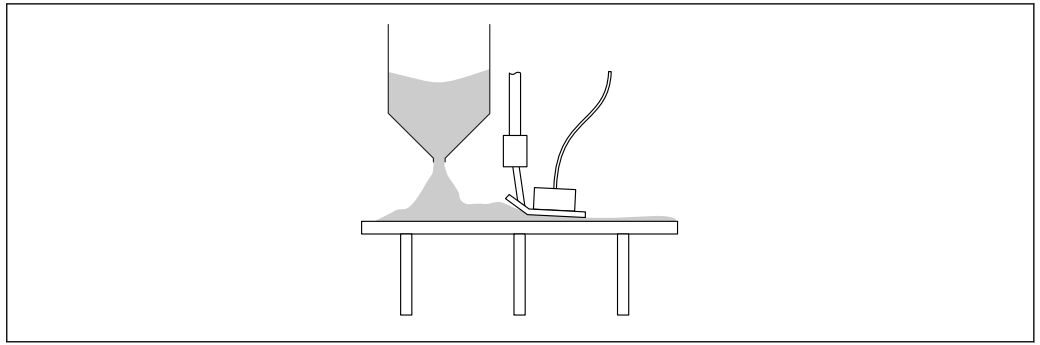
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8 Gravel, position of the baffle plate - opening hatch

Set the installation angle 1. to 55 to 70 °.

i Ideally, the device should be attached under the hatch in such a way that the first material to fall out of the hatch will first flow over the baffle plate and then over the sensor, and not that it only flows over the sensor when the hatch is fully opened. This improves moisture measurement in short batches in the CH mode if the silo discharge hatch is only open briefly (2 to 3 s).

Installation of the round sensor over a conveyor belt



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9 Installation of the round sensor over a conveyor belt.

i It is important to find the right bracket angle (2 to 3 °) depending on the material. The angle must not be too steep or too flat, depending on the material on the conveyor belt. It is also important that the entire surface of the sensor is completely covered when the material is flowing. However, material should also not collect or accumulate.

Using a sliding carriage

A sliding carriage made of 1.4301 steel is available for moisture measurements of materials on a conveyor belt.

An extremely wear-resistant version with a hard metal coating can be ordered for the measurement of abrasive materials.



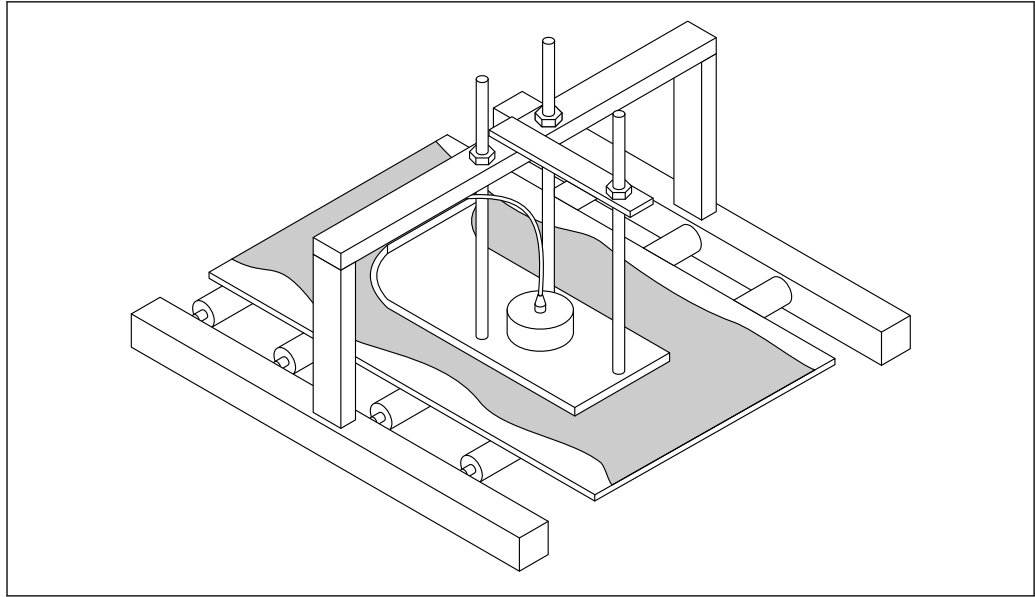
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10 Sliding carriage

Left: 1.0037 material, sliding surface with hard metal coating


Right: 1.4301 material, uncoated sliding surface

Suitable threaded bolts are supplied for the sliding carriage.



