Operating Instructions
Silopilot FMM50

Electromechanical level system
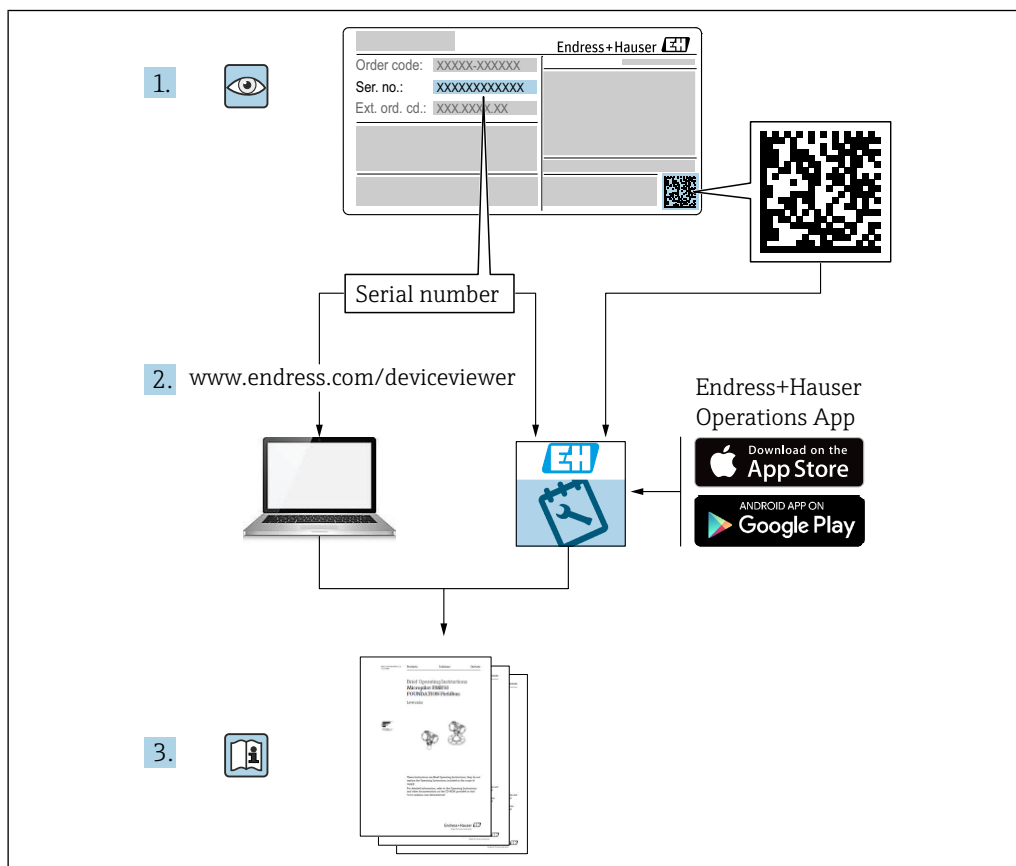

Endress+Hauser [EH]

People for Process Automation

1.

Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX.XXXX.XX

Endress+Hauser

Serial number

2. www.endress.com/deviceviewer

Endress+Hauser
Operations App

Download on the
App Store

ANDROID APP ON
Google Play

3.

Table of contents

1   About this document

1.1   Symbols

1.1.1   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.

1.1.2   Electrical symbols

⏚ Protective Earth (PE)
A terminal which must be connected to ground prior to establishing any other connections.

1.1.3   Symbols for certain types of information

☑ Permitted
Procedures, processes or actions that are permitted.

☒ Forbidden
Procedures, processes or actions that are forbidden.

ℹ Tip
Indicates additional information

▣ Reference to documentation

▤ Reference to another section

▣ Reference to graphic

1., 2., 3. Series of steps

1.1.4   Symbols in graphics

A, B, C ... View

1, 2, 3 ... Item numbers

⚠ Hazardous area

✗ Safe area (non-hazardous area)

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel must fulfill the following requirements to carry out the necessary tasks, e. g., commissioning and maintenance:
▸ Trained, qualified specialists must have a relevant qualification for the specific function and task
▸ Are authorized by the plant owner/operator
▸ Are familiar with federal/national regulations
▸ Must have read and understood the instructions in the manual and supplementary documentation
▸ Follow instructions and comply with conditions

2.2 Designated use

Only use the meter for level measurement in bunkers or silos with dusty, fine-grain or coarse-grain bulk solids or in tanks containing liquids. Improper use can pose hazards. Ensure that the measuring device is free of defects while it is in operation.

• Use the device only in media to which the process-wetted materials are adequately resistant.
• Do not exceed or drop below the limit values for the measuring device
  📖 TI00395F

2.2.1 Incorrect use

The manufacturer is not liable for damage caused by improper or non-designated use.

Clarification of borderline cases:
• In the case of special fluids and media used for cleaning, Endress+Hauser is glad to provide assistance in verifying the corrosion resistance of wetted materials, but does not accept any warranty or liability.

Danger of burns from contact with surfaces!
▸ If necessary, ensure protection against contact to prevent burns.

2.3 Workplace safety

For work on and with the device:
▸ Wear the required protective equipment according to federal/national regulations.

2.4 Operational safety

Risk of injury!
▸ Operate the device in proper technical condition and fail-safe condition only.
▸ The operator is responsible for interference-free operation of the device.

2.4.1 Conversions to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers.
▸ If, despite this, modifications are required, consult with Endress+Hauser.

2.4.2 Repair

To ensure continued operational safety:
▸ Carry out repairs on the device only if they are expressly permitted.
▸ Observe national regulations pertaining to the repair of an electrical device.
▸ Only use original spare parts and accessories from Endress+Hauser.

2.4.3 Hazardous area

To eliminate danger to persons or the facility when the device is used in the hazardous area (e.g. explosion protection):
▸ Check the nameplate to verify whether the ordered device can be used as intended in the hazardous area.

2.5 Product safety

This state-of-the-art measuring device is designed in accordance with good engineering practice to meet operational safety standards, has been tested, and left the factory in perfect functioning order.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the device.

3   Product description

Electromechanical level meter for level measurement in bunkers or silos with dusty, fine-grain or coarse-grain bulk solids or in tanks containing liquids

3.1   Product design

3.1.1   Complete device
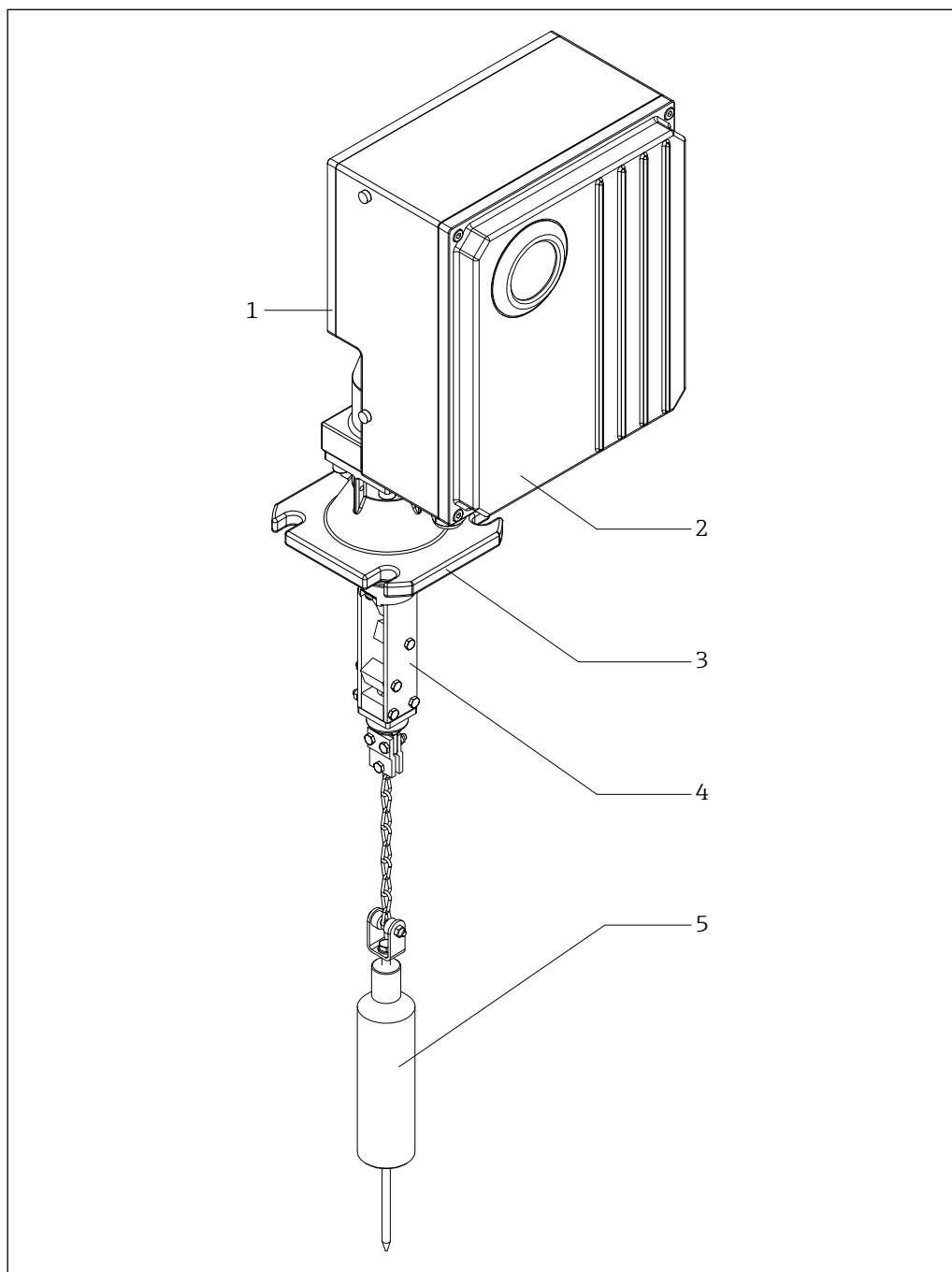
0000000203

1   Structure of the FMM50

1   Process side (spool compartment)
2   Electronics side (electronics compartment)
3   Process connection (DN100 PN16, hole sizes as per EN 1092-1)
4   Wiper
5   Sensing weight

3.1.2 Process side
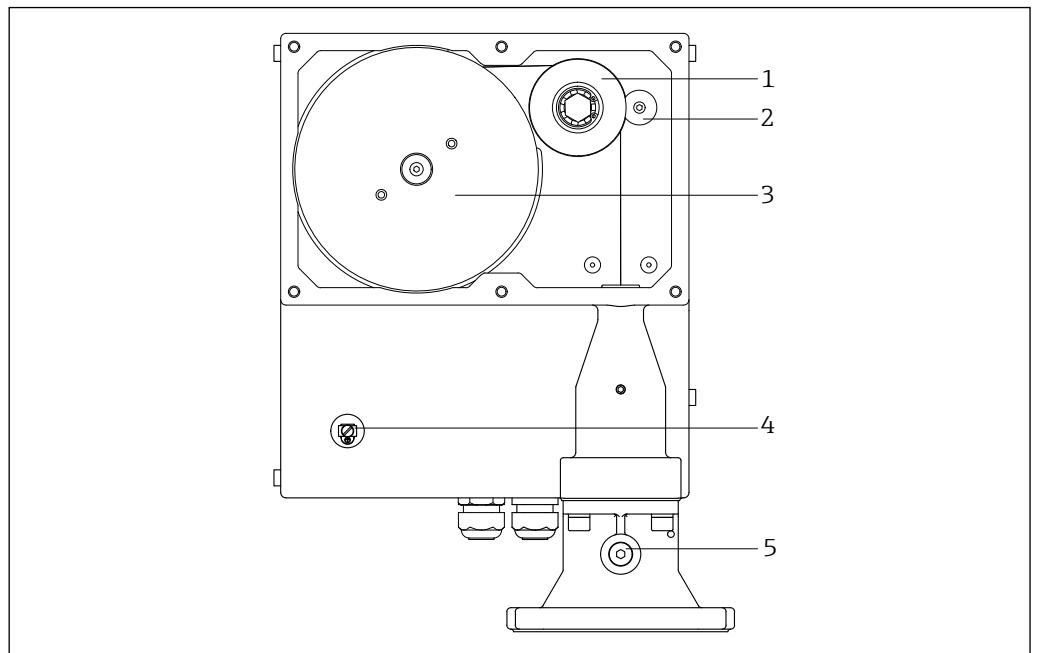
0000000204

⊡2 Process side of the FMM50

1 Counting wheel
2 Tape guide
3 Tape spool with measuring tape
4 Connecting potential matching
5 Purge air connection

3.1.3 Electronics side
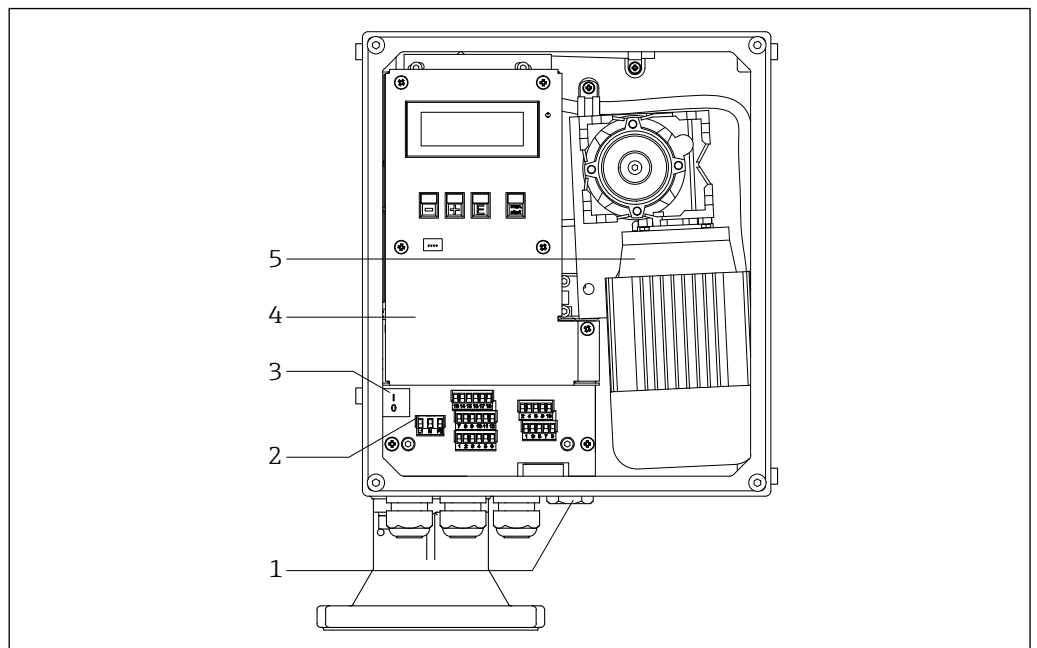
0000000205

⊡3 Electronics side of the FMM50

1 Optional external start button
2 Terminals
3 ON/OFF switch
4 Electronics
5 Motor/gearbox combination

3.1.4   Wiper
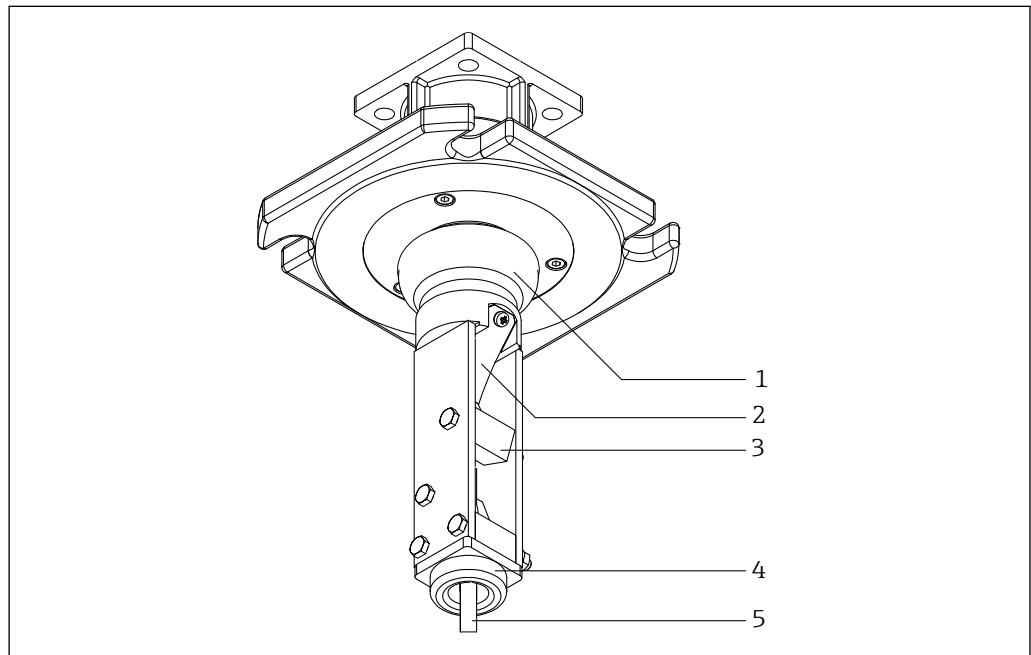
0000000207

⊠4   *Wiper of the FMM50*

1   Bellows
2   Tape-wipe scraper
3   Scraper block
4   End guide
5   Measuring tape

ℹ️ Observe minimum process connection diameter of 95 mm (3.74 in) for installation of wiper mechanism and sensing weights **B** to **D** (see order code).

3.1.5   Sensing weight
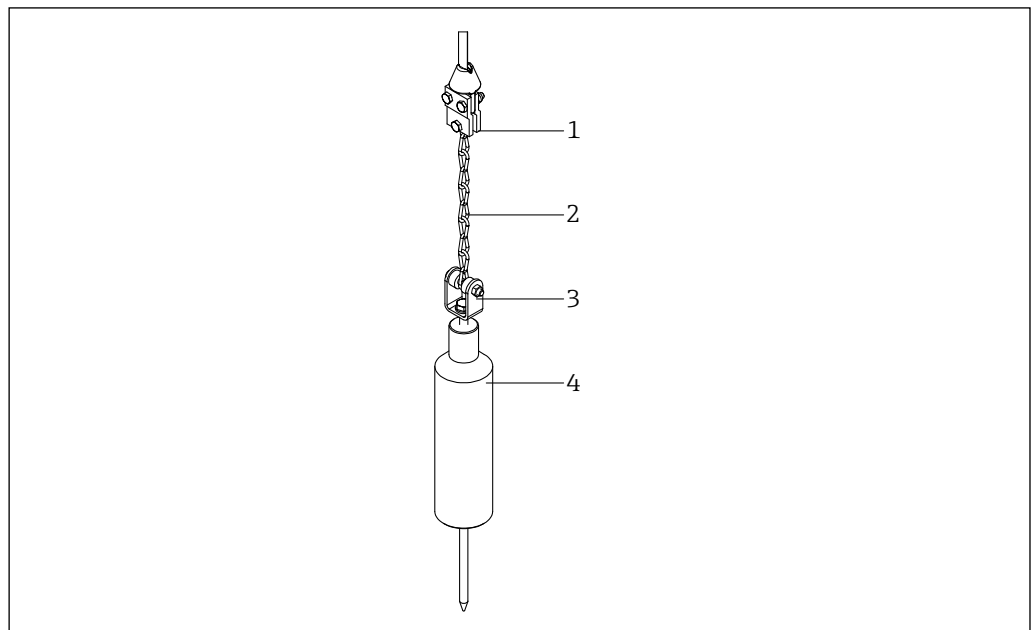
0000000206

⊠5   *Sensing weight of the FMM50 (here: steel/stainless steel)*

1   Tape border
2   Chain
3   Rotating bush
4   Sensing weight

3.2   Measuring principle

The FMM50 works according to a simple measuring principle:

1. When a measurement starts (manually or automatically), a sensing weight is lowered by a motor and spring action causes the wiper to be moved slightly out of its end position. As the weight is lowered, the measuring tape passes over a counting wheel which sends a pulse to the electronics every 5 cm.

2. When it hits the medium, the freely oscillating motor tilts from its working position, in which it is held by the weight of the sensing weight, to its rest position. This is detected by the electronics and the motor is switched off.

3. The sensing weight is pulled up again and counter pulses are detected once more.

4. As soon as the sensing weight reaches the measuring device, it causes the wiper to move to its top position which is detected by the electronics.