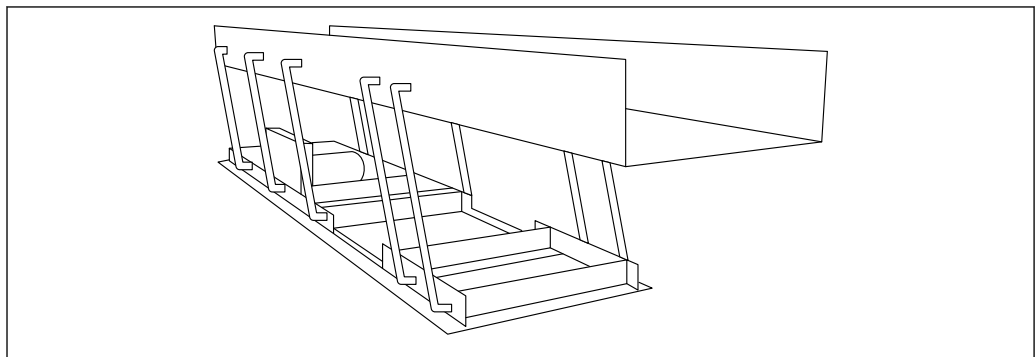
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 11 Installation example of the sliding carriage


 The bracket must be made by the user, depending on the conveyor belt.

Installation of the round sensor in a vibrating chute

It is possible to install the round sensor directly in a vibrating chute. The sensor should be installed at a point where it is guaranteed that the layer of material covering the surface of the sensor is at least 35 mm deep (moisture-dependent).



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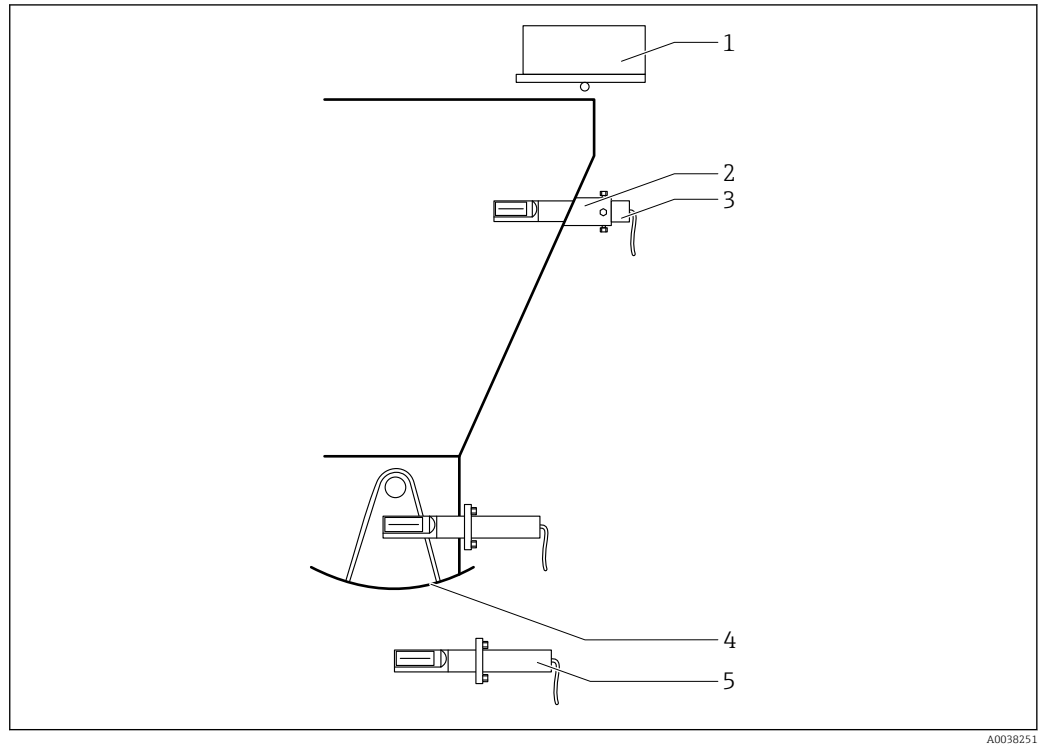
 12 Vibrating chute

Round sensor, additional installation instructions

- The round sensor can be attached above a conveyor belt with the optional universal bracket or sliding carriage. This can result in the constant compaction of materials, and therefore more precise measurements, particularly in the case of materials that are heterogeneous or flow very loosely. As the sensor is pressed against the material to be measured, this also helps to prevent caking.
- If floors or surfaces are uneven, the round sensor must be mounted at the highest point on the floor. Water must not be allowed to collect at the measuring cell, as this could falsify the measurement.
- If the round sensor is installed in areas with severe turbulence, it is recommended to use the CA or CK operating mode with a longer averaging time.

- Any stirring action of vanes and scrapers over the measuring cell should be gap-free so that a solid layer of material cannot form on the surface.
- The round sensor should not be installed in the immediate vicinity of electrical sources of interference such as motors.
- In the case of curved installation surfaces in cylindrical vessels, the center of the sensor should be flush with the radius of the vessel wall without interfering with the radial material flow in the vessel. The sensor should not protrude or be hit by vanes or scrapers.

Installation of the rod sensor in a silo or a scale vessel



13 Installation of the rod sensor in a silo

- 1 Bulk solids hatch
- 2 Weld-on attachment pipe
- 3 Installation pipe
- 4 Bulk solids hatch
- 5 Ideal installation location

i The ideal installation location is under the lower bulk solids hatch, as material caking can be checked here.

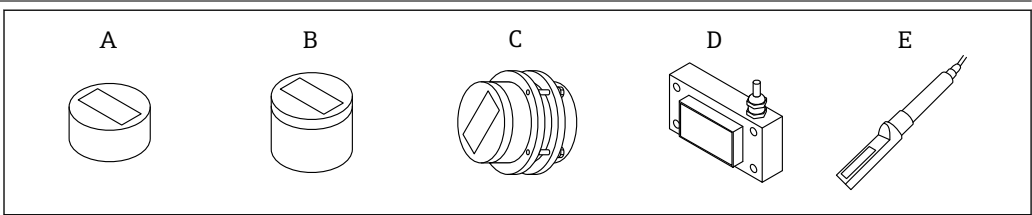
Environment

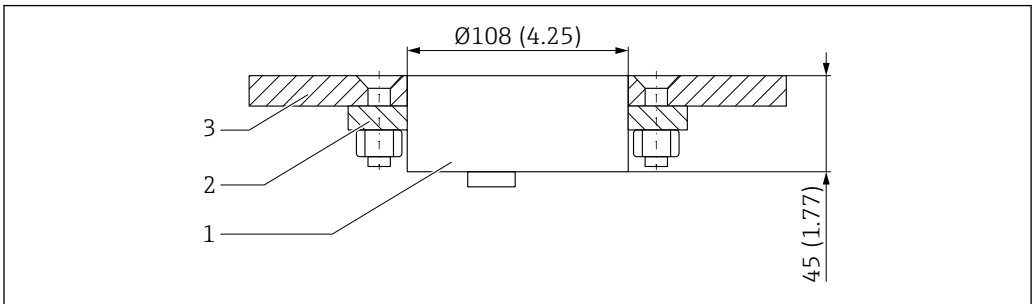
Ambient temperature range	At the housing: -40 to +70 °C (-40 to +158 °F)
Storage temperature	-40 to +70 °C (-40 to +158 °F)
Operating altitude	Up to 2 000 m (6 600 ft) above sea level
Degree of protection	IP67

Process

Process temperature range	0 to 70 °C (32 to 158 °F)
	<div><div><div></div><div>i</div></div><div>Moisture measurement below 0 °C (32 °F) is not possible. The water content of ice (frozen water) cannot be determined.</div></div>

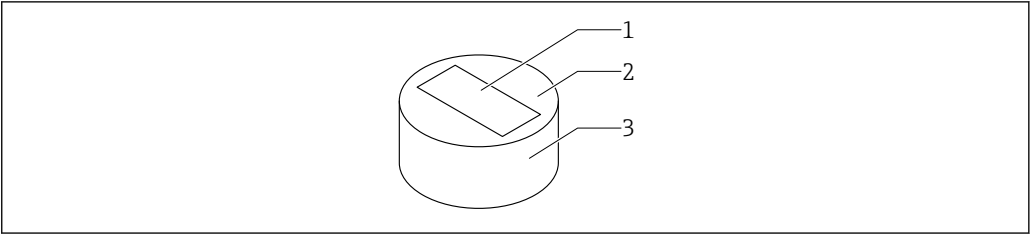
Mechanical construction

Design	<div><div><div>A</div><div>B</div><div>C</div><div>D</div><div>E</div></div><div></div><div>A0037488</div></div>
	<div><div><div><div><div></div><div>14</div></div><div>A Round sensor, short</div><div>B Round sensor, medium</div><div>C Round sensor, long</div><div>D Rectangular sensor</div><div>E Rod sensor</div></div></div></div>

Design of round sensor, short version	<div><div>Dimensions</div><div></div><div>A0037420</div></div>
	<div><div><div><div><div></div><div>15</div></div><div>Installation dimensions of round sensor, short version. Unit of measurement mm (in)</div></div><div><div>1 Round sensor, short</div><div>2 Mounting flange</div><div>3 Vessel wall</div></div></div></div>

Weight
1.25 kg (2.76 lb)

Material



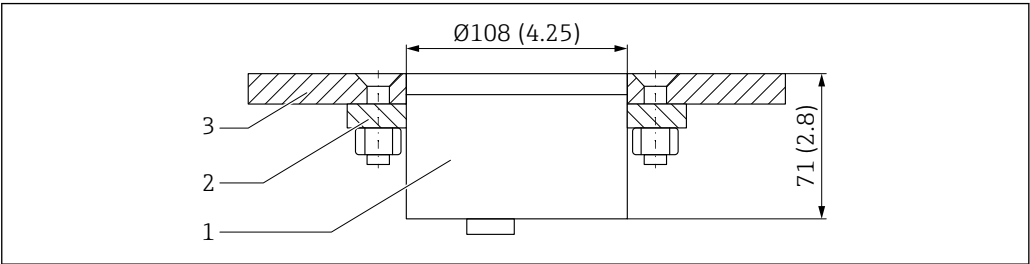
A0037491

16 Material of round sensor, short version

- 1 Measuring cell; ceramic (silicon nitride)
- 2 Sensor plate; 1.4301
- 3 Housing; 1.4301