5. The motor is switched off, the measuring cycle is ended and the measured value, which depends on the configuration, is output:
   - Display value on the LC display
   - Current value at the 4-20 mA current output
   - Relay switching (e.g. for the "top position" or "measuring" function)
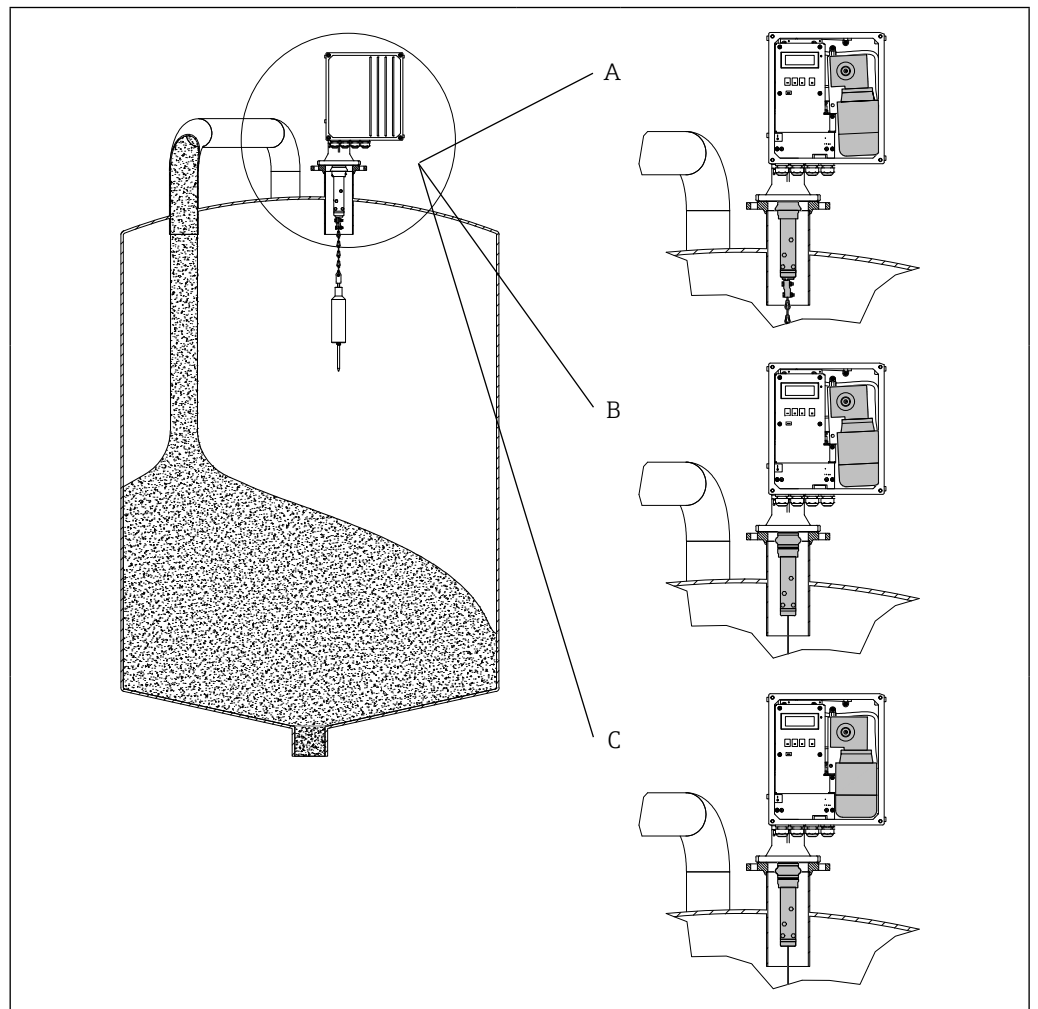
0000000208

🔲6   *Measuring principle of the FMM50*

A   Sensing weight in the top position
B   Sensing weight when lowered (run-down) or raised (run-up)
C   Sensing weight on reaching the surface of the medium

4 Incoming acceptance and product identification

4.1 Incoming acceptance

Check the following during goods acceptance:
❏ Are the order codes on the delivery note and the product sticker identical?

❏ Are the goods undamaged?

❏ Do the nameplate data match the ordering information on the delivery note?

❏ If required (see nameplate): Are the Safety Instructions, e. g. XA, provided?

❏ Is the device properly secured?
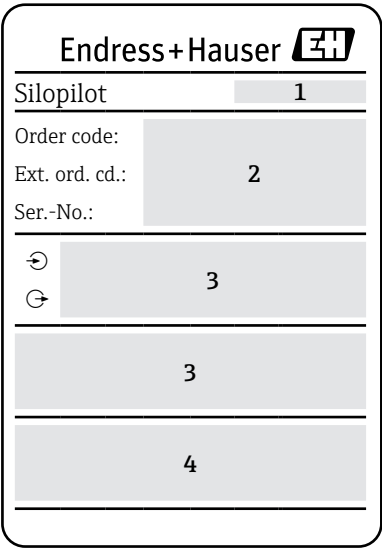
🛈 If one of these conditions is not met, please contact the manufacturer's sales office.

4.2 Product identification

The measuring device can be identified in the following ways:
• Nameplate data
• Extended order code with breakdown of the device features on the delivery note
• Enter serial number from nameplates in *W@M Device Viewer* (www.endress.com/deviceviewer): All of the information on the measuring device is displayed along with an overview of the scope of technical documentation provided
• Enter the serial number on the nameplate into the *Endress+Hauser Operations App* or use the *Endress+Hauser Operations App* to scan the 2-D matrix code (QR Code) on the nameplate

4.2.1 Nameplate

🖼 7   *Nameplate data*

1   Manufacturer address
2   Order number, external order code, serial number
3   Technical data
4   Approval-specific information

4.2.2   Manufacturer address

Endress+Hauser SE+Co. KG
Hauptstraße 1
79689 Maulburg, Germany

4.3   Storage and transport

4.3.1   Storage conditions

Use original packaging.

Storage temperature
→ 🗎84

4.3.2   Transporting the device

Transport the device to the measuring point in the original packaging.

> ℹ️ Do not remove the transportation lock until after mounting.

5   Mounting

5.1   Mounting conditions

5.1.1   Installation position

Select the installation location on the bunker or silo ceiling such that product falling inside during filling or cornices (product accumulating on container wall) collapsing inward are prevented from covering the sensing weight or damaging the measuring tape.

Take due account of the shape and location of the product inflow cone and the outflow funnel within the container. Do not run the measuring path too close to fixtures and struts so that the measuring tape does not brush against them when the sensing weight swings around.

Select the length of the wiper so that the sensing weight can move freely during downward or upward running and does not, for example, come into contact with the edges of a connection pipe. The sensing weight should be located in the middle between the container wall and filling curtain when it is run up and down.

> ℹ️ Incorrect measurements cannot be ruled out if the sensing weight cannot run free and unobstructed during the measurement.
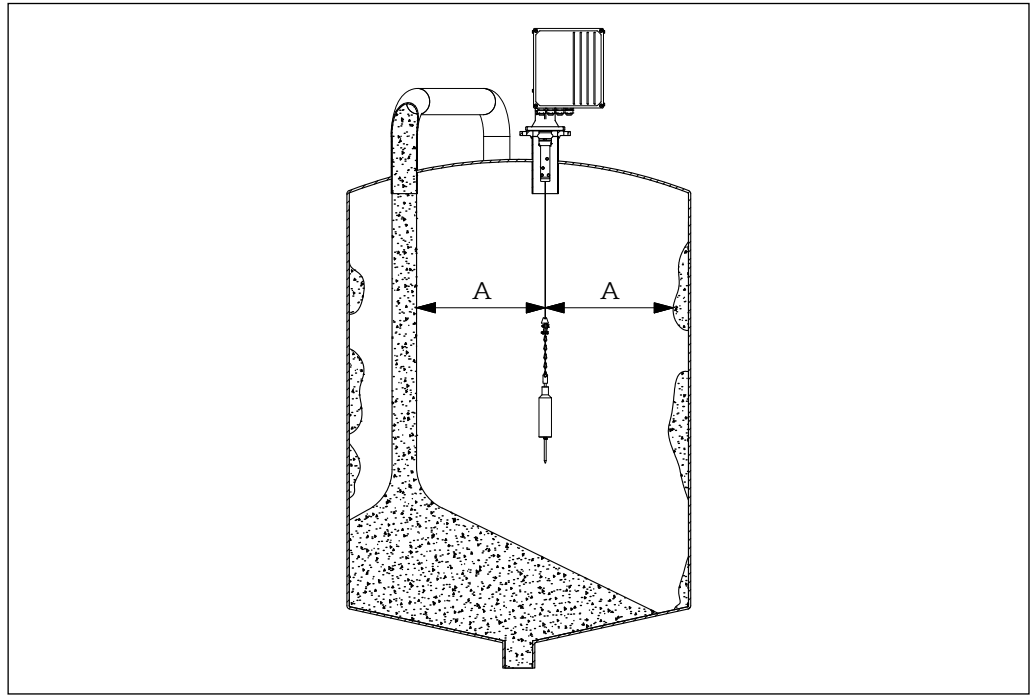
0000000209

🖼8   *Installation position*

A   Distance

Normally, the measuring device is mounted on a counter flange DN100 PN16 (bore dimensions as per EN 1092-1) or a flange of the same connection dimensions.

The counter flange must be mounted in such a way that it is perfectly horizontal so that the device can also be mounted horizontally onto it (maximum angle of inclination 2°). A suitable mounting aid (bubble level) can be found inside versions with a powder-coated housing. When the electronics cover is opened, this can be used for alignment.
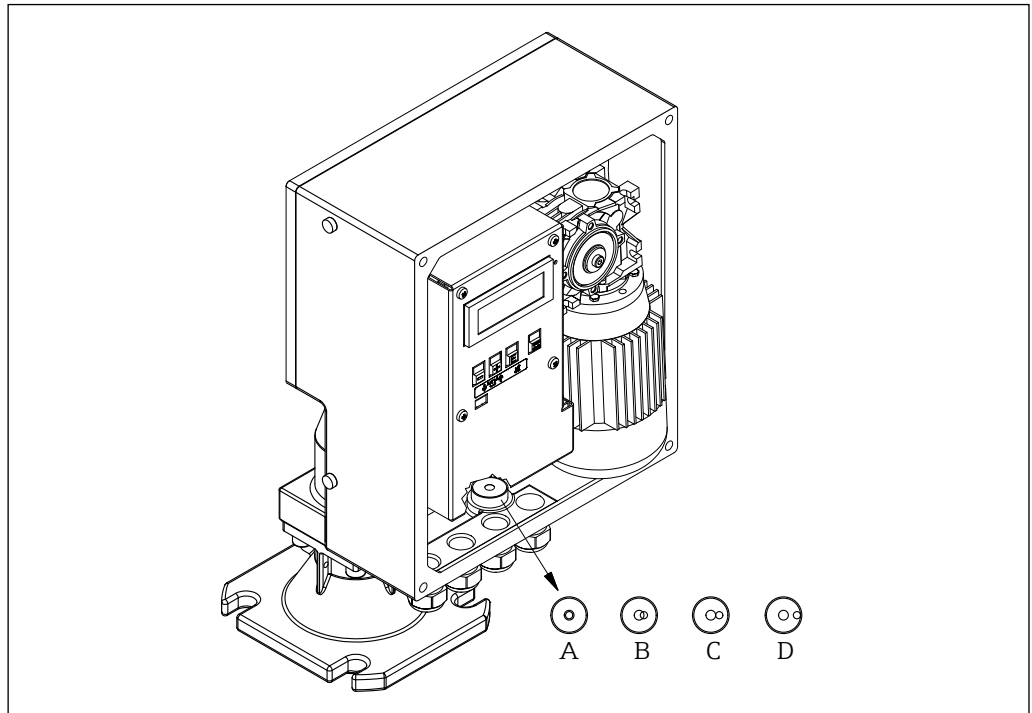
0000000210

🖼9   *Mounting aid bubble level*

A   Device is horizontal (ideal)
B   Device is inclined at 1°
C   Device is inclined at 2° (maximum angle of inclination)
D   Device is inclined at more than 2° (not permitted)

5.1.2   Ambient and process requirements

Observe the maximum process temperature of +70 ℃ (+158 ℉) at the measuring device (from the lower edge of the process adapter) during installation.
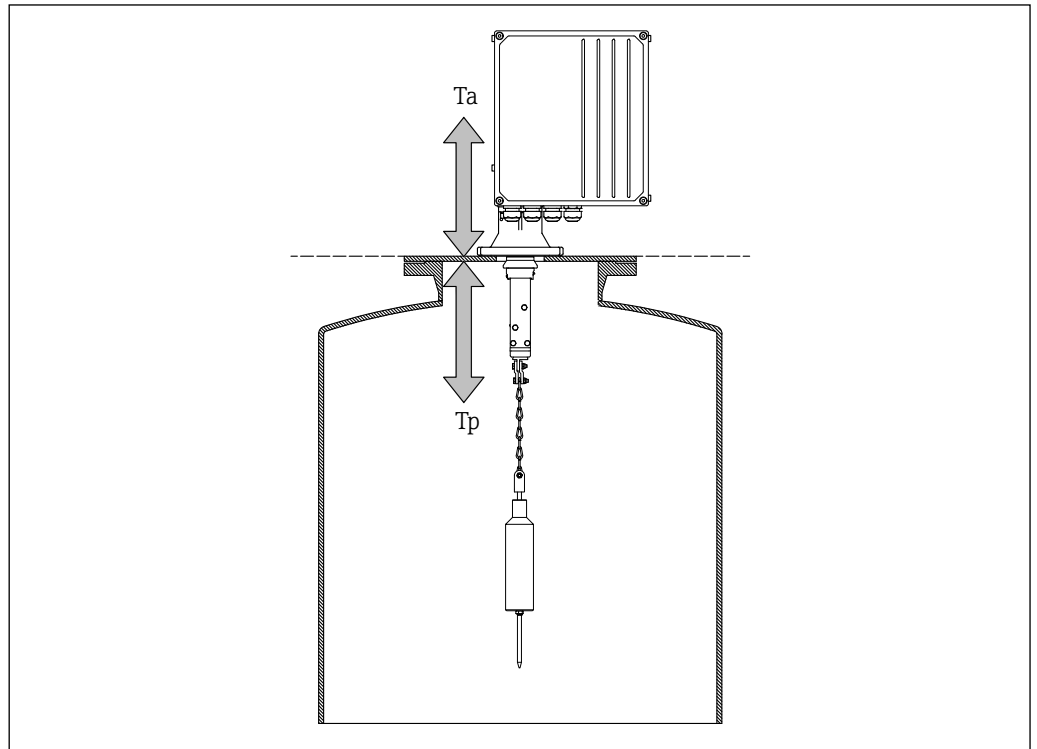
10   Ambient and process requirements

Ta   Ambient temperature → 🖺84
Tp   Process temperature → 🖺84

In case of higher process temperatures in the area of the installation site, create a suitable structural measure for compliance with this temperature condition.

Use an extension of the process connection nozzle to keep the meter away from high process temperatures. The length of the connection nozzle is based on the specific process and ambient conditions.

When mounting outdoors, use weather protection cover or attach weather protection roof.

0000000211
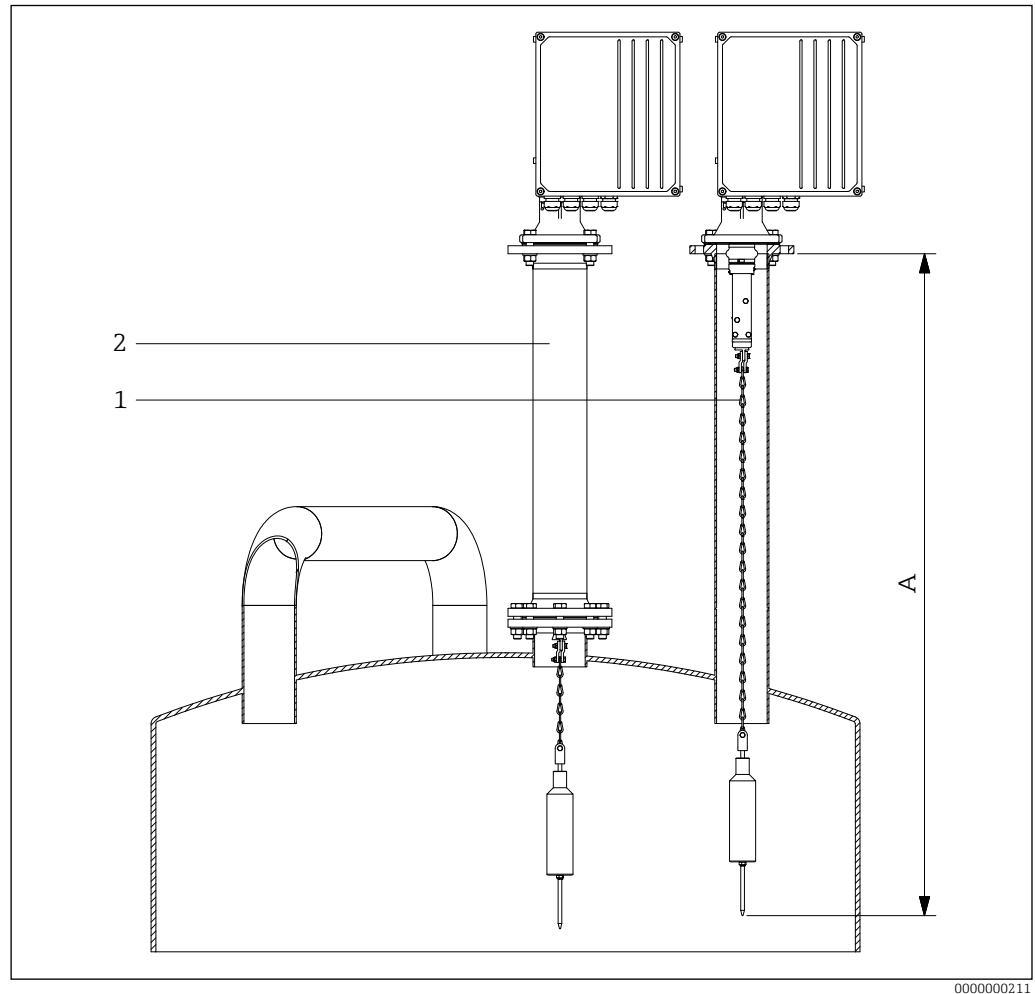
🖼11   Suggested installation to respect ambient temperatures at the device

A   Block distance (BD)
1   Extended chain
2   Process adapter extension

> ℹ️ • The following minimum lengths of the process connection nozzle are recommen-
>   ded:
>   - Minimum 500 mm for process temperatures up to +150 ℃ (+302 ℉)
>   - Minimum 1000 mm for process temperatures up to +230 ℃ (+446 ℉)
>   • Process adapter extensions that are 790 mm long and designed for use with the
>   1000 mm wipers are available as accessories.
>   • When using process nozzles with longer lengths than 230 mm (length of the stan-
>   dard wiper), longer wipers can be ordered as a device option (see ordering options).
>   Alternatively, the chain between the tape border and the sensing weight can be
>   extended accordingly; corresponding material is available as an accessory.
>   • A suitable weather protection cover for the measuring device is available as an
>   accessory.
>   • Accessories → 🔖73

5.2   Mounting the device

5.2.1   Required tool

• To open the device: Allen key 5 mm ◯ ⌸ 5 mm
• For the process connection: Appropriate installation tool
• For the sensing weight: Open-end wrench 10 mm 🔧 10 mm

To mount the device on a standard counter flange DN100 PN16 (bore dimensions as per EN 1092-1), two ring wrenches or open-end wrenches measuring 24 mm AF are needed to mount the four M16 screws.

5.2.2   Preparing the measuring device

1. Remove all remaining transport packaging.

For devices with an extended wiper (500/1000 mm):
2. Mount the wiper.
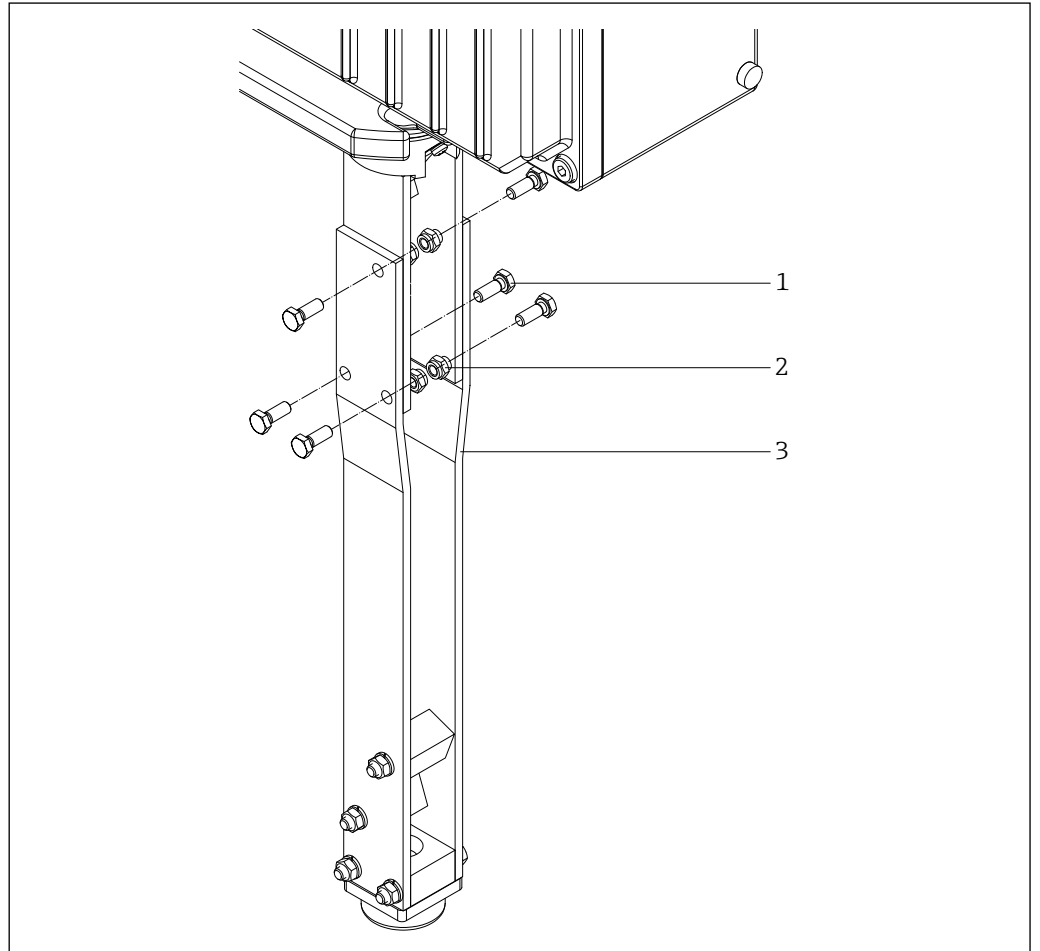
0000000226

⊡ *12   Mounting the wiper extension*

1   Hexagonal-head bolt M6
2   Hexagonal nut
3   Wiper extension

3. Remove the transportation lock on the electronics side (to the right of the motor/gear-box combination).
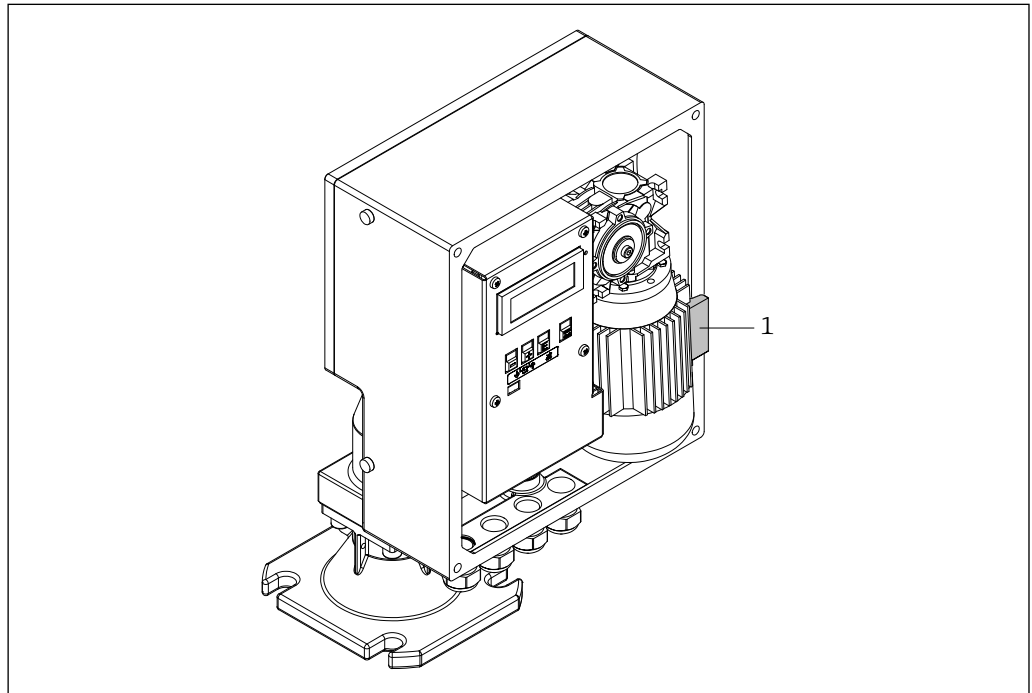
13   *Removing the transportation lock*

1   *Transportation lock*

ℹ️ If the transportation lock is not removed, this can cause unforeseeable responses on the part of the device.