Design of round sensor,
medium version

Dimensions



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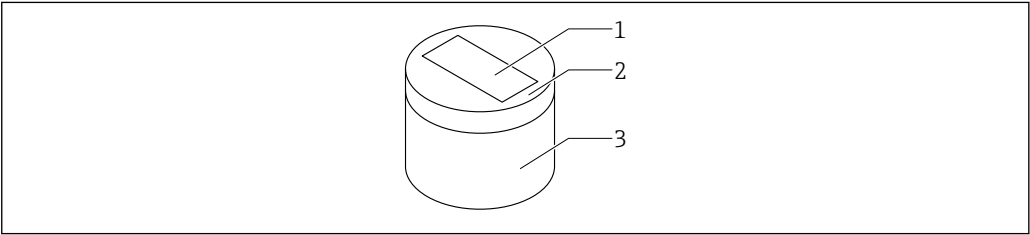
17 Installation dimensions of round sensor, medium version. Unit of measurement mm (in)

- 1 Round sensor, medium
- 2 Mounting flange
- 3 Vessel wall

Weight

2.55 kg (5.62 lb)

Material



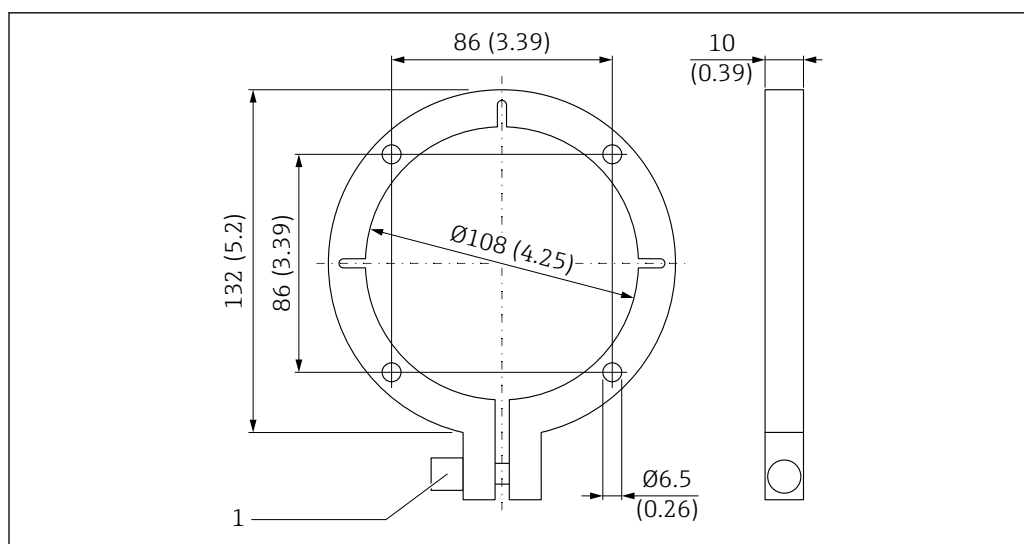
A0040106

18 Material of round sensor, medium version

- 1 Measuring cell; ceramic (silicon nitride)
- 2 Sensor head (replaceable); oil-hardened steel, optional: 1.4401; hard metal coating
- 3 Housing; 1.4301

Mounting flange Ø108 mm

The mounting flange for the short or medium version of the round sensor is normally ordered together with the device via the product structure.