For devices with a large sensing weight (such as a cage weight, bell weight or oval float):
4. Use or create structural support measures and lower the tape border an appropriate distance before mounting.
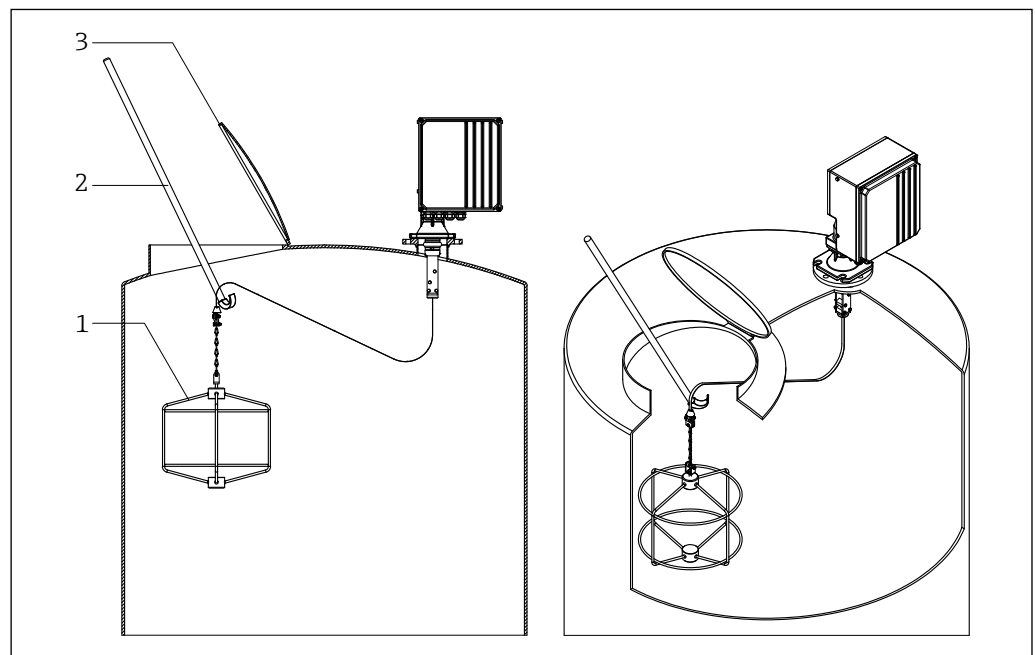
14   *Mounting large sensing weights*

1   *Sensing weight (here: cage)*
2   *Rod with hook*
3   *Entry hatch or similar*

5.2.3   Mounting the device

1. Fit the measuring device on the process connection and align it in such a way that
   - the housing is horizontal (maximum angle of inclination 2°),
   - the cable entries (and the external start button where applicable) are accessible, and
   - the display is directed towards the user.

> ℹ️ - A suitable mounting aid (bubble level) can be found inside versions with a coated housing. When the electronics cover is opened, this can be used for alignment. → 🖼 14
> - Do not crease the measuring tape when inserting it, this will result in a reduced service life.

2. Fix the measuring device with four suitable screws.

> ℹ️ When the unit is used in bunkers or silos with heavy dust generation, a slight over-pressure can be created by connecting a pressure line to the mounting flange (air volume as required), so that the spool compartment can be kept clean. A G¼ female connection is provided for this purpose. → 🖼 9

3. Mounting the sensing weight.

> ℹ️ - The sensing weight must be outside the connection when the measuring tape is wound up.
> - The maximum height of the process connection nozzle is dictated by the length of the wiper. This height is 230 mm if a standard wiper is used.
> - The wiper is also available in lengths of 500 mm and 1000 mm (see ordering options, other lengths as special version on request).
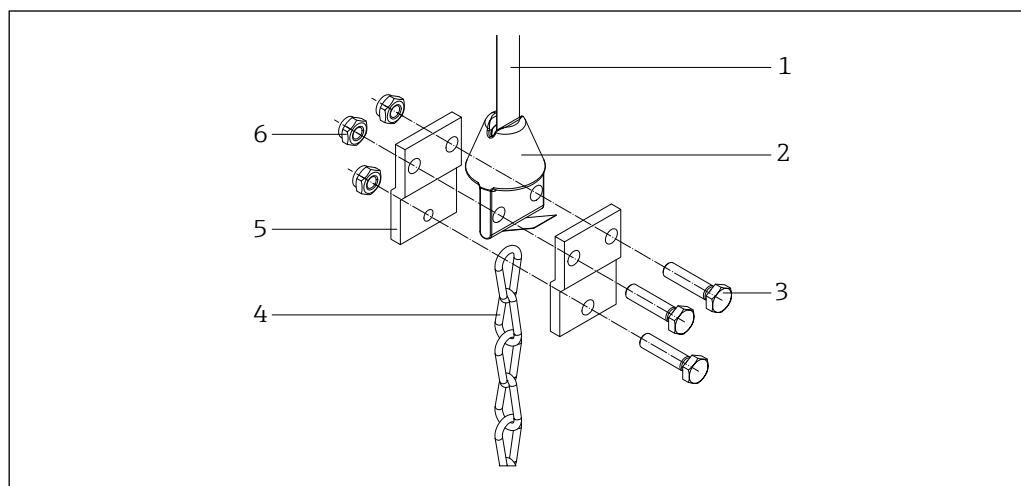
🖼 15   *Mounting the sensing weight*

1   Measuring tape
2   Tape border
3   Hexagonal-head bolt M6
4   Chain
5   Clamping bracket
6   Hexagonal nut

5.3   Post-installation check

❏ Is the device undamaged (visual inspection)?

❏ Does the device conform to the measuring point specifications?

For example:
• Process temperature
• Process pressure
• Ambient temperature

❏ Are the measuring point number and labeling correct (visual inspection)?

❏ Is the device adequately protected against precipitation and direct sunlight?

❏ Is the device properly secured?

6   Electrical connection

📖 For a device for the hazardous area:
Observe the instructions in the Ex documentation (XA).

6.1   Connection requirements

6.1.1   Required tool

• To open the device: Allen key 5 mm
  ⬡ ✐ 5 mm
• For the sensing weight: Open-end wrench 30 mm
  ✐ 30 mm
• For the terminals: Slotted screwdriver 0.6x3.5mm
  ◖ ✐ 0,6x3,5mm
• For potential equalization: Slotted screwdriver 1.0x6.5mm
  ◖ ✐ 1,0x6,5mm

6.1.2   Connecting cable requirements

The connecting cables provided by the customer must meet the following requirements:
• Permissible temperature range → 📖84
• Protection → 📖84
• Normal installation cable sufficient
• Ø 10 to 17 mm (0.39 to 0.67 in)

NOTICE

• Observe the maximum thermal load of the cables and lines introduced.
• The gland is only admissible for the connection of fixed-installation lines and cables.
  Appropriate strain relief must be ensured by the operator.
• Mount the cable gland so that it is protected against mechanical damage ("low" degree of
  mechanical risk – impact energy: 4 Joule).

6.2   Preparing the measuring device

Remove the dummy plug if present.

Housing not sealed tight!
• Operational reliability of the measuring device could be compromised. Use suitable cable
  glands that match the degree of protection.
• If the measuring device is supplied with cable glands: Observe the cable specifications

6.3 Connecting the device

6.3.1 Connect potential equalization

The potential equalization for the device must be integrated into the existing potential equalization on site.

Requirements:
• The potential equalization must be connected to the external ground terminal on the device. → ⊡9
• For optimum electromagnetic compatibility, keep the potential equalization line as short as possible.
• The recommended cable cross-section is 2.5 mm².
• The potential equalization of the FMM50 must be included in the local potential equalization.

6.3.2 Connecting the device
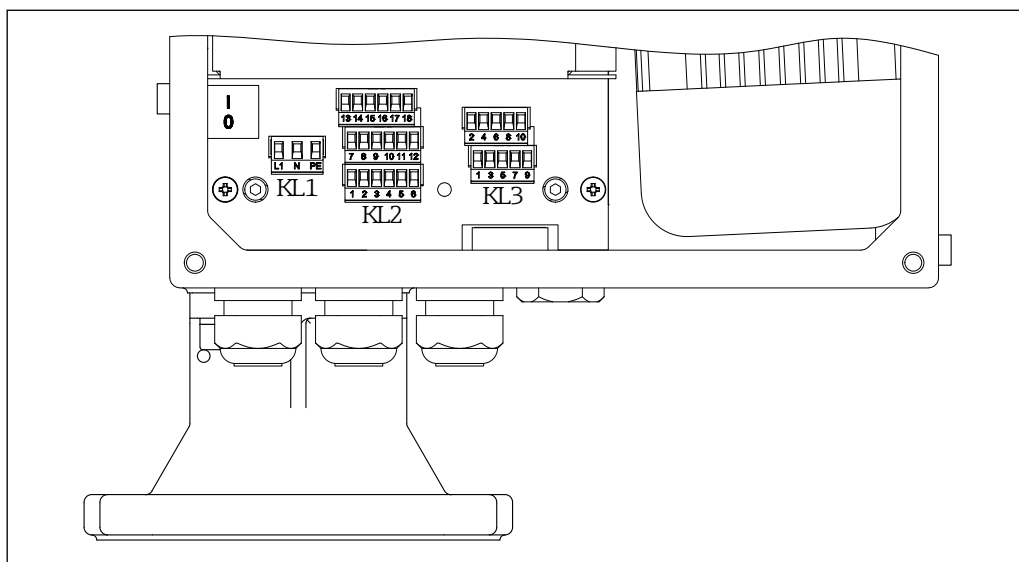
0000000222

⊡ 16 *Terminal assignment*

1. Unscrew the housing cover on the electronics side (large cover).

2. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.

3. Strip the cable and cable ends. In the case of stranded cables, also fit ferrules.

4. Connect the cable in accordance with the terminal assignment.

5. Firmly tighten the cable glands.

6. Reverse the procedure to reassemble the device.

6.3.3 Supply voltage

• Terminal assignment: 1.1 (L1) / 1.2 (N) / 1.3 (PE)
• Voltage range → 🗎83
• Ieff = 8 A (115 V) for 40 ms / 4.4 A (230 V) for 20 ms
• In accordance with IEC/EN61010 a suitable circuit breaker must be provided for the measuring device.
• Overcurrent protection device: maximum 16 A

6.3.4   Signal input

- Contact load → 🖹82

Order code	Terminal assignment		
Without	**Input 1 (active)**	**Input 2 (active)**	
	3.1	3.3	(+)
	3.2	3.4	(−)
	Input 1 (passive)	**Input 2 (passive)**	
	3.5	3.7	
	3.6	3.8	
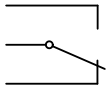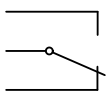
- The signal inputs (active/passive) can only be used alternatively. An input can only be assigned as either active or passive.
- In the case of the device version with an external start button, this button is connected to the passive signal input 1. Only signal input 2 (active or passive) is then available.
- A start pulse must be present for at least 200 ms for it to be evaluated.

6.3.5   Current output

- Terminal assignment: 3.9 (+) / 3.10 (−)
- Current output: 0 - 20 mA or 4 - 20 mA
- active
- Load → 🖹82

6.3.6   Relay output

- Contact load → 🖹82

Order code	Terminal assignment				
Output option A, B	**Relay 1**		**Relay 2**		
	2.1		2.4		
	2.2		2.5		
	2.3		2.6		
Output option B	**Relay 3**	**Relay 4**	**Relay 5**	**Relay 6**	
	2.7	2.10	2.13	2.16	
	2.8	2.11	2.14	2.17	
	2.9	2.12	2.15	2.18	

6.4   Ensuring the degree of protection

1. Check that the housing seals are clean and fitted correctly. Dry, clean or replace the seals if necessary.

2. Tighten all housing screws.

3. Firmly tighten the cable glands.

4. Unused cable entries must be sealed with suitable blanking plugs.

6.5 Post-connection check

❑ Is the device or cable undamaged (visual inspection)?

❑ Do the cables used comply with the requirements?

❑ Do the mounted cables have adequate strain relief?

❑ Are the cable glands mounted and firmly tightened?

❑ Does the supply voltage match the specifications on the nameplate?

❑ No reverse polarity, is terminal assignment correct?

❑ If supply voltage is supplied: does information appear on the display

❑ Are all the housing covers installed and tightened?

7 Operation options
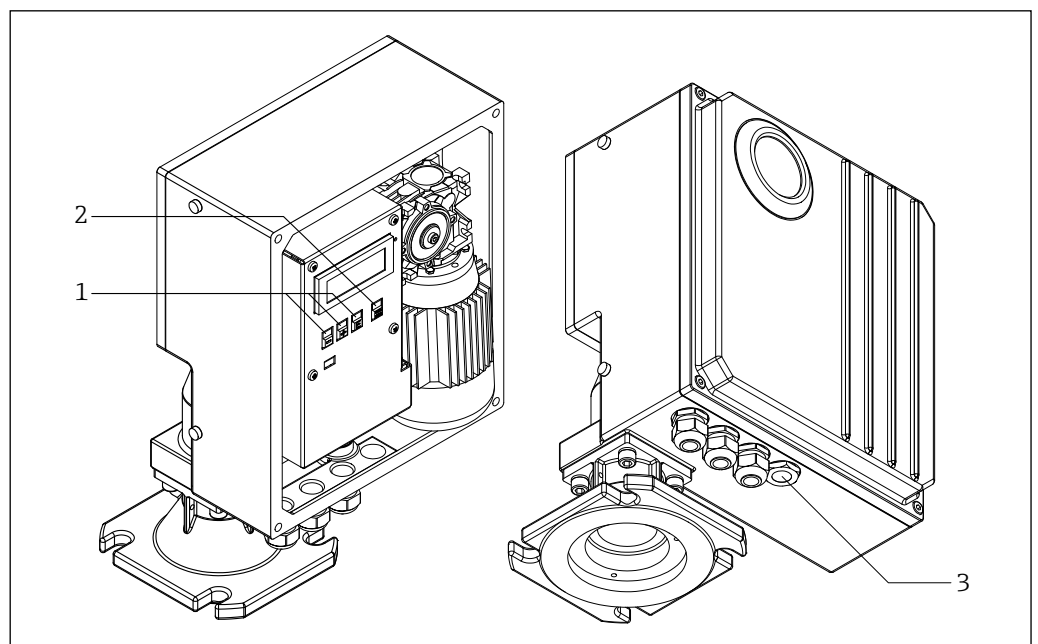
0000000221

⬛ *17 Operation options*

1 Operating keys for configuration
2 Button to start a measurement manually
3 External button to start a measurement manually

7.1 Structure and function of the operating menu

Overview operating menu and parameters → 🖹85
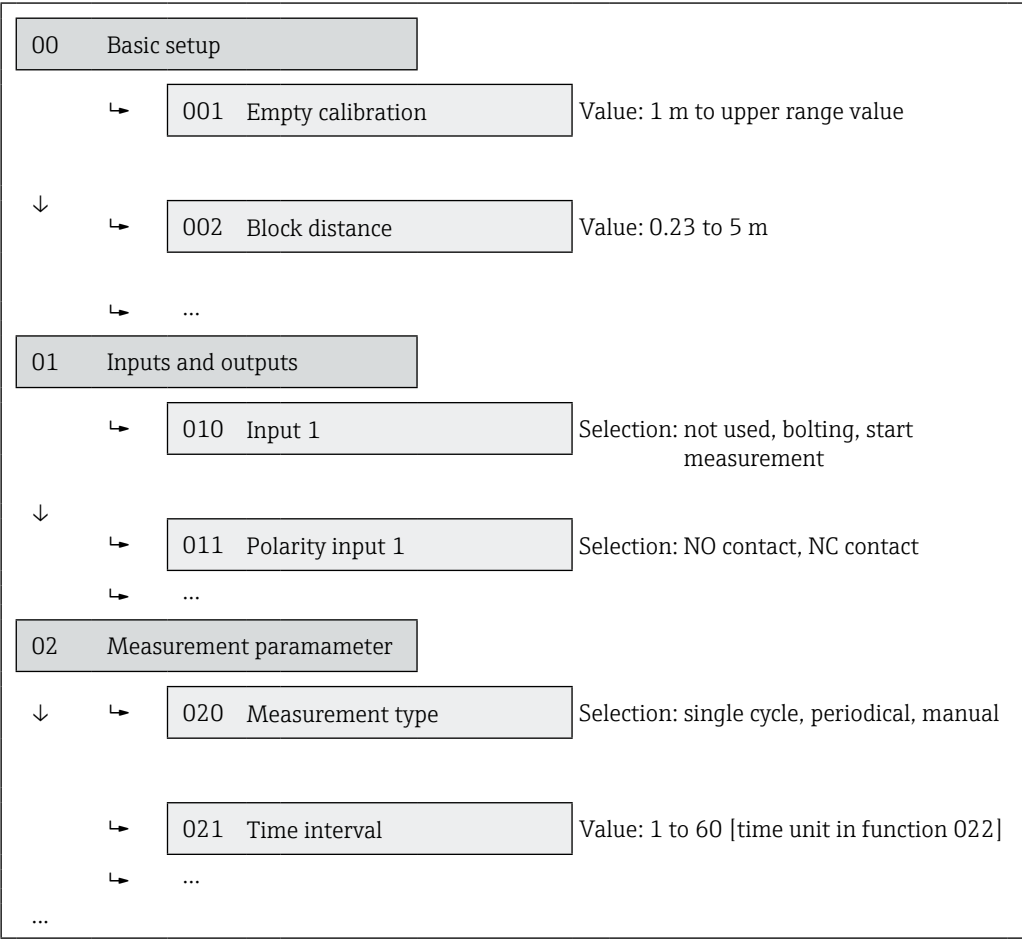
🖼18   Schematic structure of the operating menu

7.2 Access to the operating menu via the local display

7.2.1 Operational display
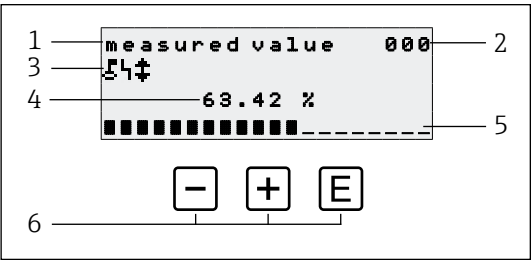
🖼19   Operational display

1   Name of function
2   Function number
3   Display symbols
4   Measured value and unit
5   Bargraph of measured value
6   Operating elements

Operating options

Key	Meaning
E	Switch to group selection 00, 01, …
+ / −	Not used

ℹ
- The operational display essentially corresponds to the measured value display (function 000).
- The operational display appears automatically after the start-up procedure. Only then can a measurement operation commence.
- During initial commissioning, function 060 "language" and function 083 "distance unit" appear once only. Afterwards, the measured value display appears. → 🕮28
- The default values are always shown in bold in the following chapters, unless they are explicitly mentioned.

Display symbols

Symbol	Meaning
🔒	This lock symbol is displayed when the measuring device is locked and no entries can be made.
⌐	This alarm symbol is shown when the device is in an alarm condition (error condition). A flashing symbol indicates that a fault has occurred.
↕	This symbol flashes when the device is in the "manual" measurement mode. When the button is pressed, the symbol disappears and the direction selected (run up ↑ run down ↓) is shown.

7.2.2 Navigation view
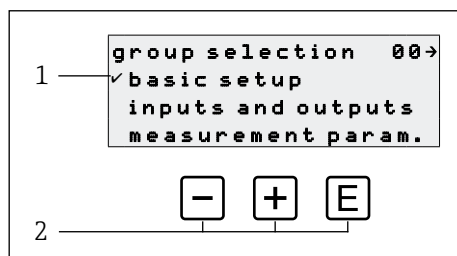
🖻20 *Navigation view*

1 Function groups
2 Operating elements

The active selection of the function group (here "basic setup") is indicated by a check mark in front of the menu text.

Operating options

Key	Meaning
−	Moves the active function group down
+	Moves the active function group up
E	Switches to the active function group

7.2.3   Edit view

Entering a value	Selecting a value
1 — empty calibr. 001 — 2 3 — 35 m 4 — distance flange to min. filling [−] [+] [E] 5	1 — input 1 010 — 2 ✓not used 3 — bolting start measurement [−] [+] [E] 5

🔲 *21   Edit view*

1   Name of function
2   Function number
3   Numerical value or selection
4   Help text
5   Operating elements

Operating options

Key	Meaning
[−]	**Entering a value** • Activates the edit mode • Changes the displayed character (9, 8, 7, … , Z, Y, X, …) **Selecting a value** Moves the active option down
[+]	**Entering a value** • Activates the edit mode • Changes the displayed character (0, 1, 2, … , A, B, C, …) **Selecting a value** Moves the active option up

[E]	• Navigation to the right within a function group
	• In edit mode:
	  - Change to the next character
	  - At the end, accept the entry by switching to the next function

Editing options
The following characters are available for selection when editing:
• Numerical values: 0 to 9 and "." (period) as the separator in the unit selected
• Tag number (function 080): additionally letters A to Z and "-" (minus)
• Navigation characters:
  - "←" goes one or more spaces to the left
  - "→" goes one or more spaces to the right

7.2.4   Operating elements

Key	Meaning
[−]	**Entering a value** Activates the edit mode and reduces the value **Selecting a function group or a value** Moves the active option down
[+]	**Entering a value** Activates the edit mode and increases the value **Selecting a function group or a value** Moves the active option up
[E]	• Navigation to the right within a function group • In edit mode: Accept the value entered
[−] + [+]	Navigation to the left within a function group
[+] + [E]	Increases the contrast of the liquid crystal display
[−] + [E]	Decreases the contrast of the liquid crystal display

Key	Meaning
$\boxed{-}$ + $\boxed{+}$ + $\boxed{E}$	▪ Enables or disables hardware locking ▪ Operating keys have no function on their own ▪ "man. start" and external start button are not locked
$\boxed{\text{man.}\atop\text{start}}$ or external start button	The measurement procedure starts if the device is in the display mode (function 000)

7.2.5   Navigating and selecting from list

Different operating elements are used to navigate through the operating menu.
The function group (00, 01, 02, etc.) and the function number (000, 001, 002, etc.) appear on the top left of the display.

Example: Configuring safety distance

1. $\boxed{E}$ → Switch to group selection

```
group selection   00→
✓basic setup
 inputs and outputs
 measurement param.
```

2. $\boxed{-}$ / $\boxed{+}$ → Change the function group to be selected until the function group can be selected

```
group selection   04→
✓safety settings
 linearization
 display
```

3. $\boxed{E}$ → Select the safety settings function group; the first function in this group is displayed

```
output on alarm   040
✓MIN (0/3.6mA)
 MAX (22mA)
 hold
```

4. $\boxed{E}$ → Switch to the next function(s) of the function group until the desired function is displayed

```
safety distance   042
        0.00  m
minimum distance
to empty calibration
```

5. $\boxed{-}$ / $\boxed{+}$ → Edit mode activated, the first character starts flashing, enter the desired character string

```
safety distance   042
  ■.00         m
minimum distance
to empty calibration
```

6. $\boxed{E}$ → Accept the entry and change to the next function

7.2.6   Disabling write protection via the access code

If the lock symbol appears on the local display and in front of the input values in the functions, configuration is protected by an access code. No more values can be entered or changed in the entire operating menu with the exception of the **unlock parameter 074** function.

If write access is locked via local operation, it can be unlocked by entering the access code via the relevant access option.

The lock via access code is enabled and disabled as follows:
1. Select the **unlock parameter 074** function

2. Enter the access code
   100   → Write protection is disabled
   <>100   → Write protection is enabled

ℹ️ If the keypad is locked, the lock symbol also appears on the display. However in this case the unlock parameter 074 = 100.

7.2.7 Enabling and disabling the keypad lock

If the lock symbol appears in the local display and in front of the input values of the functions, the parameterization is protected by a key lock, no more values can be entered or changed in the entire operating menu.

The keypad lock is enabled and disabled as follows:
1. ⊟+⊞+�: Press all operating keys while the device is in the measured value 000 mode.
   → The keypad lock is enabled

2. ⊟+⊞+Ⅽ: Press all operating keys again while the device is in the measured value 000 mode.
   → The keypad lock is disabled

ℹ️ If write protection is enabled via the access code, the lock symbol appears on the display. However in this case the unlock parameter 074 is unequal 100.

8 Commissioning

8.1 Function check

Before commissioning the measuring point, check whether the post-installation and post-connection checks have been performed.

- "Post-installation check" checklist → 📖20
- "Post-connection check" checklist → 📖23

8.2 Powering up the measuring device

ℹ️ If nothing appears on the local display or a diagnostic message is displayed: "Diagnostics and troubleshooting" chapter → 📖51

First time the device is switched on, the following appears on the display:
Initialization phase

```
Initialization


Jan 26 2015
```
          ↓
The device type, version (hardware and software) and the order code are displayed
```
FMM50
V01.06.12

A1A1A1AA11A1
```
          ↓

1. Set operating language

```
language              060
✓Deutsch
 English
 Francais
```

↓

2. Set distance unit

```
distance unit         083
✓m
 ft
 in
```

↓

Display switches to the measured value screen

```
measured value        000

        63.42 %
■■■■■■■■■■■■_____
```

ℹ️ A measurement must first be performed before it is possible to obtain a measured value that is valid for the current measuring point.

8.3 Set operating language

Selection of the language for the text on the display in function **language 060**:

```
language              060
✓Deutsch
 English
 Francais
```

Selection: Deutsch, **English**, Francais, ニホソゴ (Katakana, Japanese)

ℹ️ Other operating languages can be ordered optionally (product configurator)

8.4 Configuring the device

The device is configured via the individual function groups and the associated functions in the groups.

Function group	Device functions
Basic setup (00) → 📖30	Adapting to the application (for example full and empty calibration)
Inputs and outputs (01) → 📖36	Device functions for changing the behaviour of the inputs and of the relay outputs, for example by specifying the relay output functions
Measurement paramameter (02) → 📖31	Adapting to the measurement requirements (for example specifying the time interval for periodic measurement)
Current output (03) → 📖34	Adapting the current output (for example selecting the magnify function)
Safety settings (04) → 📖45	Adapting the measuring device to the safety requirements (for example selecting the behaviour of the current output in an alarm condition)
Linearization (05) → 📖41	Adapting the measuring device to the application with regard to measured value generation (for example selecting to display a volume in a technical unit)
Display (06) → 📖36	Adapting the display (for example selecting the menu language)

Function group	Device functions
Diagnostics (07) → 🖥51	Error analysis and troubleshooting (for example resetting to default values)
System parameters (08) → 🖥41	Advanced adaptation of the measuring device to the measuring point (for example entering a tag name)

8.4.1   Basic setup

In most cases, the basic setup is sufficient for successful commissioning, more complex measurement tasks may require further settings.
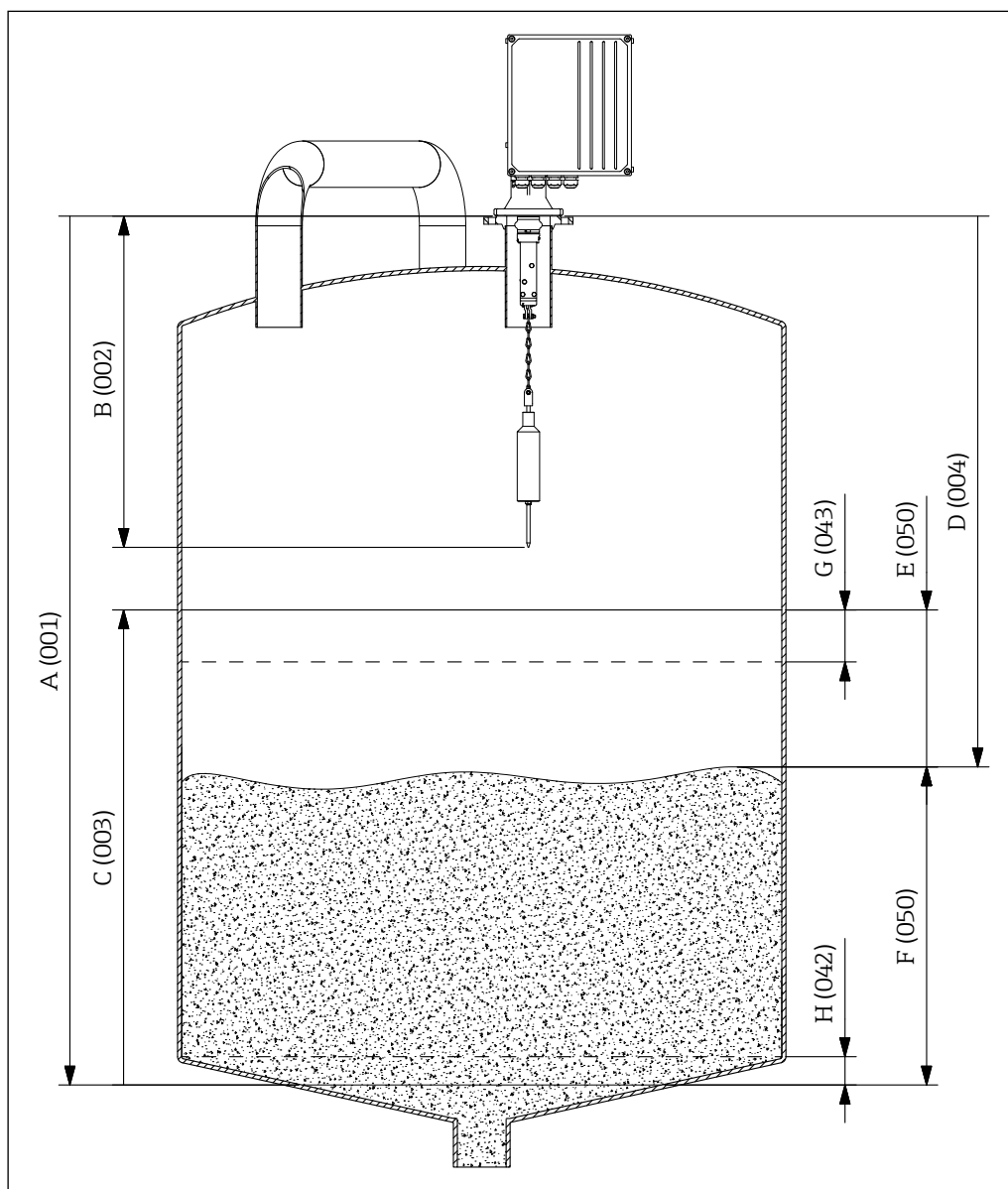
🖼*22   Parameters of the basic setup*

A   Empty calibration
B   Block distance
C   Full calibration
D   Distance
E   Ullage
F   Level/volume
G   Security distance
H   Safety distance

8.4.1.1 Empty calibration

Input distance between the mounting flange (reference point for measurement) and the minimum fill level (= zero point) in **empty calibr. 001** function:

```
empty calibr.     001
          35 m
distance flange to
min. filling
```

Range of values: 1 m … **length of measuring tape** (or converted value in feet/inches)

8.4.1.2 Block distance

Enter distance between the flange of the device and the end of the sensing weight (in upper limit position) in **block distance 002** function:

```
block distance    002
        0.80 m
distance flange to
bottom weight
```

Range of values: 0.23 to 5 m (or converted value in feet/inches)
Default: 0.8 m

> ℹ Table detailing all the default values depending on the wiper length and the sensing weight → 🕮 82

8.4.1.3 Full calibration

Input distance between the minimum fill level (=zero point) and the maximum fill level (= span) in **full calibration 003** function:

```
full calibration 003
          34 m
measuring range
max.=empty-bd
```

Range of values: 1 m … empty calibr. - block distance (or converted value in feet/inches)
Default: Length of measuring tape - 0.8 m

8.4.1.4 Measurement type

Select type of measurement of the device in **measurement type 020** function:

```
measurement type 020
✓single cycle
 periodical
 manual
```

Selection:
- **single cycle**
  Activation of single cycle measurement (manually using buttons on the device or using a corresponding input signal in function 010 and 012)
- **periodical**
  Activation of time-controlled measurements (time interval defined in functions 021 and 022)
- **manual**
  The sensing weight can only be moved using the keys on the device. This type of measurement allows the user to move the sensing weight slowly, e.g. when changing the cage sensing weight.

> **NOTICE**
>
> In the manual mode, the upper limit switch and the tape switch have no function! Users must themselves check in which position the sensing weight is currently located. With this type of measurement, the sensing weight can (depending on the maximum tape length) be lowered into unauthorized areas of the container (or into an outlet worm for example). Due to the high tensile forces of the measuring device, the measuring tape may tear or be pulled out of the sensing weight attachment in this mode of operation.

> **ℹ** A measurement can only be taken when the device is in the "measured value (000)" mode. This also applies to the device version with an external start button.

8.4.1.5 Distance/measured value

Display of the measured distance between the device and the medium and the current measured value in **dist./meas.value 004** function:

```
dist./meas.value 004
distance 0.90 m
meas.val  3.75 %
```

The display depends on the number of decimal places (function 062), the distance unit (function 083) and also linearization where applicable.

8.4.1.6 Time interval

Input time interval for the measurement type "periodical" (see function 020) depending on the unit (see function 022) in **time interval 021** function:

```
time interval     021
       1 h
```

Range of values: **1** ... 60 (Function 022)

> **ℹ** The minimum time for a measuring cycle depending on the ambient temperature and the measuring range must be observed. → 📖83

8.4.1.7 Time unit

Input unit of time interval (see function 021) in **time unit 022** function:

```
time unit         022
✓h
 min.
```

Selection:
- **h** (Hour(s))
- min. (Minute(s))

8.4.1.8 Normal or short

Select operating mode for the "single cycle" and "periodical" type of measurement in **normal or short 023** function:

```
normal or short   023
✓normal
 short
```

Selection:
- **normal**

  At the start of a measurement, the measuring device lowers the sensing weight as far as the product and the sensing weight is then pulled back into the upper end position.

- short
  At the start of a measurement, the measuring device lowers the sensing weight as far as the product and the sensing weight is then only raised by the length specified in function 028 "run-up length".

ℹ️ Notes on the "short" operating mode:
- The weight moves back into the upper end position every 20 measuring cycles.
- Use input or relay output with "upper limit position" function for locking to protect the sensing weight from spillage.
- Relay output cannot be used for counting pulses, since the device does not move to a defined point (and thus no defined distance) at the end of a measurement.
- Before dismounting the device, move the sensing weight to the upper end position ("manual" type of measurement).

8.4.1.9 Run-up length

Input of the length that the sensing weight moves up in the "short" operating mode (see function 023) in **run up length 028** function:

```
run-up length    028
        1.0 m
run-up length
for short measure
```

Range of values: **1 m** ... Empty calibration - 1 m (or converted value in feet/inches)
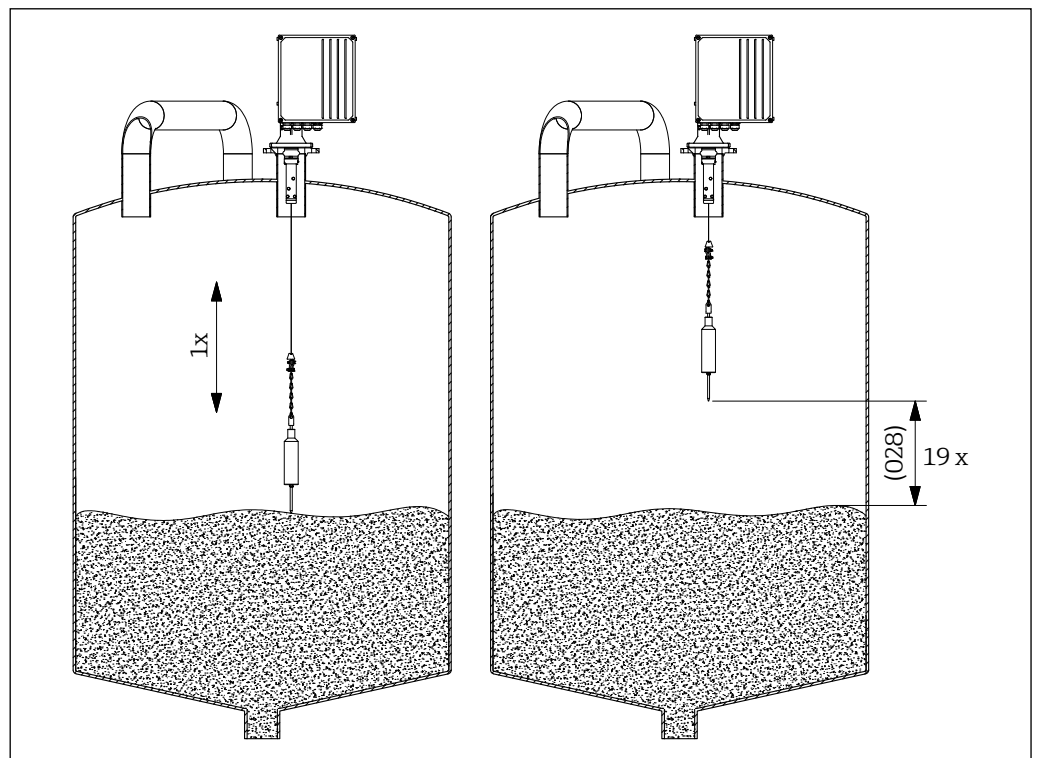
🔲 23   *Run-up length*

8.4.2   Current output

8.4.2.1   Current mode

Selection behavior of current output in **current mode 030** function:

```
current mode    030
✓normal
 magnify
```

Selection:
- **normal**

  The current output supplies a current of 0/4 to 20 mA (adjustable in function 033) referred to 0 to 100 % of the set measuring range (see function 002 "full calibr.").
- magnify

  Only a part of the measuring range is mapped to the output current range of 0/4 to 20 mA, this range is defined in 031 "0/4mA value" and 042 "20mA value" function.
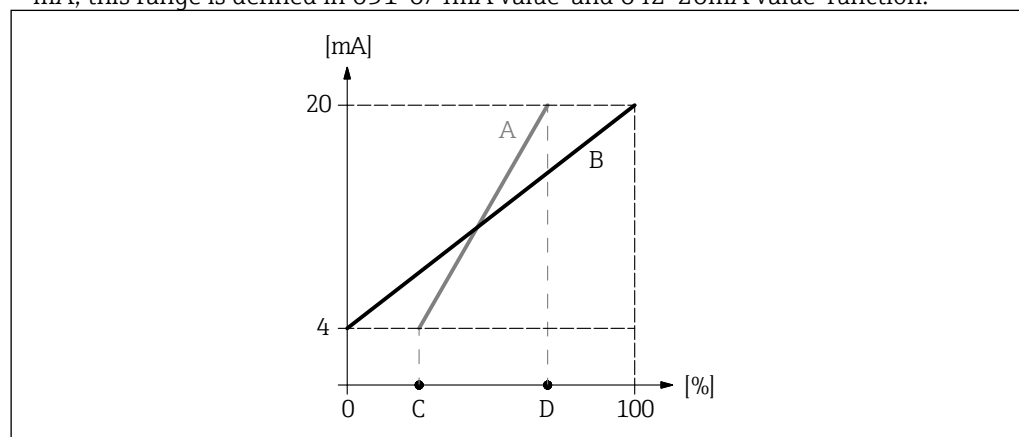
☒24   Current mode

A   Magnify
B   normal
C   Function 031 (0/4mA value)
D   Function 032 (20mA value)

8.4.2.2   0/4mA value

Input lower limit current output (see function 030) in **0/4mA value 031** function:

```
0/4mA value     031
      30.00 %
```

Range of values: depends on distance unit and/or CU

8.4.2.3   20mA value

Input upper limit current output (see function 030) in **20mA value 032** function:

```
20mA value      032
      70.00 %
```

Range of values: depends on distance unit and/or CU

ℹ️ When changing the maximum scale value (in function 057), the 0/4 mA value or the 20 mA value must also be adapted.