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19 Mounting flange Ø108 mm

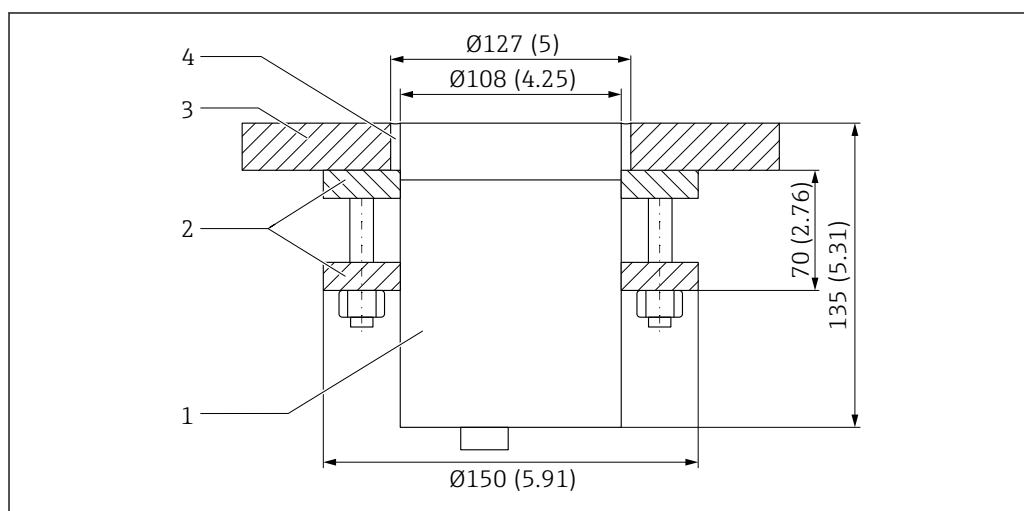
1 M6 Allen key

Material

1.4301

Design of round sensor, long version

Dimensions



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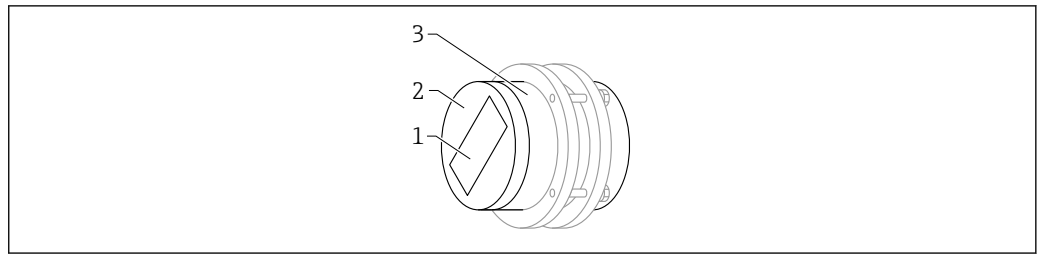
20 Installation dimensions of round sensor, long version. Unit of measurement mm (in)

- 1 Round sensor, long
- 2 Mounting frame with clamping ring
- 3 Vessel wall
- 4 Gap for sand filling or silicone seal

Weight

3.7 kg (8.16 lb)

Material



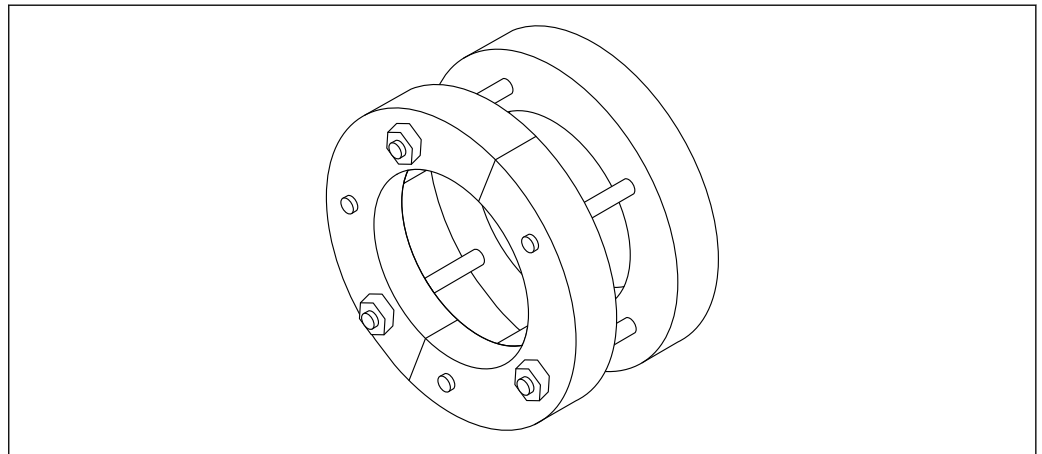
A0040107

21 Material of round sensor, long version

- 1 Measuring cell; ceramic (silicon nitride)
- 2 Sensor head (replaceable); with hard metal; 1.4401
- 3 Housing; 1.4301

Mounting frame Ø108 mm

The mounting flange for the long version of the round sensor is normally ordered together with the device via the product structure.



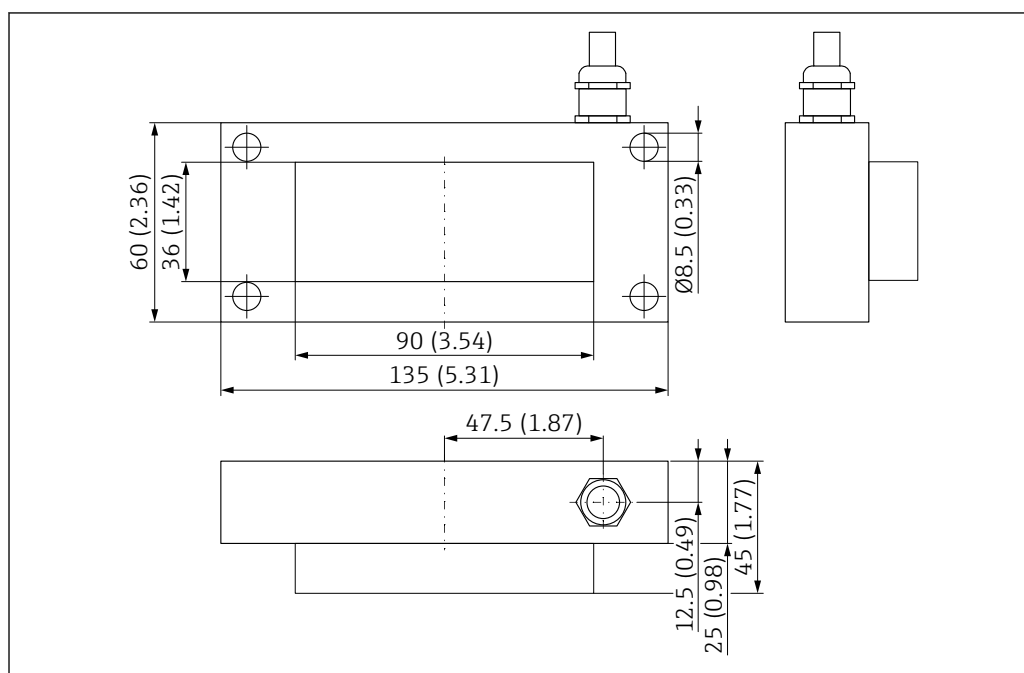
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22 Mounting frame Ø108 mm