8.4.2.4   Current range

Selection current output range (see function 030) in **current range 033** function:

```
current range    033
✓4-20mA
 0-20mA
```

Selection:
- **4-20mA**
- 0-20mA

ℹ️ The behaviour of the current output can be influenced by the level/volume 050 function as follows:
- The settings "level DU" or "level CU" cause an increasing output current as the level increases.
- The settings "ullage DU" or "ullage CU", on the other hand, cause a decreasing output current as the filling level increases.
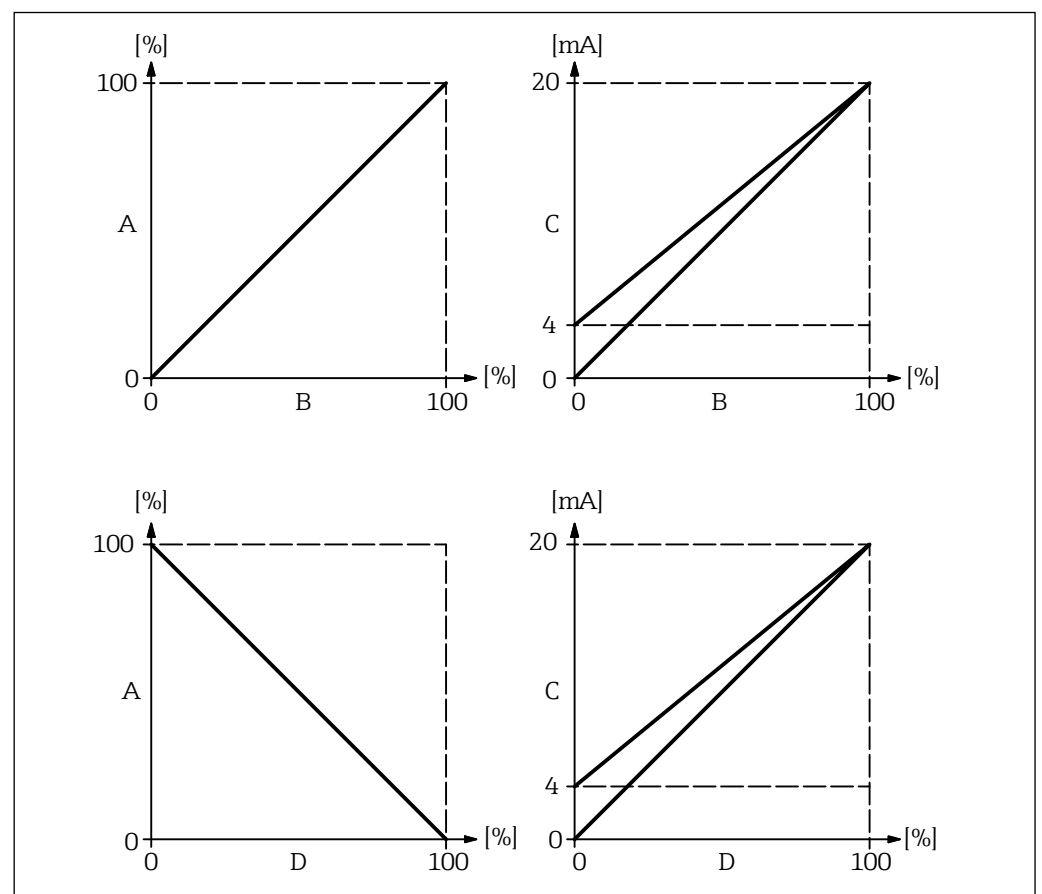
🖼️ *25   Behaviour of the current output*

A   *Filling level*
B   *Level (volume)*
C   *Current*
D   *Ullage*

8.4.3   Display

8.4.3.1   Back to home

Input of time until return to measured value display (000) in **back to home 061** function:

```
back to home      061
        100 s
time until jump back
home automatically
```

Range of values: 3 ... 9999 seconds
Default: 100

8.4.3.2   No. of decimals

Selection number of decimal places (among others for the measured value display (000))
in **no. of decimals 062** function:

```
no. of decimals   062
✔x
 x.x
 x.xx
```

Selection:
- x
- x.x
- **x.xx**
- x.xxx

8.4.3.3   Format display

Activation test LC display (all points are activated for approx. 2 seconds) in **format display 063** function:

```
format display    063
✔off
 on
```
→
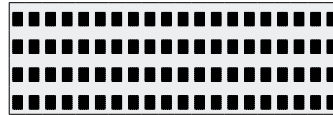
Selection:
- **off**
- on

8.4.4   Output

8.4.4.1   Relay output 1

Selection behavior relay 1 in **relay output 1 014** function:

```
relay output 1    014
✔alarm
 threshold
 service interval
```

Selection:
- **alarm**
  Relay switches as soon as an error is detected.
- threshold
  Relay switches as soon as a set limit value (see function 017 and 018) is exceeded or
  not reached.
- service interval
  Relay switches when the value set in the service interval (024) function is reached.
- counter pulses
  Relay switches at the pulse value set in function 015 and at the counter pulse length set
  in function 016.
- reset pulse
  Relay switches at the reset pulse length set in function 019 before a new measurement

(for example, to reset an external counter).
- band return
  Relay switches during reversal in direction of tape from tape run-down to tape run-up.
- running up
  Relay switches when the sensing weight runs up.
- top position
  Relay switches as soon as the upper end position of the sensing weight (end of measurement) is reached.
- measuring
  Relay switches during the entire measuring cycle.
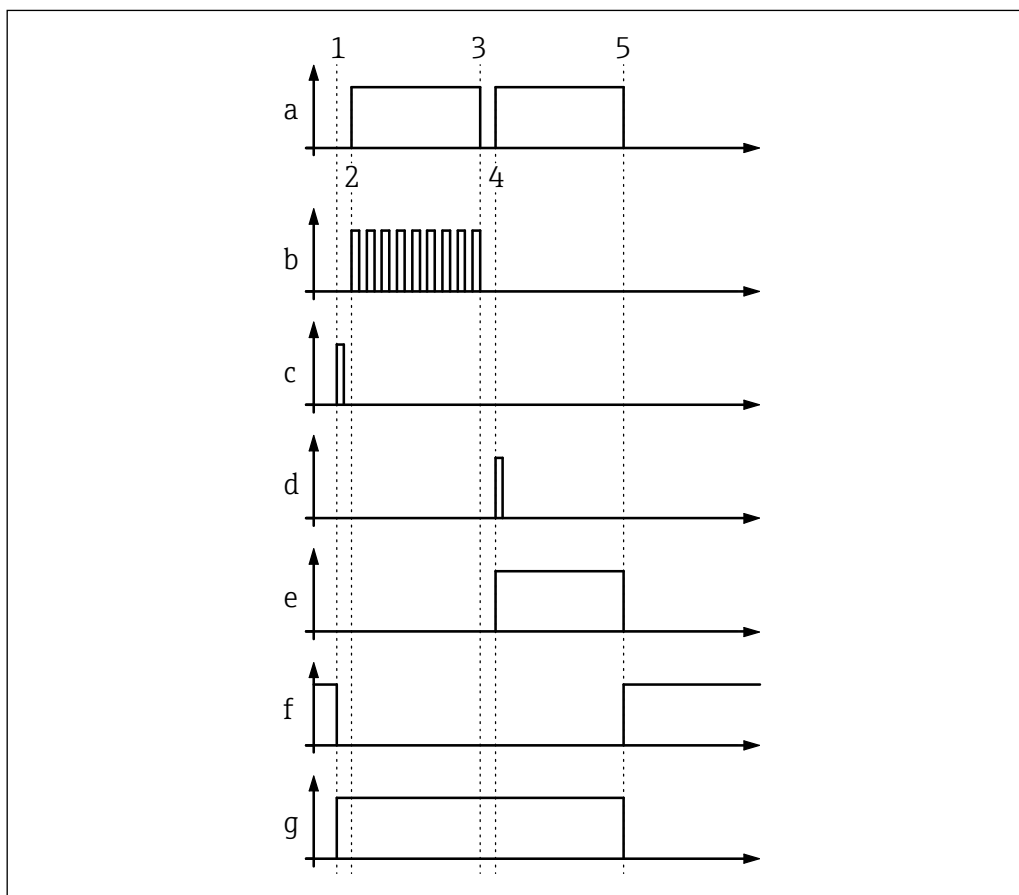
26   Programmable relay output functions

Measurement cycle (a)

1. A measurement starts (time-controlled or event-controlled)
2. The sensing weight is lowered
3. The surface of the medium is detected (measured value generation)
4. The sensing weight is raised
5. The measurement ends

Programmable relay output functions

Relay output function	Meaning
Counter pulses (b)	Output pulses that correspond to the length of unwound tape
Reset pulse (c)	Pulse before every new measurement
Band return (d)	Displays the lower reversal in direction of the tape (from tape run-down to tape run-up)
Running up (e)	Displayed when the tape runs back up
Top position (f)	Indicated when the upper end position is reached (end of measurement)
Measuring (g)	Indicates an active measuring cycle, for example to lock a filling system to protect the sensing weight from being buried

Relay output function	Meaning
Alarm	Relay switches in a fault condition
Threshold	Relay switches when a set threshold is exceeded or not reached
Service interval	Relay switches when the set number of measuring cycles is reached

> - The rest position corresponds to the state of the relays with the power supply switched off, this corresponds to an active alarm if the "alarm" function is selected.
> - A selected limit value (function 017) with an associated hysteresis (function 018) applies for all relays where the "threshold" function has been selected. It is not possible to set individual values for the threshold and hysteresis for each relay.

8.4.4.2 Relay output 2 to 6

The functionalities of the outputs correspond to those of the relay for output 1 (see function 014). Outputs 3 (01C) to output 6 (01E) are only optionally available (see order code).
Default:
- Relay output 2 (01A): Service interval
- Relay output 3 (01B): Measuring
- Relay output 4 (01C): Threshold
- Relay output 5 (01D): Reset pulse
- Relay output 6 (01E): Band return

8.4.4.3 Pulse weight

Input run-down distance (set value x 5 cm) per pulse at the counter pulse output in **pulse weight 015** function:

```
pulse weight      015
        10
length per pulse
output = value * 5cm
```

Range of values: 1 to 20 (5 to 100 cm or converted value in feet/inches)
Default: 1

Example pulse weight = 4:
Every 0.2 m run-down distance, the preset counting pulse output, for example relay 1, outputs a counting pulse (input pulse length in "pulse length (016)" function).
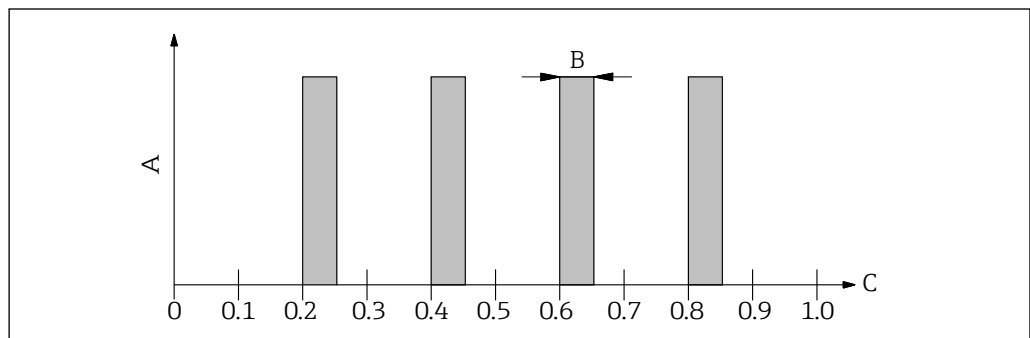
27   Pulse weight

A   Counter pulse
B   Pulse length
C   Move distance of measuring tape

8.4.4.4 Pulse length

Input counter pulse length (value range dependent on pulse weight in function 015) in **pulse length 016** function:

```
pulse length      016
         50 ms
length of the
counter pulse
```

Range of values:
- 30 to 100 ms (pulse weight = 1)
- 30 to 250 ms (pulse weight = 2)
- 30 to 400 ms (pulse weight = 3)
- 30 to 550 ms (pulse weight = 4 to 20)

Default: 50 ms

8.4.4.5 Threshold

Input limit value of relay outputs with selected relay output function 014 = "limit value" in percent of the measuring range (level) in **limit value 017** function:

```
limit value       017
      60.00 %
relative to the
full scale (003)
```

Range of values: 0 to 100 %
Default: 60 %
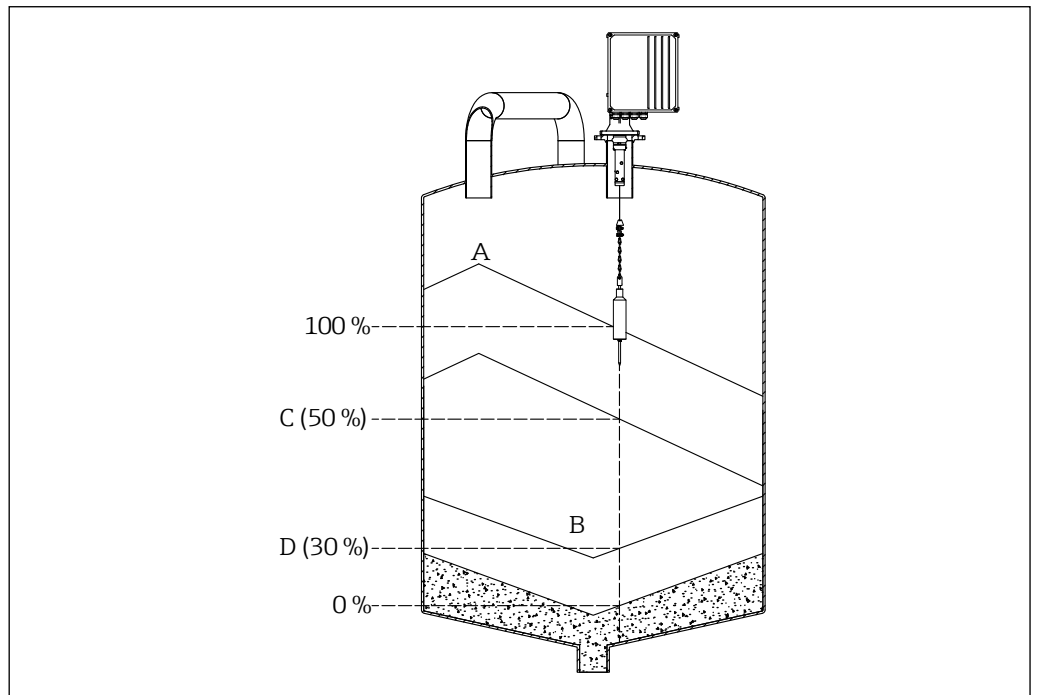
🖼28   Limit value and hysteresis behaviour

A   Product cone
B   Slope
C   Threshold (017) = 50 % reached, relay is enegized
D   Hysteresis (018) = 30 % undercut, relay drops out

8.4.4.6 Hysteresis

Input hysteresis of relay outputs with selected relay output function 014 = "limit value" (related to falling below the limit value in function 017) in percent of the measuring range in **hysteresis 018** function:

```
hysteresis       018
      60.00 %
relative to the
full scale (003)
```

Range of values: 0 to 100 %
Default: 3 %

8.4.4.7 Reset pulse

Input length reset pulse with selected relay output function 014 "reset pulse" in milliseconds in **reset pulse 019** function:

```
reset pulse      019
       300 ms
length of the
reset pulse
```

Range of values: 30 to 1000 ms
Default: 300 ms

8.4.5 Inputs

8.4.5.1 Input 1

Selection behavior of input 1 in **input 1 010** function:

```
input 1          010
✔not used
 bolting
 start measurement
```

Selection:
- **not used**
- bolting
  If there is a signal at input 1 (see also function 011), the measuring device is blocked for further measurements. If necessary, the sensing weight is moved into the upper end position, and the measurement is cancelled immediately.
- start measurement
  If there is a signal at input 1, the measuring device starts a new measurement.

> In the device version with an external start button, this button is connected to input 1. The function is then set to "start measurement" at the factory.

8.4.5.2 Polarity input 1

Selection polarity input 1 for selected "bolting" or "start measurement" (function 010) in **polarity input 1** function:

```
polarity input 1  011
✔NO contact
 NC contact
```

Selection:
- **NO contact**
  The input function becomes active if the input contact is closed (passive input) or voltage is applied (active input).
- NC contact
  The input function becomes active if the input contact is opened (passive input) or the voltage level drops (active input).

8.4.5.3   Input 2 (012)

For selection options see input 1 (010)
Default: not used

8.4.5.4   Polarity input 2 (013)

For selection options see contact input 1 (011)
Default: NO contact

8.5   Advanced settings

8.5.1   Device tag

Input maximum 16-digit alphanumeric measuring point designation in **tag no. 080** function:

```
tag no.          080
  Ratingen Silo 1
```

Default: ----------------

8.5.2   Distance unit

Length unit selection (basis for all display and input values, with the exception of the customer unit (CU), if this has been selected) in **distance unit 083** function:

```
distance unit    083
✓m
 ft
 in
```

Selection:
- **m** (Meter)
- ft (Feet)
- in (Inch)

8.5.3   Linearization

8.5.3.1   Level/volume

Selection of measured value display (000) in **level/volume 050** function:

```
level/volume     050
✓level CU
 level DU
 ullage CU
```

Selection:
- **level CU**
  Display the level in customer units. The unit can be selected in the customer unit function (056), and the full-scale value can be set in the maximum scale function (057). Measured value linearization is possible.
- level DU
  Display the level in the selected distance unit (function 083).
- ullage CU
  Display the ullage in customized units. The unit can be selected in the customer unit function (056), and the full-scale value can be set in the maximum scale function (057). Measured value linearization is possible.
- ullage DU
  Display the residual distance in the distance unit selected (function 083).

The reference point for residual distance and/or residual volume is the "full calibration (003)".

Example of volume measurement (no linearization)
- Full calibration (003) = 20 m
- Silo volume (in selected measuring range) = 500 m^3
- Current level = 4 m

Measurement of current volume
Level/volume (050) = level CU
Linearization (051) = linear
Customer unit (056) = m^3
Maximum scale (057) = 500
→ Measured value (000) = 100 m^3

Measurement of residual volume
Level/volume (050) = ullage CU
Linearization (051) = linear
Customer unit (056) = m^3
Maximum scale (057) = 500
→ Measured value (000) = 400 m^3

8.5.3.2 Linearization

Activation linearization (relationship between the fill level and the container volume and/or product weight and permits a measurement in customer units (CU)) in **linearization 051** function:

```
linearization    051
✓linear
 table on
 clear table
```

Selection:
- **linear**
  The relationship between the fill level and the container volume is linear.
- **table on**
  Activates a previously entered linearization table.
- **clear table**
  Deletes an existing linearization table
- **manually**
  Enter a linearization table

Manual linearization
If the fill level is not proportional to the volume and/or weight within the set measurement range (full calibration (003)), a linearization table can be entered. The following preconditions apply:
- The maximum 32 pairs of values for fill level/volume and/or fill level/weight are known (e.g. gauging capacity by liters).
- The fill level values must be entered in ascending order (curve rises monotonically).
- The fill heights for the first and last points of the linearization curve should correspond to the empty and full calibration.
- Linearization is performed in the basic setup unit (distance unit (083)).
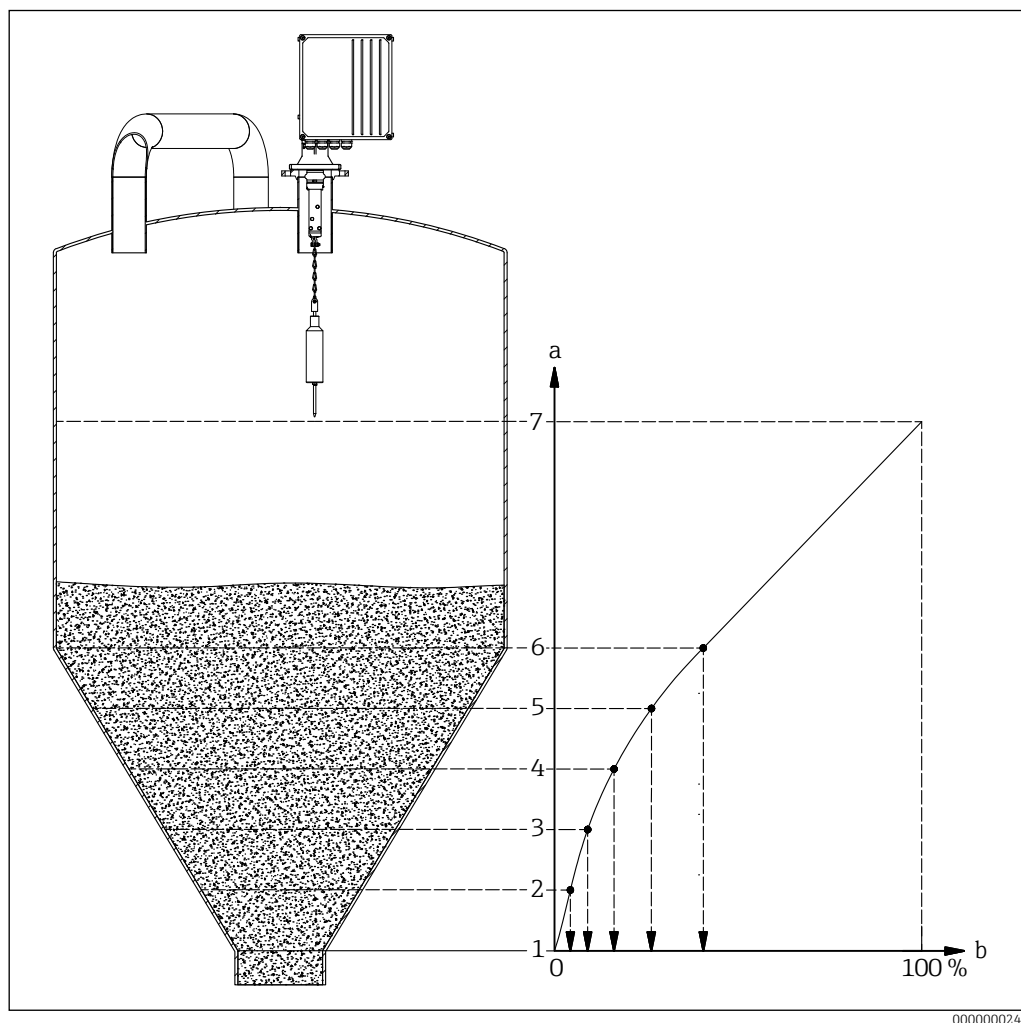
🖾 *29   Manual linearization*

a   Level marks
b   Volume

ℹ️ • Before entering a linearization table, any tables still present from before must be deleted (linearization (051) = "delete table").
• Once a linearization table has been entered, it must be activated (linearization (031) = "table on").
• Once a linearization table has been entered, it can be deactivated by selecting "linear". This does not delete the table and it can be reactivated at any time by selecting "table on".

Entering a linearization table

1. Select manual linearization (= enter a linearization table)

```
linearization    051
✓manually
 linear
 table on
```

2. Select table point 1 (start with 1, maximum 32 points)

```
linearization    052
TabNr→        1
level    0.000m
volum    0.000%
```

3. Enter the level pertaining to point 1

```
linearization    053
TabNr         1
level→  0.000m
volum   0.000%
```

4. Enter the associated volume (weight)

```
linearization    054
TabNr         1
level   0.000m
volum→  0.000%
```

5. Should another point be entered in the table?

```
next point       055
✓yes
 no
```

6. Select table point 2

```
linearization    052
TabNr→        2
level   0.000m
volum   0.000%
```

Continue either until 32 table points have been selected or until manual entry of the linearization table is completed by selecting "next point = no". Once the linearization table has been activated via "table on", linearization is activated.

ℹ If the customer unit (function 056) and/or maximum scale (function 057) is changed, the linearization table has to be re-entered and/or also adjusted!