Material

Steel, galvanized

Design of rectangular sensor Dimensions



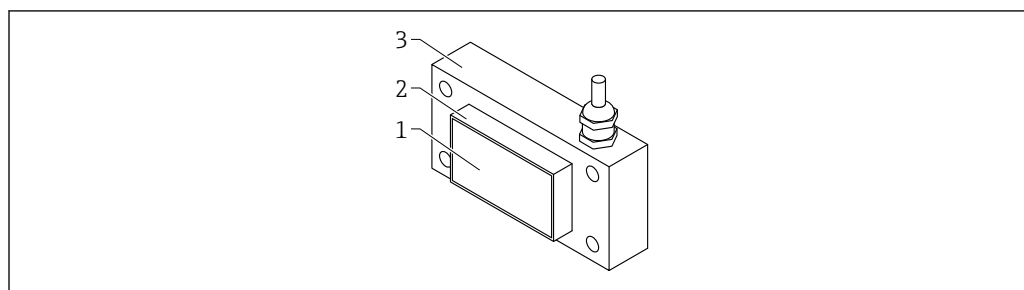
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23 Dimensions of rectangular sensor. Unit of measurement mm (in)

Weight

1.27 kg (2.8 lb)

Material



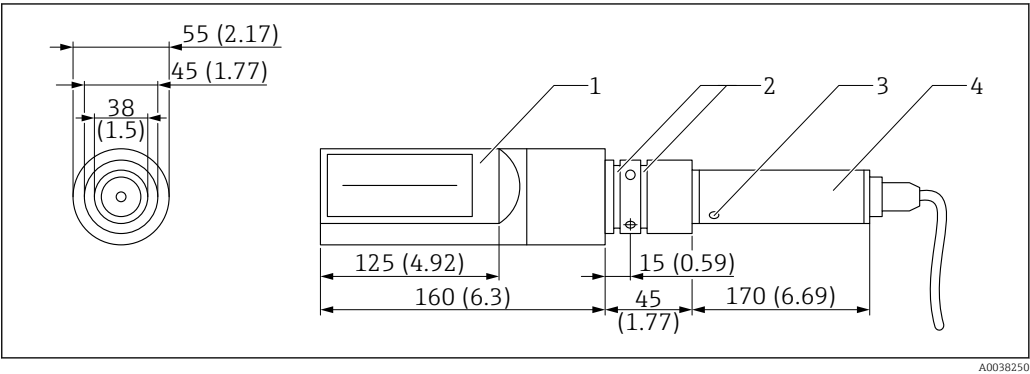
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24 Material of rectangular sensor

- 1 Measuring cell; ceramic (silicon nitride)
- 2 Sensor; 1.4301
- 3 Housing; 1.4301

Design of rod sensor

Dimensions



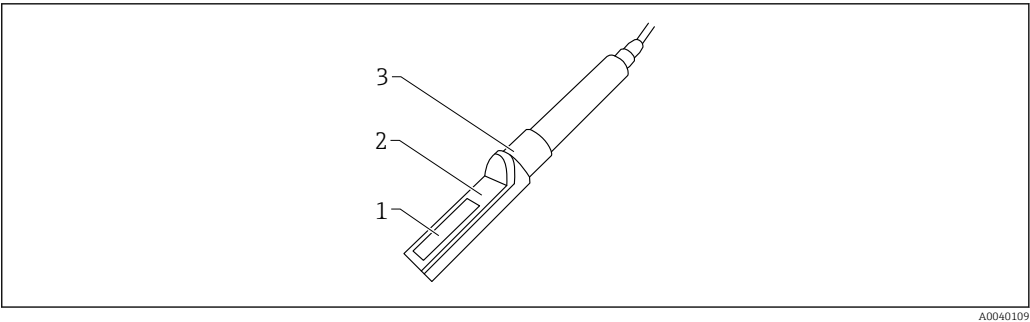
25 Dimensions of rod sensor. Unit of measurement mm (in)

- 1 Sensor
- 2 O-ring
- 3 Internal temperature sensor
- 4 Electronics housing

Weight

2.5 kg (5.51 lb)