8.5.3.3   Customer unit

Selection customer unit in function **customer unit 056**:

```
customer unit    056
✓%
 kg
 t
```

Selection:
- **%** (Percentage)
- Weight: kg, t
- Volume: m^3, ft^3
- Length: m, ft, in

8.5.3.4   Maximum scale

Input upper-range value (in the selected unit and the selected decimal places) in **max. scale 057** function:

```
max.scale        057
      100 %
```

Range of values: 1 to 100000
Default: 100

8.5.4 Safety settings

8.5.4.1 Output on alarm

Selection behavior current output in case of error in **output on alarm 040** function:

```
output on alarm    040
✓MIN (0/3.6mA)
 MAX (22mA)
 hold
```

Selection:
- **MIN (0/3.6mA)**
  Current drops to 0 mA or to 3.6 mA (depending on function 033) in case of error.
- MAX (22mA)
  Current increases to 22 mA in case of error.
- hold
  In the event of an error, the last output current is retained.
- user-specific
  In the event of an error, the current set in function 041 is output.
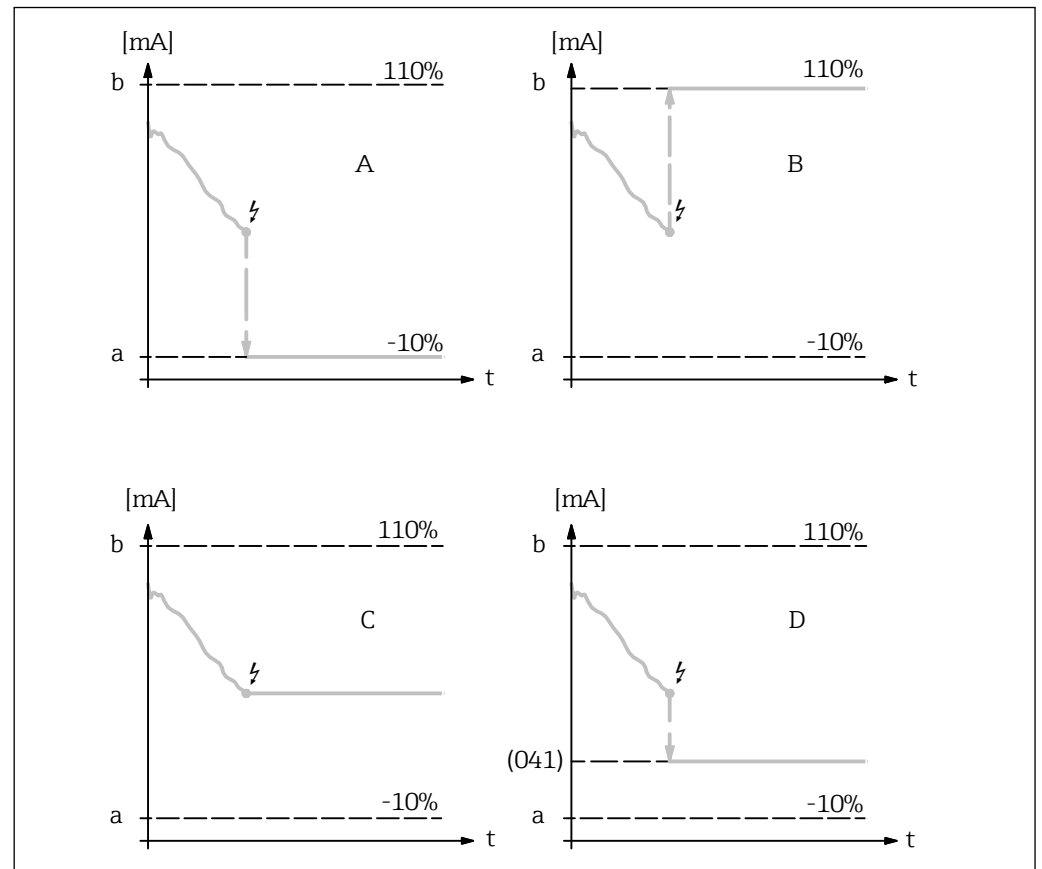
⊡ 30   Behaviour of the current output in the event of an error

a   3.6 mA
b   22 mA
A   MIN (0/3.6mA)
B   MAX (22mA)
C   Hold
D   User-specific

8.5.4.2 Output on alarm

Input user-specific current value in case of error (see function 040) in **output on alarm 041** function:

```
output on alarm   041
        3.60 mA
```

Range of values: 0 to 22.00 mA
Default: 3.60 mA

8.5.4.3 Safety distance

Input minimum distance to parameterized zero point in **safety distance 042** function:

```
safety distance  042
        0.00 m
minimum distance
to empty calibration
```

Range of values: **0 m** ... (full calibration - safety distance) (or converted value in feet/inches)

ℹ️ This function prevents the measuring tape from being lowered into an unauthorized area of the silo or bunker, such as an outlet worm.

8.5.4.4 Security distance

Input security distance before block distance in **security distance 043** function:

```
security dist.    043
        0.00 m
minimum distance
to full calibration
```

Range of values: **0 m** ... (full calibration - safety distance) (or converted value in feet/inches)

ℹ️ This zone is used as a warning that if the fill level continues to rise, future measurements might be invalid since the block distance (and therefore also the minimum run-down length of the FMM) might be undershot.

8.5.4.5 In security distance

Selection of alarm behavior when security distance is reached (if a value greater than zero was entered in function 043 "security distance") in **in security distance 044** function:

```
in securit.dist.  044
✓warning
 alarm
```

Selection:
- **warning**
- alarm

8.5.4.6 In safety distance

Selection of alarm behavior when safety distance is reached (if a value greater than zero was entered in function 042 "safety distance") in **in safety distance 045** function:

```
in safety dist.   045
✓warning
 alarm
```

Selection:
- warning
- **alarm**

Device response when the safety distance is reached

1. In safety distance = warning
- The sensing weight stops when the safety distance is reached.
- The current measurement (level = full calibration (002) – safety distance (042)) ends with a valid measured value.
- The current value that corresponds to the measured value is output at the current output.
- Warning W661 is shown on the display (error symbol flashes).

2. In safety distance = **alarm**
- The sensing weight stops when the safety distance is reached.
- The current measurement is rejected (the last valid measured value is displayed).
- The current value at the current output adopts the value selected in the "output on alarm" (041).
- Error A660 is shown on the display (error symbol is permanently lit).
- The relay with the selected "alarm" function switches.

8.5.5 Service interval

8.5.5.1 Service interval

Input number of measuring cycles until next service (among others tape change) in **service interval 024** function:

```
service interval 024
        45000
num. of measurements
til tape change
```

Range of values: 1 to 90000
Default: 45000 (measuring tape made of stainless steel) / 10000 (measuring tape made of plastic)

> - If the set value is reached, the FMM issues a warning.
> - The relay output with the "service interval" function switches.
> - Resetting the warning or the switched relay output in "service interval counter 025" function
> - The number of measurements of the FMM until the next service depends on the process environment, the value must be adjusted depending on the degree of contamination and/or condition of the measuring tape.

8.5.5.2 Service interval counter

Display current service interval counter and reset counter in **service interval counter 025**:

```
serv.int.counter 025
        5678
```

Range of values: 0 to 90000

> To reset a service message, the maintenance interval counter must be set to 0. After the number of measurements entered in the "service interval 024" function, a warning appears again.

8.6   Simulation

The simulation makes it possible to simulate different process variables in the process and the alarm behavior of the device without real level measurements, as well as to check downstream signal chains (for example, the switching of a discharge screw).

8.6.1   Simulation

Selection of measured value simulation in **simulation 026** function:

```
simulation        026
✓sim.off
 sim.level
 sim.volume
```

Selection:
- **sim. off**
  Simulation is switched off.
- sim. level
  A fill level can be specified in function 027. In such cases, the range of values is based on the maximum scale value entered in function 057. The value entered is shown on the measured value display. The functions of the relay outputs (e.g. the limit value) and the current output follow the simulation value.
- sim. volume
  A volume can be specified in function 027. In such cases, the range of values is based on the maximum scale value entered in function 057. The value entered is shown on the measured value display. The functions of the relay outputs (e.g. the limit value) and the current output follow the simulation value.
- sim. current
  A current value can be specified in function 027. The measured value display continues to show the last measured value. The functions of the relay outputs (e.g. the limit value) do not follow the simulation value.

> - During simulation, the measured value display (function 000) shows the alarm symbol.
> - When in simulation mode, normal measuring with the FMM is not possible.
>   - If the device was in manual mode before simulation was activated, the sensing weight remains in its current position.
>   - If the FMM was in measuring mode before simulation was activated, this mode remains active. The last measured value is saved internally and is shown on the measured value display when the simulation is over.
>   - If the FMM was in single cycle mode before simulation was activated, this mode is no longer active. The inputs and the "man.start" button are deactivated. A measurement which has already been started is ended as usual, the measured value is saved internally and is shown on the measured value display when the simulation is over.

8.6.2   Simulation value

Input value of simulation type selected in function 026 in **simulation value 027** function:

```
sim.value         027
     10.00 mA
```

Range of values: 0 to 99 m (Level)
                 0 to 22.00 mA (Current)
                 0 to 100000 (Volume)

Example of fill level simulation
Device settings:
- Empty calibration (001) = 50 m
- Full calibration (003) = 45 m
- Relay output 1 (014) = threshold
- Threshold (017) = 50 %
- Hysteresis (018) = 10 %
- Level/volume (050) = level CU
- Linearization (051) = linear
- Customer unit (056) = m^3
- Maximum scale (057) = 10000

1. Simulation (026) = sim. level
   Simulation value (027) = 8000
- ▶ Measured value (000) = 8000 m^3
- ▶ Current output = 16.8 mA
- ▶ Relay 1 is energized.

2. Simulation (026) = sim. level
   Simulation value (027) = 2000
- ▶ Measured value (000) = 2000 m^3
- ▶ Current output = 7.2 mA
- ▶ Relay 1 is de-energized.

8.6.3 Protecting settings from unauthorized access

To protect the configuration of the FMM against unintentional modifications after commissioning, the following options are available:
- Write protection via access code
- Write protection via keypad lock → 🗐28

Input unlock parameter to lock parameter input in **unlock parameter 074** function:

```
unlock parameter 074
        100
for lock code
see manual
```

Range of values:
- 100
  Parameter input unlocked
- <>100
  Parameter input locked

9 Operation

9.1 Set operating language

Operating languages supported by the FMM → 🗐29

9.2 Configure display

- Basic settings for the local display → 🗐49
- Local display test → 🗐36

9.3 Reading measured values

- Measured value (000) → 🗐36
- Distance/measured value (004) → 🗐32

9.4 Adapt measured values to process conditions

All the functions from chapter "Commissioning" are available for this purpose.

9.5 Manual

The "manual" mode (see measurement type 020 function) gives the user the possibility to move the sensing weight slowly (for example for a tape change).

In the manual mode, the measured value 000 function automatically shows the length of tape that has been lowered. The value displayed depends on the distance unit (m, ft, in) selected in function 083 and on the number of decimal places to be displayed as selected in function 062.

> - The sensing weight can only be moved manually in measured value 000 function.
> - The last valid measured value remains saved internally, it is not overwritten in manual mode. The outputs continue to follow this value (e.g. with a 50 % fill level, 12 mA is still output at the current output).
> - After the manual mode has been finished, the measured value display is automatically switched back to the originally selected display (for example level in customer units).

NOTICE

In the manual mode, the upper limit switch and the tape switch have no function! Users must themselves check in which position the sensing weight is currently located. With this type of measurement, the sensing weight can (depending on the maximum tape length) be lowered into unauthorized areas of the container (or into an outlet worm for example). Due to the high tensile forces of the measuring device, the measuring tape may tear or be pulled out of the sensing weight attachment in this mode of operation.

9.6 LED

The green LED positioned to the right of the LC display is used to display the pulses of the counting wheel during a measurement process. The counting wheel sends a pulse to the evaluation electronics every 5 cm of tape length. The status of the LED changes at the same time. Once the measurement process is complete, the last LED status is retained.
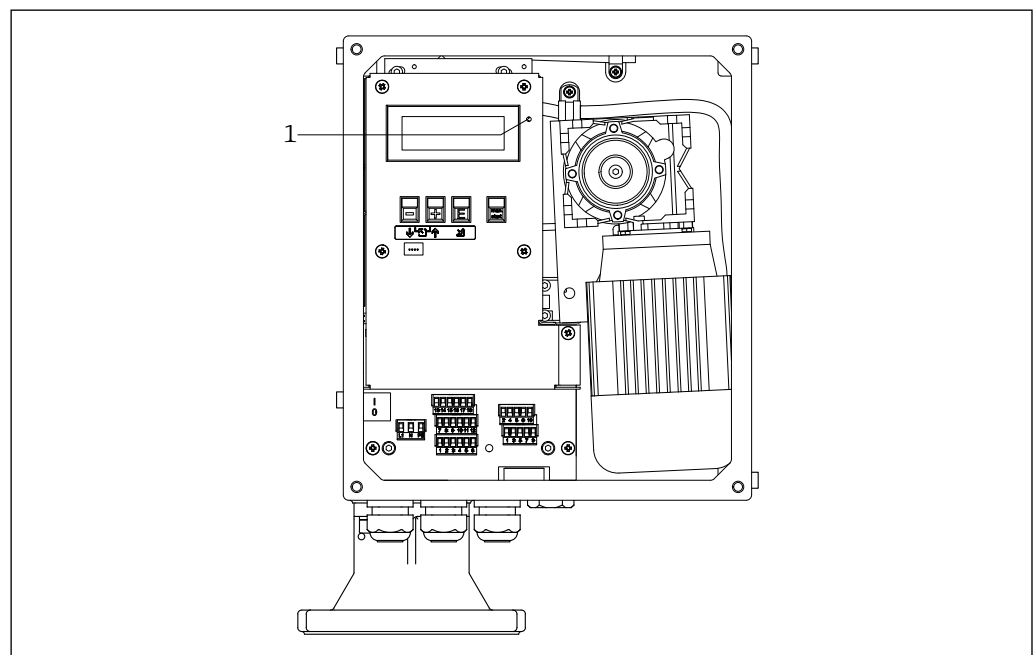
0000000220

🖼31   LED

1   LED for counting wheel pulses

10   Diagnostics and troubleshooting

10.1   General troubleshooting

Troubleshooting the local display

Error	Possible cause	Remedy
Local display dark and no output signals	No contact between connecting cables and terminals	Check the connection of the cables and correct if necessary
	Electronics are defective	Repair the FMM → 🖹69
Local display is dark, but signal output is within the valid range	Display is set too bright or too dark	Adjust the contrast setting → 🖹26
	Display module is defective	Repair the FMM
Text on local display appears in a foreign language and cannot be understood.	Incorrect operating language is configured	Change the operating language → 🖹29

Troubleshooting the output signals

Error	Possible cause	Remedy
Signal output outside the valid range	Electronics are defective	Repair the FMM → 🖹69
Device shows correct value on local display, but signal output is incorrect, though in the valid range	Parametrization errors	Check and correct parameterization
Device measures incorrectly	Parametrization errors	Check and correct parameterization
	Device is being operated outside the range of application	Observe limit values

Troubleshooting access problems

Error	Possible cause	Remedy
Not possible to write to parameters, access code = 100	Hardware locking enabled	Disable locking
Not possible to write to parameters, access code 100	Software locking enabled	

10.2   Diagnostic functions on the local display

10.2.1   Diagnostic messages

Faults detected by the self-monitoring system of the FMM are displayed as a diagnostic message in alternation with the measured value 000 function.
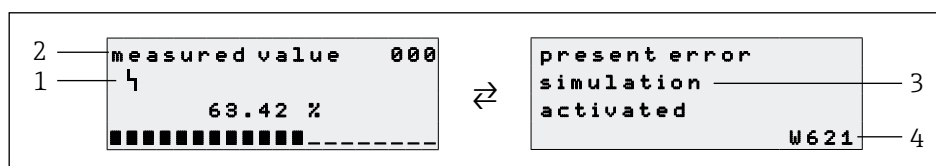
🖼32   *Diagnostic messages*

1   Alarm symbol
2   Measured value (Function 000)
3   Help text pertaining to the current error
4   Error code

If two or more diagnostic events (alarm or warning) are pending simultaneously, only the diagnostic message of the diagnostic event with the highest priority (= lowest number) is shown.

10.2.2   Present error

Display present error with error code and letter "W" for warning or "A" for alarm in **present error 070** function:

```
present error    070
simulation
activated
            W621
```

If there is a warning, it will only be displayed. In the case of an alarm, this is also output via the "alarm" relay output, provided that this has been selected.

10.2.3   Previous error

Display previous error with error code and letter "W" for warning or "A" for alarm in **previous error 071** function:

```
previous error   071
minimum run down
length underflow
            A440
```

10.2.4   Resetting errors

Delete the displayed errors in **clear error 072** function:

```
clear errors     072
✓keep
 erase previous
 erase present
```

Selection
- **keep**
  Errors are not deleted.
- erase previous
  The last error is deleted.
- erase present
  The current error is deleted.
- erase all
  The current (070) and previous (071) errors are deleted.

10.3   Overview of the diagnostic functions

Error code	Diagnostic messages	Remedy
A100	Checksum error in internal program memory	1. Reset hardware 2. Avoid EMC problems 3. If the alarm is still present after a reset, contact service and/or replace the electronics
A101	Check sum error in EEPROM 1	
A102	Check sum error in EEPROM 2	
A103	Initialization failed	
A106	Program download error	Only for service technicians: Repeat download and/or restart
W110	Default service parameters loaded	1. Warning that a reset has been performed 2. Disappears automatically the next time an entry is made
W111	Default user parameters loaded	
W112	Default input/output configuration loaded	
W113	Default table for linearization loaded	

Error code	Diagnostic messages	Remedy
A120	Error when loading the service parameters	1. Reset hardware 2. Avoid EMC problems 3. If the alarm is still present after a reset, contact service and/or replace the electronics
A121	Error when loading the user parameters	
A122	Error when loading the input / output configuration	
A123	Error when loading the last measured values	
A124	Error when loading the linearization table	1. Check linearization table 2. Enter the linearization table again if necessary
A125	Error when loading the display texts	1. Reset hardware 2. Avoid EMC problems 3. If the alarm is still present after a reset, contact service and/or replace the electronics
A130	Process of saving the service parameters has failed	
A131	Process of saving the user parameters has failed	
A132	Process of saving the input/output configuration has failed	
A133	Process of saving the measured values has failed	
A134	Process of saving the linearization has failed	
A200	Interface to motor controller defective	1. Reset hardware 2. Avoid EMC problems 3. If the alarm is still present after a reset, contact service and/or replace the electronics
A201	Initialization of the motor controller failed	
A202	Fatal motor error	

ℹ The fatal motor error A202 comprises multiple errors in the motor drive system and indicates critical damage to the electronics and/or motor.

Error code	Diagnostic messages	Remedy

A203	Temperature switch inside motor is triggered	1. Reset hardware
		2. Avoid excessive heating of the measuring device:
		  - Observe the minimum time for a measuring cycle → 🖹83
		  - Observe the maximum ambient temperature
		  - Observe the maximum weight of the sensing weight
		3. If the alarm is still present after a reset, contact service and/or replace the motor

A205	Motor current consumption is too high	
A204	Line voltage is too low	1. Reset hardware 2. Check the supply voltage 3. After replacing the electronics: Use the right spare part 4. If the alarm is still present after a reset, contact service
A207	Line voltage is too high	

ℹ • The limits of the permitted supply voltage are dictated by the order code.
• This error message appears when using an electronics system for the 180 to 253 V AC voltage range and a local supply voltage in the 90 to 127 V AC range.
• Only use suitable spare parts.

Error code	Diagnostic messages	Remedy
A206	Motor driver defective	1. Reset hardware 2. If the alarm is still present after a reset, contact service and/or replace the electronics
A220	Temperature in the device is too high	1. Check the ambient temperature 2. Check the measurement cycle time → 📖83
A330	Maximum time for a measurement exceeded	1. Check the wiper → 📖58 The wiper must move to the upper end position for a measurement to finish. 2. If the alarm persists after several measurements, contact service

- • When a measurement starts, an internal counter is started. If the measurement is not completed within approximately 10 minutes, this error message appears.
  - • If the wiper does not reach the top position, no pulses are received from the counting wheel. A450 is then the last error code in function 071.

Error code	Diagnostic messages	Remedy
A340	Sensing weight/tape is torn	1. Check the sensing weight and measuring tape: Replace sensing weight and/or measuring tape if necessary 2. Motor is in contact with the tape switch for an extended period when the tape is run up: Check installation (maximum angle of inclination 2°)

The error message appears if the motor is in contact with the tape switch for approx. 100 ms.

Error code	Diagnostic messages	Remedy
A350	Sensing weight is buried	1. Free the sensing weight by hand 2. If the sensing weight is not buried: Check the current consumption of the motor
A430	Tape switch expected	Contact service and/or replace tape switch
A431	Limit switch expected	Contact service
A440	Minimum run-down distance not reached	1. Check the installation position 2. Observe minimum sensing weight run-down distance of 20 cm. 3. Sensing weight present?
A450	Time for counting wheel pulses exceeded	1. Check the counting wheel 2. Reset hardware 3. If the alarm persists after several measurements, contact service

This error message mostly appears in conjunction with error A330 if the upper end position is not reached.

Error code	Diagnostic messages	Remedy
A460	Slip on counting wheel	1. Check the counting wheel 2. Reset hardware 3. If the sensing weight is located near the level: Check the wiper to see whether it has left the measuring device 4. If the alarm persists after several measurements, contact service

> - The error message appears if the difference between the counting wheel pulses during run-up and run-down is too large.
> - If the wiper does not fully leave the measuring device, the sensing weight is understood to have arrived at the upper end position when the weight is raised and therefore this is interpreted as the end of the measurement procedure. This is what causes a maximum difference between the counting wheel pulses.

Error code	Diagnostic messages	Remedy
A470	The measurement could not be started	Check the device for damage or blocking parts
W611	Less than 2 points entered in linearization table	1. Check linearization table 2. Add missing linearization points if needed
W621	Simulation activated	Switch off simulation → 🖹48
A630	Maximum drain length exceeded	Check adjustment → 🖹30
A650 W651	Security distance not reached	1. Check the installation situation 2. Check parameterization
A660 W661	Safety distance not reached	
W681	Measurement range exceeded	

> - The error message appears if the measuring device detects a measured value above the full calibration (tape switch is triggered).
> - If this error message occurs regularly, the installation position should be inspected to ensure that no struts or internal fixtures are obstructing the lowering (run-down) of the sensing weight.

Error code	Diagnostic messages	Remedy
W690	Linearization incomplete or unusable	1. Check linearization table 2. Add missing linearization points if needed
W700	Tape must be changed	1. Check measuring tape, replace if necessary 2. Reset service interval counter

> If this error message appears regularly without there being a need to replace the tape, the service interval 024 can be increased. → 🖹47

10.4   Resettting the device

Reset to factory settings in **reset 073** function:

```
reset              073
          0
for reset code
see manual
```

Range of values:
- 333
  performs reset
- <>333
  does not perform a reset

ℹ️
- At least one basic setup must have been performed before the measuring device can be reset.
- Table for noting the set parameters in order to be able to restore the desired functions after a reset → 🗎85

10.5   Device information

The following functions contain information about the identification of the device.

10.5.1   Protocol and software version

Display of protocol and software version in **protocol+sw-no. 081** function:

```
protocol+sw-no.  081
V01.01.00
```

ℹ️ For information on repairing or ordering spare parts for firmware versions for special technical products (TSP), contact Endress+Hauser Service.

10.5.2   serial number

Display of the serial number in **serial number 082** function:

```
serial no.         082
        1001
```

10.6   Firmware history

Release date	Firmware version	Changes	Documentation
01.2020	01.06.12-X2	Software revised: Special version with measurement range of 110 m	BA00286F/97/de/14.17
01.2020	01.06.12-X1	Software revised: Czech language version	BA00286F/97/de/14.17
01.2020	01.06.12	Software revised: Correction of the "Short" operating mode when empty calibration is reached	BA00286F/97/de/14.17
03.2017	01.06.11	Software revised: Minor corrections to help text	BA00286F/97/de/14.17

Release date	Firmware version	Changes	Documentation
01.2015	01.06.10	Software revised: - Mapping error A460 in the "Short" operating mode - "Run-up length" function (028) added for the "Short" operating mode	BA00286F/97/de/14.17
05.2012	01.06.08	Software revised: Modification of moving sensing weight into upper end position	BA00286F/97/de/14.17
04.2011	01.06.07	Software revised: Minor changes to manual mode	BA286F/97/de/04.10
09.2009	01.06.06	Software revised: Minor changes to Japanese language version	BA286F/97/de/12.07
06.2009	01.06.05	Software revised: Minor changes to Japanese language version	BA286F/97/de/12.07
09.2007	01.06.04	Software revised: New serial numbers according to E+H Standard 223	BA286F/97/de/11.06
08.2007	01.06.03	Software upgrade: Extended functionality at the Service level	BA286F/97/de/11.06
03.2007	01.06.02	Software revised: Minor changes to "unlock parameter" function (074)	BA286F/97/de/11.06
02.2007	01.06.01	Software revised: Japanese help text in function 061 and 061 corrected	BA286F/97/de/01.07
12.2006	01.06.00	Software upgrade: "in safety distance" (045) function added	BA286F/97/de/11.06
03.2006	01.05.01	Software upgrade: Japanese language version with Japanese help	BA286F/97/de/07.05
12.2005	01.05.00	Software upgrade: French language version	BA286F/14/fr/07.05
11.2005	01.04.00	Software upgrade: Enhanced functionality	BA286F/97/de/07.05
10.2005	01.03.00	Software upgrade: Japanese language version with English help	BA286F/97/de/07.05
09.2005	01.02.02	Software upgrade: Enhanced functionality	BA286F/97/de/07.05
07.2005	01.02.01	Software upgrade: Enhanced functionality	BA286F/97/de/07.05
06.2005	01.02.00	Software upgrade: Output current range extended to 0-20 mA (033)	BA286F/97/de/04.05
12.2004	01.01.00	Original software	BA286F/97/de/12.04

11 Maintenance

The following maintenance work may be required depending on the level of fouling.

11.1 External cleaning

When cleaning the exterior of the measuring device, ensure that the cleaning agent used does not corrode the housing surface and seals.

11.2 Cleaning the spool compartment

The cleaning periods depend on the properties of the bulk solid. If a lot of dust has accumulated, we would recommend blowing in small amounts of clean compressed air via the mounting flange.

11.3 Wiper check

The two scraper blocks in the wiper are worn to a greater or lesser extent depending on the abrasive nature of the product and then no longer sufficiently clean the measuring tape.

With the wiper removed, check the following points:
- Check whether the measuring tape is cutting into the cone and bore of the end guide. If there are deep gashes, there is a risk of the measuring tape jamming. Replace the end guide if necessary.
- Are the two tape-wipe scrapers in good contact with the measuring tape? If worn, the tape-wipe scrapers must be replaced.
- Is the bellows still in perfect condition? If it is damaged, it must be replaced.
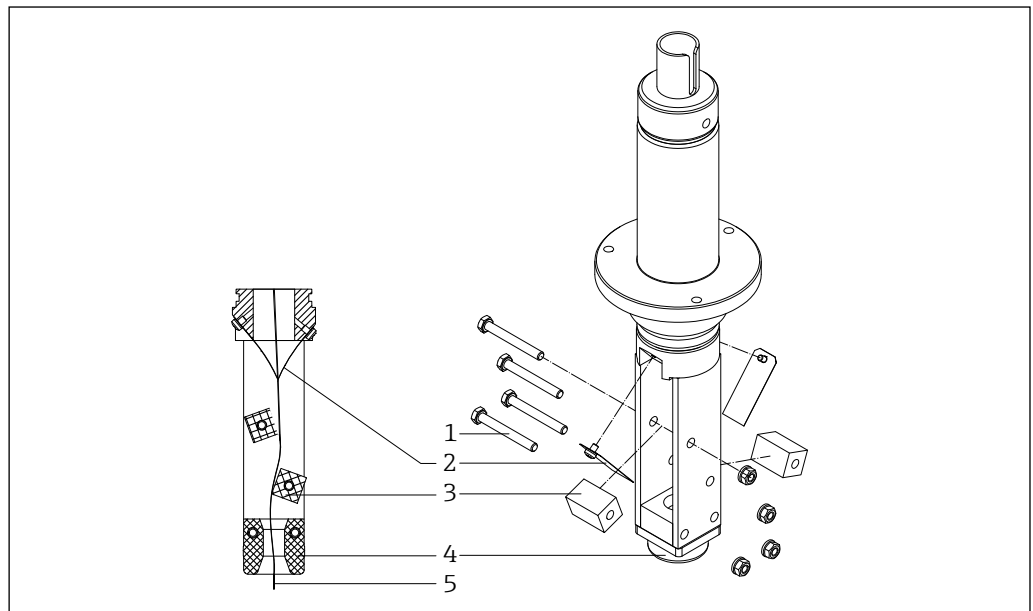
0000000234

⊡33   Wiper check

1   Screws M6x50
2   Tape-wipe scraper
2   Scraper block
3   End guide
4   Measuring tape

11.3.1 Measuring tape check

The greatest mechanical load is put on the measuring tape, therefore the tape should be checked as follows at regular intervals:

1. If the visible part (sensing weight in the upper limit position) of the measuring tape is damaged, unwind it a bit (type of measurement: "manual" 020) until it looks flawless and in perfect condition.

2. Cut off the damaged part and re-mount the sensing weight.

3. If the measuring tape is damaged over a longer distance, the entire measuring tape must be replaced.

> • Do not cut off too much, consider the original tape length and the measurement range required (container height).
> • Tape spools in standard lengths are available as accessories for easy changeover. → 🖹62

11.3.2 Spool compartment check

The spool compartment must be inspected at regular intervals:
- If the tape spool is severely attacked or damaged, it must be replaced.
- If the counting wheel is very difficult to turn when the measuring tape is unloaded or if it is damaged, it must be replaced.
- If the tape guide is badly damaged, it must be replaced.
- If the cover gasket is badly affected or damaged, it must be replaced.

11.4 Service

Endress+Hauser offers a wide variety of services for maintenance such as onsite inspection and maintenance or device tests.

> Contact your Endress+Hauser Sales Center for information on services and spare parts.

12 Repair

12.1 General notes

Repair and modification concept
The Endress+Hauser repair and modification concept provides for the following:
- The measuring devices have a modular design.
- Spare parts are grouped into logical kits and are accompanied by Installation Instructions.
- Repairs are carried out by Endress+Hauser Service or by appropriately trained customers.
- Certified devices can only be converted to a variant with different certification by the Endress+Hauser Service team or at the factory.

Notes concerning repair and modification
Observe the following when repairing or modifying a measuring device:
- Use original Endress+Hauser spare parts only.
- Carry out the repair according to the Installation Instructions.
- Observe the applicable standards, national regulations, Ex documentation (XA) and certificates.
- Document every repair and modification and enter the details in the W@M life cycle management database.

12.2   Spare parts

General notes:
- Please refer to the instruction leaflet supplied or these Operating Instructions for installation instructions.
- Each spare part is identified by an order number. When changing parts, please make sure that only a suitable spare part is installed.
- Other spare part numbers apply for special versions (TSP) of devices, please contact Endress+Hauser if you want to order a spare part for your special version.

⚠ WARNING
- If incorrect spare parts are installed in Ex-certified devices, the device is no longer compliant with Ex specifications and can no longer be operated in the hazardous area.
- If the wrong supply voltage is selected, this can destroy spare parts immediately.

12.2.1   Electronics side
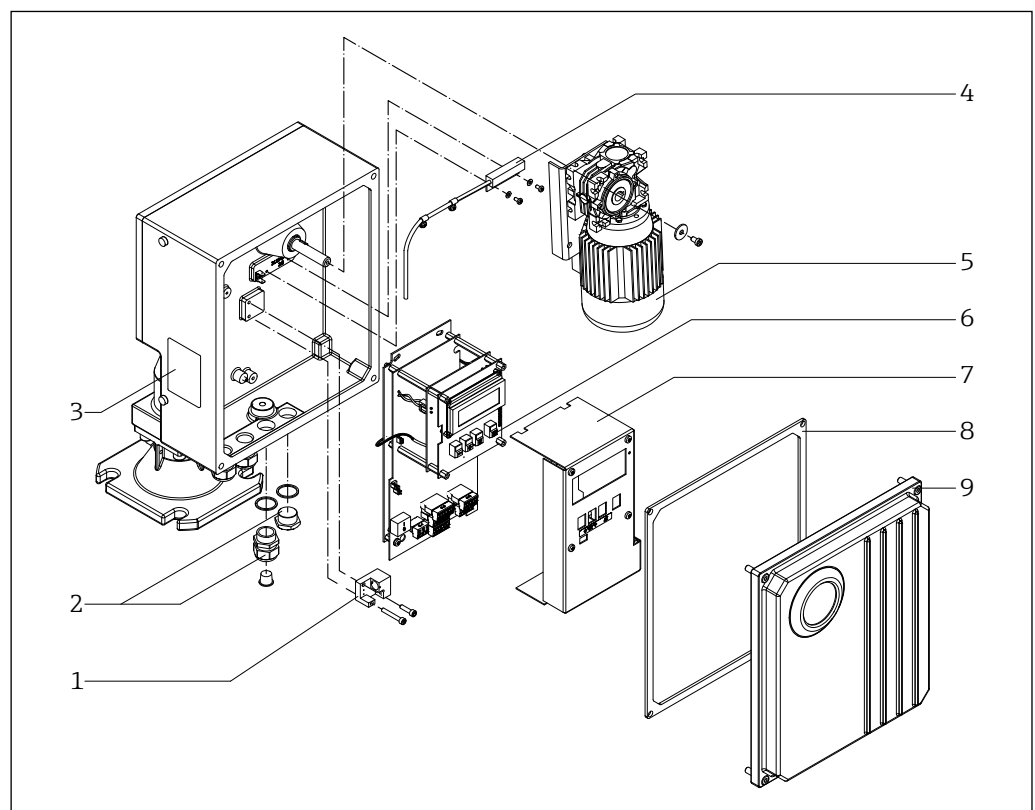
0000000217

🖼 *34   Spare parts electronics side*

1   Tape switch unit
   52028117   Tape switch unit, mounting material

2   Cable glands and/or external start button
   52028118   Cable gland, 4 parts, with Ex certification
   52028119   Cable gland, 4 parts, without Ex certification
   52028178   Operation key start measurement, external

3   Nameplate
   71296636   Replacement nameplate

ℹ When ordering, please specify the order code of the device which is to receive the replacement nameplate.

4   Device heater
   52028177   Device heater, 115/230 VAC

5   Motor/gearbox unit

71113428	Motor/gearbox unit incl. connection and potential matching line, 230 V AC, 500 N
71113432	Motor/gearbox unit like 71113428 + extended climate resistance
71113429	Motor/gearbox unit incl. connection and potential matching line, 230 V AC, 250 N
71113433	Motor/gearbox unit like 71113429 + extended climate resistance
71113430	Motor/gearbox unit incl. connection and potential matching line, 115 V AC, 500 N
71113434	Motor/gearbox unit like 71113430 + extended climate resistance
71113431	Motor/gearbox unit incl. connection and potential matching line, 115 V AC, 250 N
71113436	Motor/gearbox unit like 71113431 + extended climate resistance

6   Electronic unit, preassembled on mounting plate

52028120	230 V AC, 2 relay, not an Ex version, without heating connection
71001310	like 52028120 + extended climate resistance
52028121	230 V AC, 6 relay, not an Ex version, without heating connection
71001311	like 52028121 + extended climate resistance
52028122	230 V AC, 2 relay, Ex version, without heating connection
71001312	like 52028122 + extended climate resistance
52028123	230 V AC, 6 relay, Ex version, without heating connection
71001313	like 52028123 + extended climate resistance
52028124	115 V AC, 2 relay, not an Ex version, without heating connection
71001314	like 52028124 + extended climate resistance
52028125	115 V AC, 6 relay, not an Ex version, without heating connection
71001315	like 52028125 + extended climate resistance
52028126	115 V AC, 2 relay, Ex version, without heating connection
71001316	like 52028126 + extended climate resistance
52028127	115 V AC, 6 relay, Ex version, without heating connection
71001317	like 52028127 + extended climate resistance
52028128	230 V AC, 2 relay, not an Ex version, with heating connection
71301716	like 52028128 + extended climate resistance
52028129	230 V AC, 6 relay, not an Ex version, with heating connection
71301719	like 52028129 + extended climate resistance
52028130	230 V AC, 2 relay, Ex version, with heating connection
71301720	like 52028130 + extended climate resistance
52028131	230 V AC, 6 relay, Ex version, with heating connection
71301721	like 52028131 + extended climate resistance
52028132	115 V AC, 2 relay, not an Ex version, with heating connection
71301722	like 52028132 + extended climate resistance
52028133	115 V AC, 6 relay, not an Ex version, with heating connection
71301725	like 52028133 + extended climate resistance
52028134	115 V AC, 2 relay, Ex version, with heating connection
71301727	like 52028134 + extended climate resistance
52028135	115 V AC, 6 relay, Ex version, with heating connection
71301729	like 52028135 + extended climate resistance

7   Electronic cover

52028155	Cover, steel plate with inscription
71001329	Cover, steel plate with inscription + extended climate resistance

8   Cover seal for electronics compartment

52028104	Seal, non-Ex version
52028105	Seal, Ex version or climate version

9 Housing cover (incl. cover seal)

52028136	Housing cover, not coated, non-Ex version, no window
52028137	Housing cover, coated, non-Ex version, no window
52028138	Housing cover, not coated, Ex version, no window
71026889	like 52028138 + extended climate resistance
52028139	Housing cover, coated, Ex version, no window
52028140	Housing cover, not coated, non-Ex version, with window
52028141	Housing cover, coated, non-Ex version, with window
71026891	like 52028141 + extended climate resistance

12.2.2 Process side
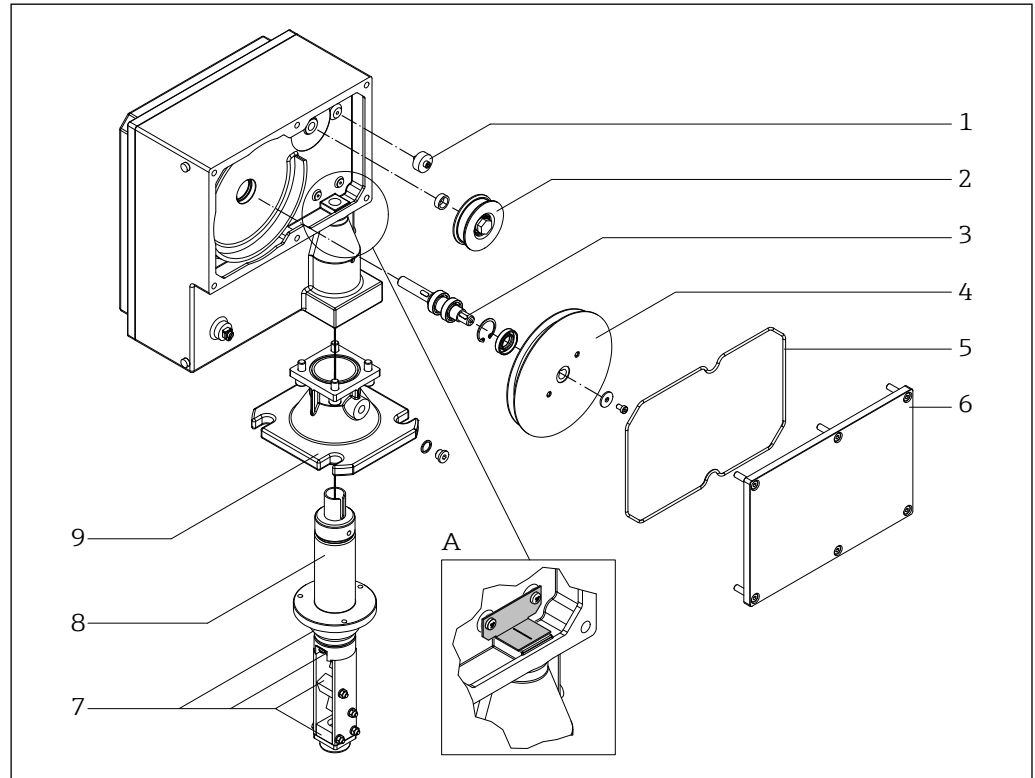
🖻 35   *Spare parts for the process side*

0000000242

1 Tape guide kit

52028115	Tape guide, guide plate, mounting material
71026887	like 52028115 + extended climate resistance

> For devices from year of construction 2016, the guide plate (**A**) is no longer mounted and is therefore no longer included in the tape guide kit.

2 Counting wheel

52028103	Counting wheel, complete

3 Drive shaft

52028102	Drive shaft incl. ball bearings, shaft seal and mounting material

4 Tape spool

52028111	Steel, stainless steel measuring tape, 25 m
71026882	316Ti, stainless steel measuring tape, 25 m (extended climate resistance)
52028112	Steel, stainless steel measuring tape, 35 m
71026884	316Ti, stainless steel measuring tape, 35 m (extended climate resistance)
52028113	Steel, stainless steel measuring tape, 50 m
71026885	316Ti, stainless steel measuring tape, 50 m (extended climate resistance)

52028114	Steel, stainless steel measuring tape, 70 m
71026886	316Ti, stainless steel measuring tape, 70 m (extended climate resistance)
71301749	Steel, stainless steel measuring tape, 90 m
71301750	316Ti, stainless steel measuring tape, 90 m (extended climate resistance)
71301745	Steel, plastic measuring tape, 15 m
71301748	316Ti, plastic measuring tape, 15 m (extended climate resistance)

5 Cover seal for spool compartment

| 52028116 | Seal |

6 Housing cover (incl. cover seal)

52028142	Housing cover, not coated
52028143	Housing cover, coated
71026894	like 52028143 + extended climate resistance
52028144	Housing cover, not coated, process pressure up to 3 bar
52028145	Housing cover, coated, process pressure up to 3 bar
71026897	like 52028145 + extended climate resistance

7 Wiper spare parts kit

| 52028080 | End guide, tape-wipe scrapers, scraper block, bellows, mounting material, process temperature of up to +70 ℃ (+158 ℉) |
| 52028081 | End guide, tape-wipe scrapers, scraper block, bellows, mounting material, process temperature of up to +150/230 ℃ (+302/446 ℉) |

8 Wiper

52028068	230 mm, aluminum/steel, process temperature of up to +70 ℃ (+158 ℉)
52028069	230 mm, stainless steel, process temperature of up to +70 ℃ (+158 ℉)
52028070	230 mm, aluminum/steel, process temperature of up to +150 ℃ (+302 ℉)
52028071	230 mm, stainless steel, process temperature of up to +150 ℃ (+302 ℉)
52028072	500 mm, aluminum/steel, process temperature of up to +70 ℃ (+158 ℉)
52028073	500 mm, stainless steel, process temperature of up to +70 ℃ (+158 ℉)
52028074	500 mm, aluminum/steel, process temperature of up to +150 ℃ (+302 ℉)
52028075	500 mm, stainless steel, process temperature of up to +150 ℃ (+302 ℉)
52028076	1000 mm, aluminum/steel, process temperature of up to +70 ℃ (+158 ℉)
52028077	1000 mm, stainless steel, process temperature of up to +70 ℃ (+158 ℉)
52028078	1000 mm, aluminum/steel, process temperature of up to +150 ℃ (+302 ℉)
52028079	1000 mm, stainless steel, process temperature of up to +150/230 ℃ (+302/446 ℉)

9 Process adapter

| 52028146 | Process adapter, not coated, incl. seal and mounting material |
| 52028147 | Process adapter, coated, incl. seal and mounting material |