Material

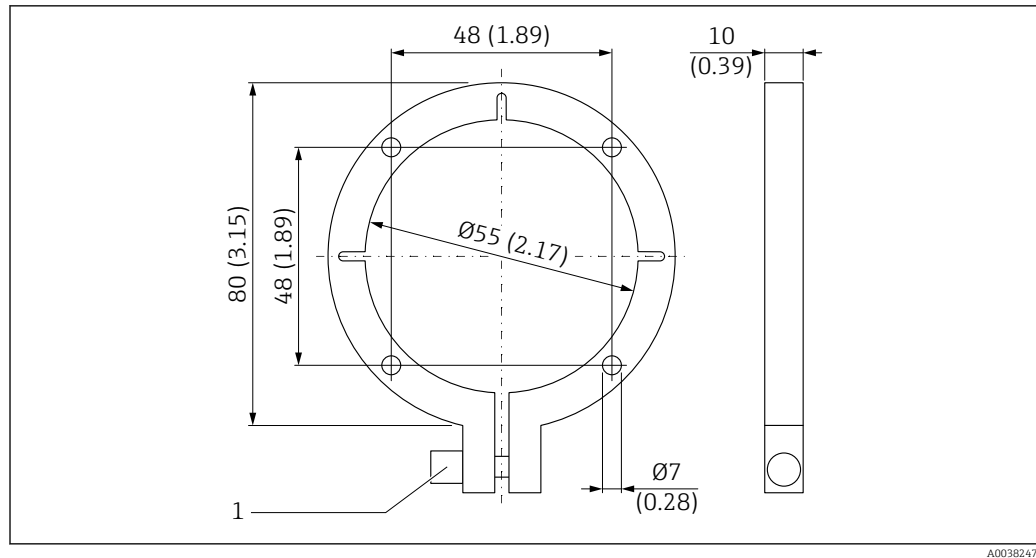


26 Material of rod sensor

- 1 Measuring cell; ceramic (silicon nitride)
- 2 Sensor head (replaceable); 1.4301
- 3 Housing; 1.4301

Mounting flange
Ø55 mm (2.17 in)

The mounting flange for the rod sensor is normally ordered together with the device.



27 Mounting flange Ø55 mm (2.17 in)

1 M6 Allen key

Material

1.4301

Certificates and approvals

CE mark	<p>The measuring system meets the legal requirements of the applicable EU Directives. These are listed in the corresponding EU Declaration of Conformity along with the standards applied.</p> <p>Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.</p>
Pressure equipment with allowable pressure ≤ 200 bar (2 900 psi)	<p>Pressure instruments with a flange and threaded boss that do not have a pressurized housing do not fall within the scope of the Pressure Equipment Directive, irrespective of the maximum allowable pressure.</p> <p>Reasons:</p> <p>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".</p> <p>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.</p>
RoHS	<p>The measuring system complies with the substance restrictions of the Restriction on Hazardous Substances Directive 2011/65/EU (RoHS 2).</p>

Ordering information

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

1. Click Corporate
2. Select the country
3. Click Products
4. Select the product using the filters and search field
5. Open the product page

The Configuration button to the right of the product image opens the Product Configurator.

**Product Configurator - the tool for individual product configuration**

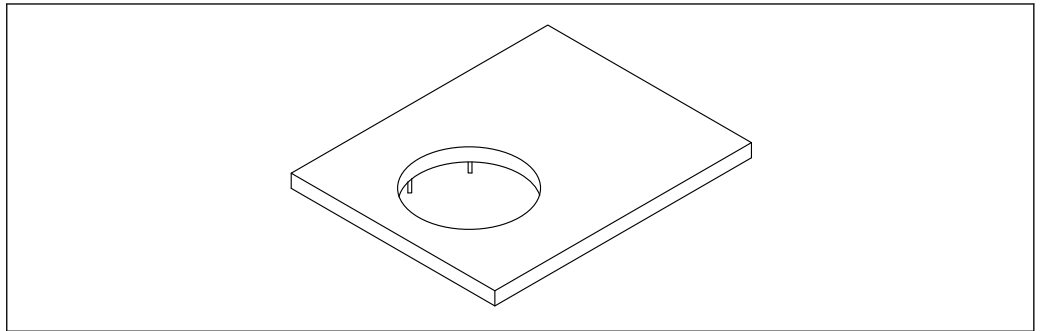
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability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

Accessories

Device-specific accessories**Baffle plate for round sensor**

With sensor cut-out Ø108 mm

The baffle plate for the round sensor can be ordered together with the device via the "Accessory enclosed" section of the product order structure.



A0037579

28 Baffle plate with sensor cut-out Ø108 mm

Material

1.4301

Dimensions

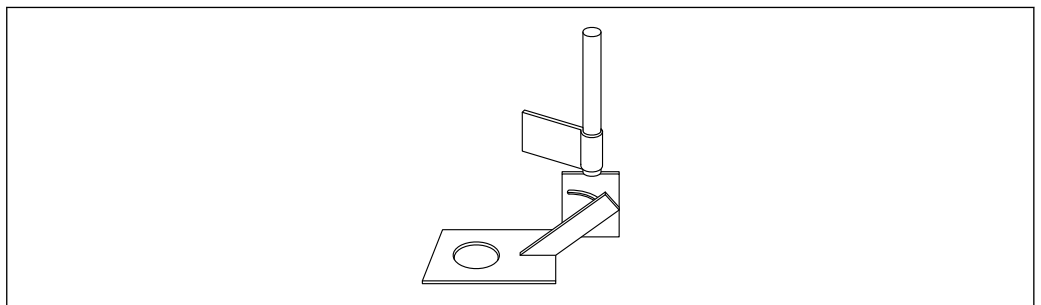
- Length: 300 mm (11.81 in)
- Width: 200 mm (7.87 in)
- Height: 6 mm (0.24 in)

Universal holder with tilt mechanism for round sensor

The universal holder for the round sensor can be ordered together with the device via the "Accessory enclosed" section of the product order structure.



Tilt mechanism with retaining head. For installing the device beneath a silo hatch or above a conveyor belt.



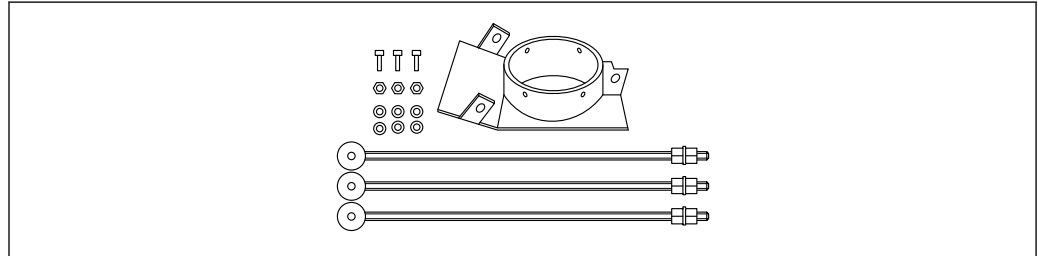
A0037577

29 Universal holder for round sensor with tilt mechanism for retaining head

Material
1.4301

Sliding carriage, for round sensor

The sliding carriage for the round sensor can be ordered together with the device via the "Accessory enclosed" section of the product order structure.



A0037578

 30 Sliding carriage

Material

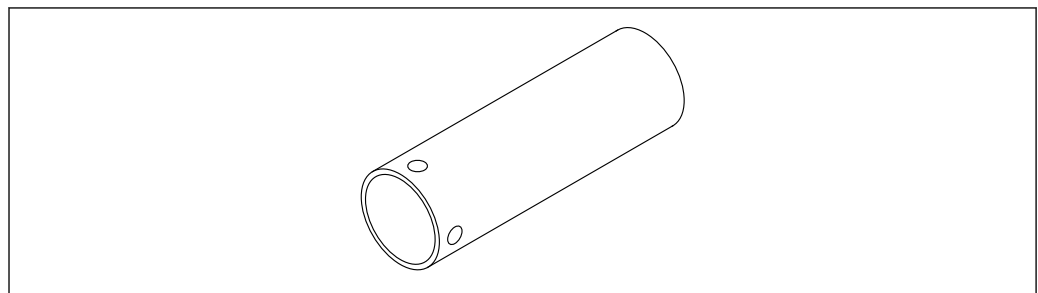
- Fastening:
1.4301
- Sliding carriage:
1.0037 or 1.4301
- Sliding surface:
Coated hard metal (for sliding carriage made of 1.0037) or uncoated hard metal (for sliding carriage made of 1.4301)
- 3× threaded bolts for fastening




For installation on conveyor belts.

Installation pipe 1 m for rod sensor

The installation pipe for the rod sensor can be ordered together with the device via the "Accessory enclosed" section of the product order structure.



A0037581

 31 Installation pipe 1 m for rod sensor

Material
1.4301

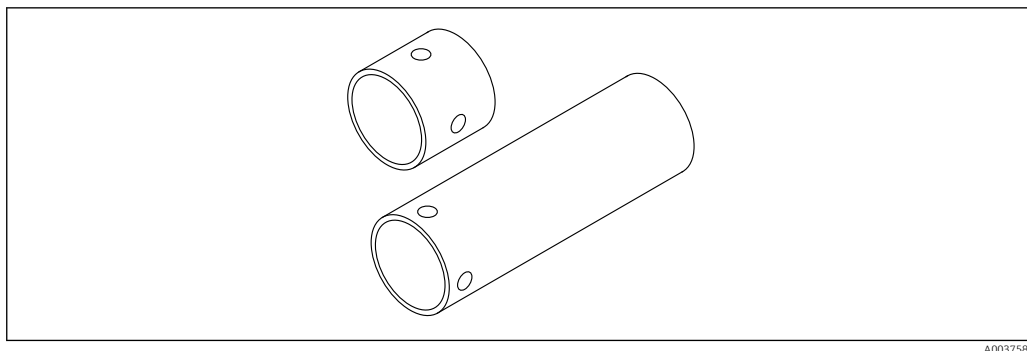
Dimensions

- D = 55 mm
- L = 1 m


Adapter set for rod sensor

The adapter set for the rod sensor can be ordered together with the device via the "Accessory enclosed" section of the product order structure.

Adapter from 55 mm to 76.2 mm outer diameter.



A0037580

 32 Adapter set for rod sensor

Material

- 1.4301
- 1× installation pipe/extension D=55 mm L=0.2 m
- 1× adapter to D=76.2 mm L=80 mm

Documentation

The following documentation types are available in the Downloads section of the Endress+Hauser website (www.endress.com/downloads):



For an overview of the scope of the associated Technical Documentation, refer to the following:

- *W@M Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2D matrix code (QR code) on the nameplate

Operating Instructions (BA)

Your reference guide

These Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

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