12.2.3 Sensing weight
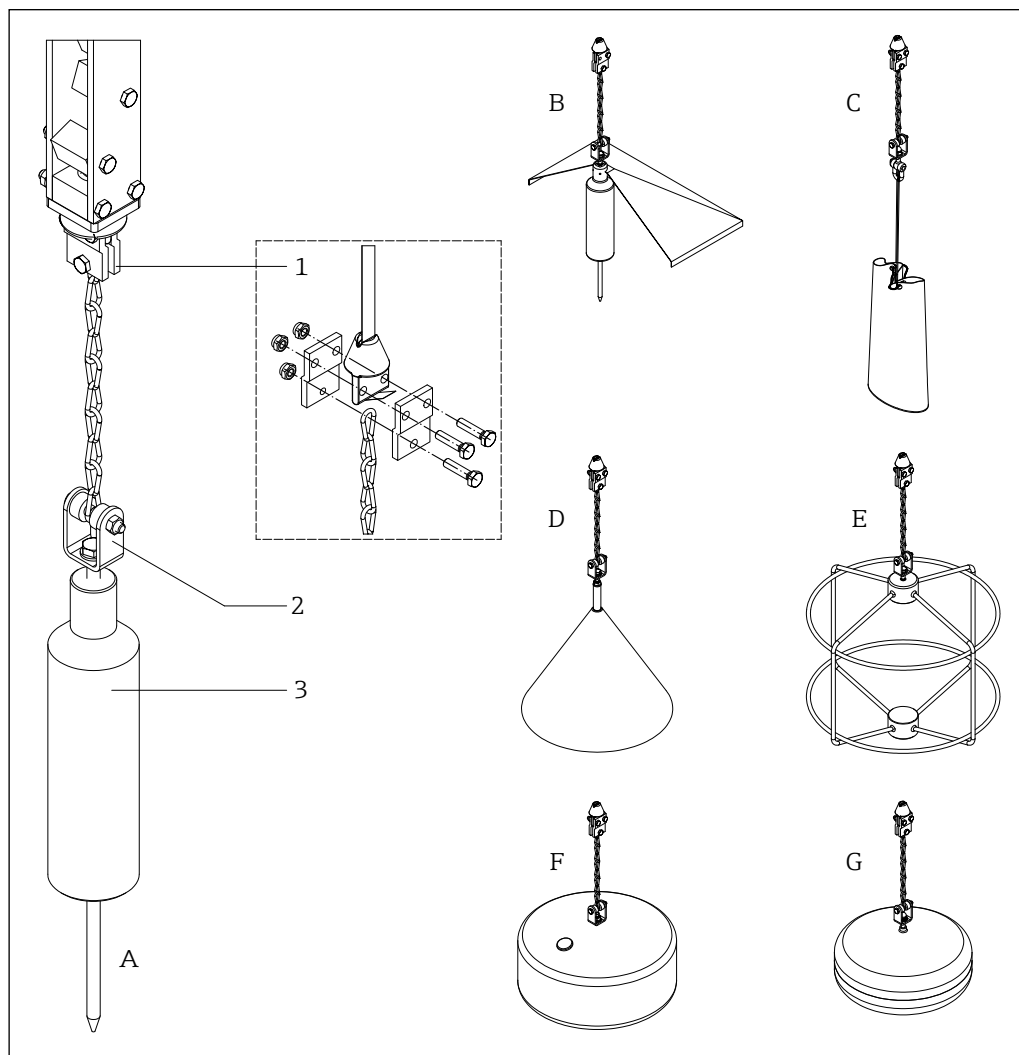
*36   Spare parts sensing weight

0000000229

1 Sensing weight mounting
52028088   Tape border, rotating bush, chain, mounting material, steel
52028089   Tape border, rotating bush, chain, mounting material, stainless steel

2 Rotating bush
52028100   Rotating bush, mounting material, steel
52028101   Rotating bush, mounting material, stainless steel

3 Sensing weight (incl. rotating bush)
52028090   Steel (A)
52028091   Stainless steel (A)
52028092   Steel + umbrella (B)
52028093   Stainless steel + umbrella (B)
52028094   Medium bag (C)
52028096   Stainless steel cage (E)
52028098   Stainless steel bell (D)
52028099   Float, PVC (F)
71301751   Float, 316Ti (G)

12.3   Replacing components

12.3.1   Replacing the tape spool

0000000236
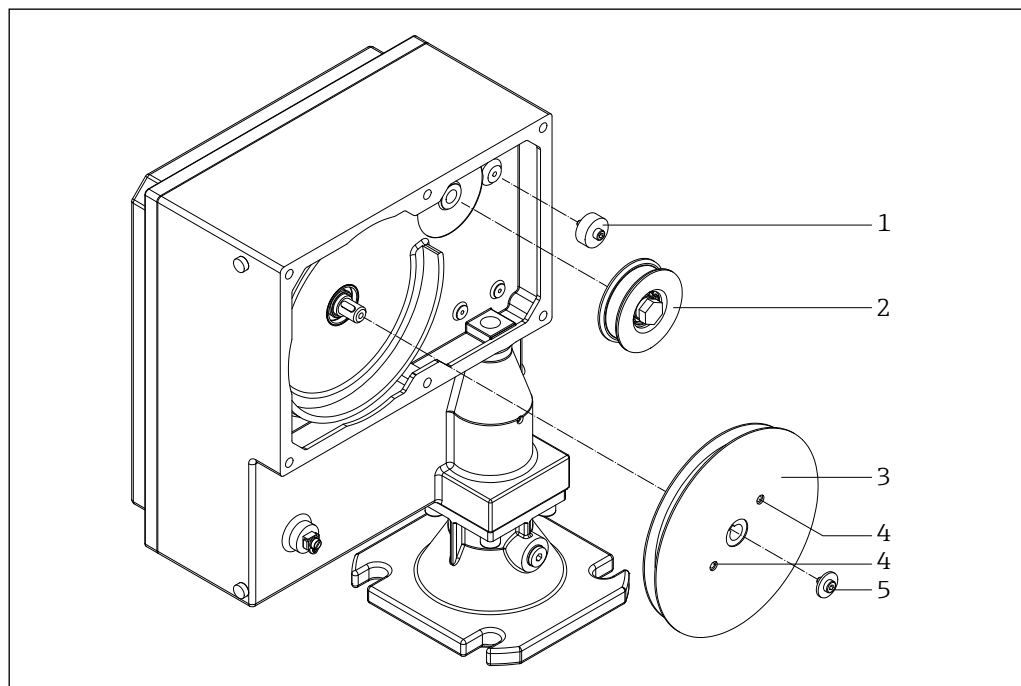
⊞ *37   Replacing the tape spool*

1   Tape guide
2   Counting wheel
3   Tape spool
4   Thread M6
5   Securing screw

Replacing the tape spool

1. Move the sensing weight down a little (at least 5 cm) in the "manual mode (020)" type of measurement to relieve the tension on the measuring tape.

ℹ️ When using larger sensing weights, such as the skeleton weight, the weight must be lowered to an appropriate hatch. → ⊞18

2. Switch off the power supply if the sensing weight is easily accessible (move mains switch to "O" (off)). Disconnect the mains cable if the measuring device needs to be removed.

3. Remove and/or expose the measuring device until the wiper and sensing weight are accessible.

4. Remove the tape border from the measuring tape. → ⊞19

5. Unfasten the tape spool's locking screw.

ℹ️ To simplify the process of changing the tape, we recommend removing the counting wheel and tape guide.

6. Screw the M6 screws (at least 50 mm, DIN EN ISO 4017) evenly into the relevant reel holes. This pulls the reel off the drive shaft.

ℹ️ Alternatively, a removal tool is also available as accessory.
→ 🔖81

38   Usage removal tool

7. Carefully remove the tape spool and unwound part of the measuring tapes from the device.

8. A new tape spool is then installed in reverse order.

12.3.2 Replacing the wiper
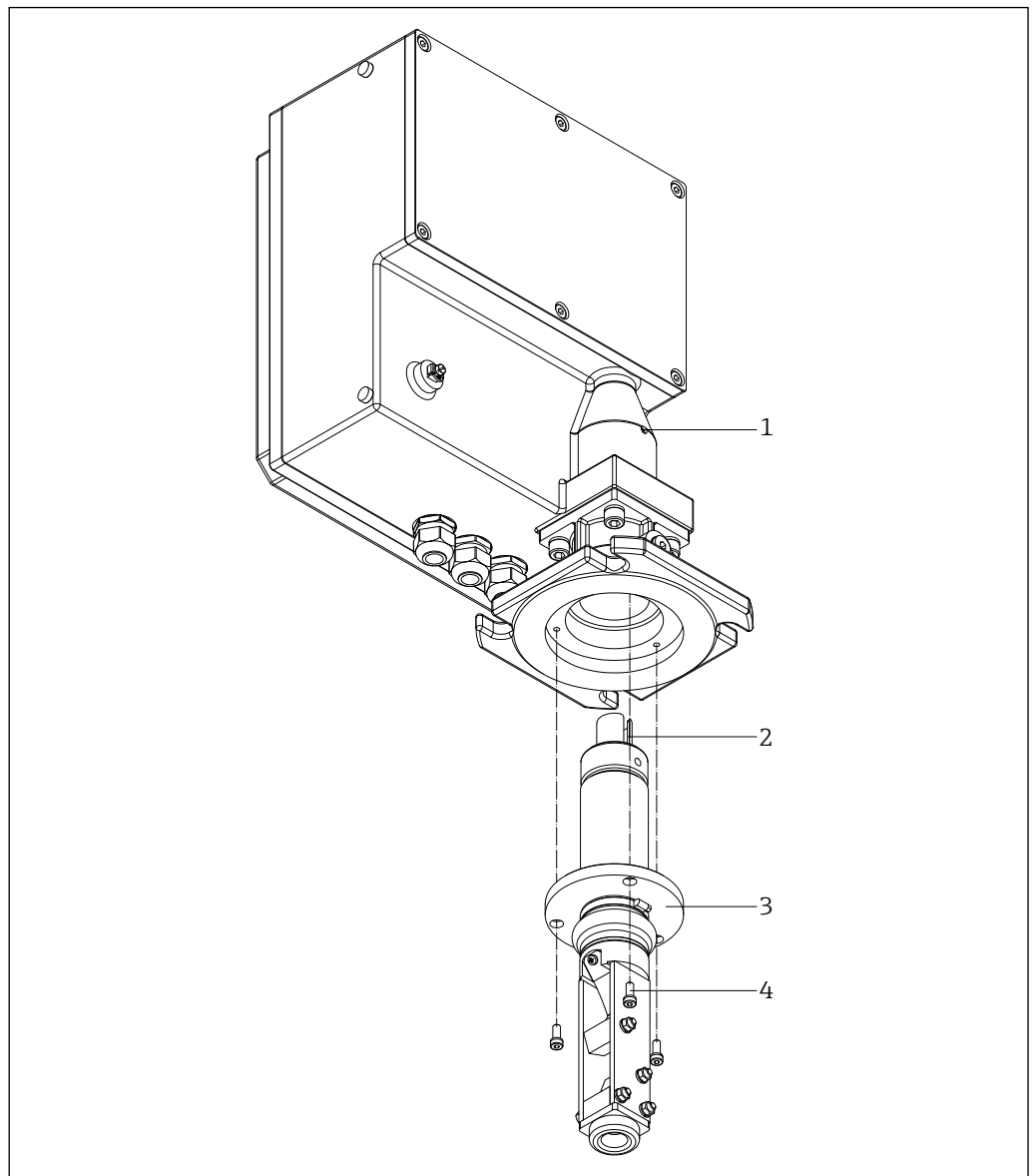
0000000237

⊡*39   Replacing the wiper*

1   Guide screw
2   Guide groove of wiper
3   Wiper
4   Mounting screws M6x16

Replacing the wiper

1. Move the sensing weight down a little (at least 5 cm) in the "manual mode (020)" type of measurement to relieve the tension on the measuring tape.

2. Switch off the power supply if the sensing weight is easily accessible (move mains switch to "O" (off)). Disconnect the mains cable if the measuring device needs to be removed.

3. Remove and/or expose the measuring device until the wiper and sensing weight are accessible.

4. Release the tape border and remove it (and therefore also the sensing weight) from the measuring tape.

5. Release the three M6 screws on the wiper, the wiper can now be removed.

When dismantling and/or installing, ensure that the measuring tape is positioned correctly in the wiper. The measuring tape must not be turned in the spool compartment. The spool compartment cover should be opened during installation for this purpose.

6. Reassemble in reverse order, making sure that the guide groove on the wiper is correctly positioned in relation to the guide screw on the housing.

12.3.3 Replacing the motor/gearbox unit
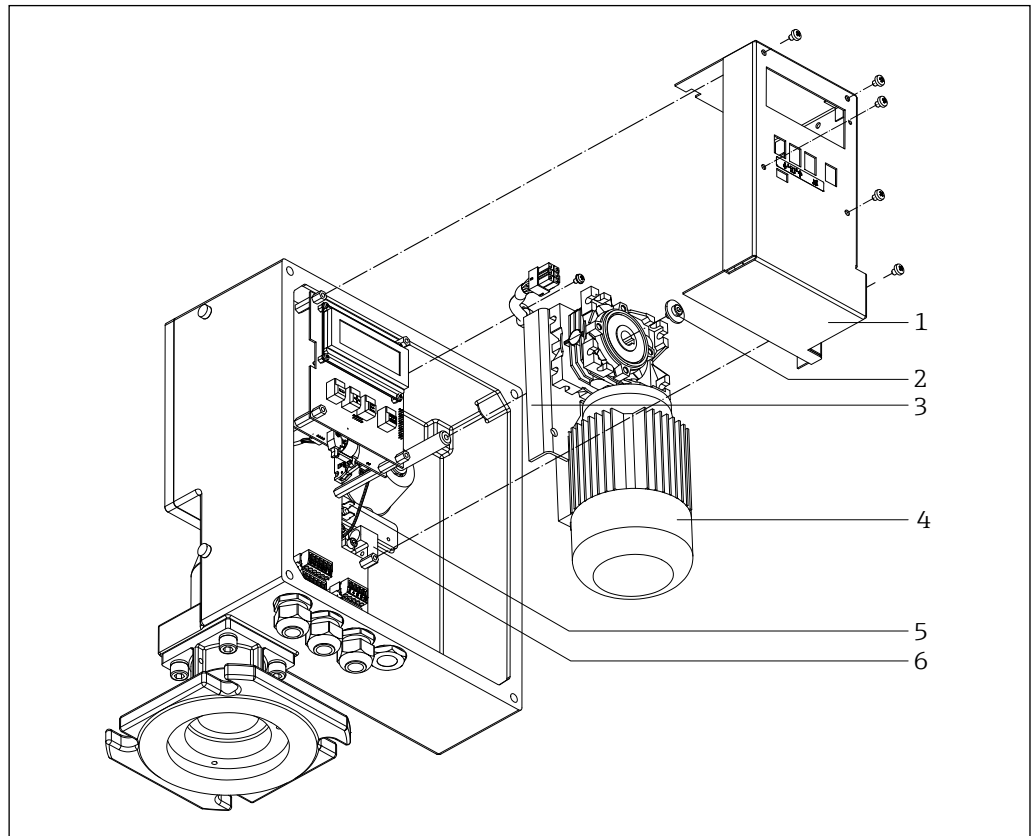
🖼40   Replacing the motor/gearbox unit

1   Cover plate
2   Securing screw
3   Switch plate
4   Motor/gearbox unit
5   Ground terminal
6   Switch socket

Replacing the motor/gearbox unit

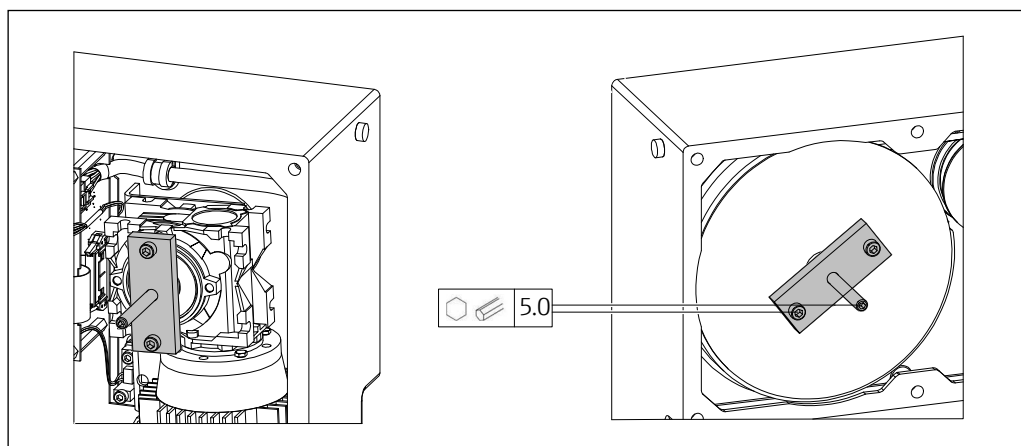1. Move the sensing weight down a little in the "manual mode" (020) type of measurement to relieve the tension on the measuring tape and therefore the drive shaft, and then fix the sensing weight or the measuring tape in place.

A tape stopper is available as accessory for this purpose.
→ 🕮81
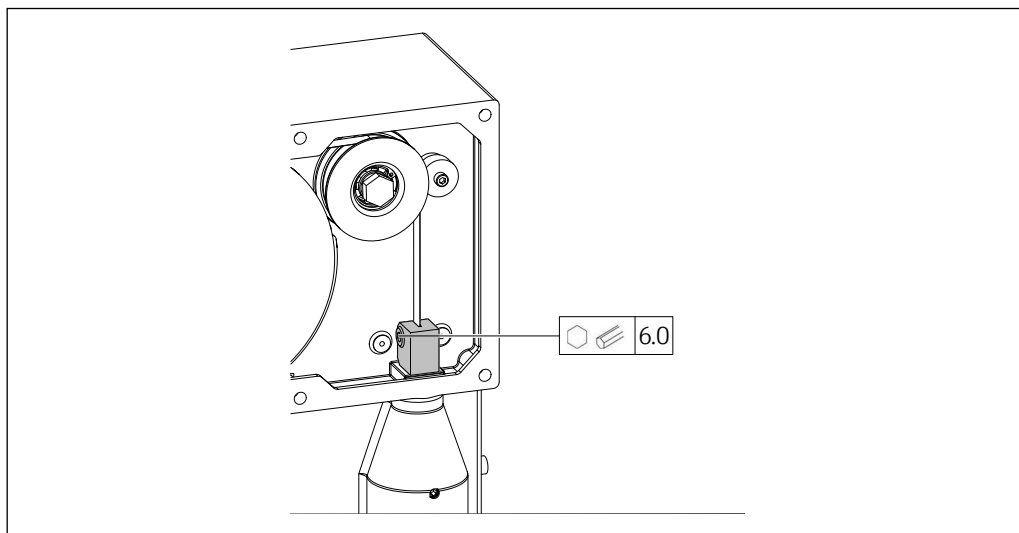
41   *Usage tape stopper*

2. Switch off the power supply if the sensing weight is easily accessible (move mains switch to "O" (off)). Disconnect the mains cable if the measuring device needs to be removed.

⚠ WARNING

The DC link of the meter retains a dangerous voltage for approx. 20 minutes after the supply voltage has been disconnected. Therefore, wait 20 minutes after disconnecting the supply voltage before removing the cover!

3. Loosen the cross-head screws (x 5) of the cover plate and take off the cover.

4. Disconnect the plug of the motor connection cable (top right).

5. Loosen the locking screw on the drive shaft and carefully pull out the motor/gearbox unit, along with the switch plate connected to it, by around 10 cm.

A removal tool is also available as accessory for this purpose. → 🖹81

6. Disconnect the earthing line from the earthing terminal and you can now fully remove the drive unit.

7. A new drive unit is then installed in reverse order.

- Use a suitable tool to force the spring in the switch socket back so that you can insert the switch plate.
- Carefully guide in the switch plate ensuring that the switch is not damaged.

12.3.4   Replacing the electronic unit

- The electronic unit should only be replaced by a specialist.
- When working with electronic components, ensure that you have sufficient ESD protection (protection against electrostatic discharge).
- Only use the electronics permitted for the device type when replacing parts (the use of incorrect electronics may result in the destruction of the device or the loss of Ex-certification).

⚠ WARNING

The DC link of the meter retains a dangerous voltage for approx. 20 minutes after the supply voltage has been disconnected. Therefore, wait 20 minutes after disconnecting the supply voltage before removing the cover!

Once an electronic unit has been replaced, a basic setup must be performed again and all the parameters must be re-entered. Therefore the following procedure is recommended:
• Make a note of all the settings, including the values in a linearization table if one has been entered.
• After replacement, transfer all the settings noted and if necessary the values from a linearization table.

ℹ There are two types of housing:
  • In the older version up to around device no. 1100, all the PC boards must be removed individually to remove the electronics. Therefore, the electronics unit should only be replaced by Endress+Hauser Service.
  • In the latest version, the entire electronics along with the carrier plate can be removed. This housing version is recognizable from the four (of a total of five) securing screws that are visible when the cover plate is mounted.
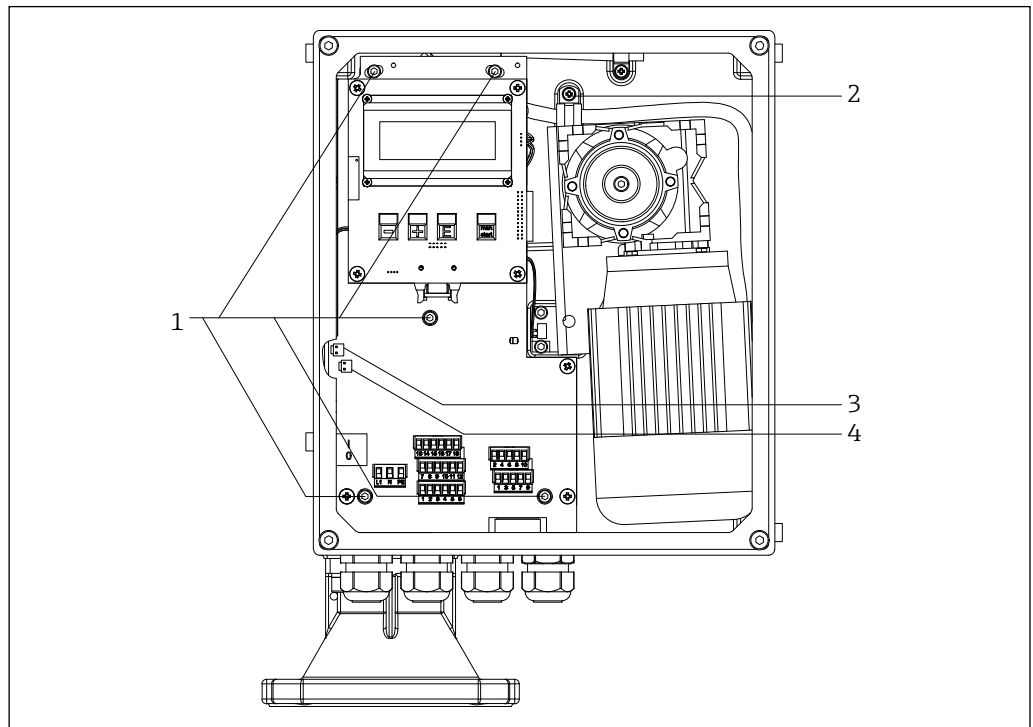
0000000202

🔲 *42   Replacing the electronic unit*

1   Screws M5x8
2   Screw to fix the motor connecting cable
3   Socket for temperature fuse (only certified device versions)
4   Socket for optional device heater

Replacing the electronic unit

1. Disconnect the supply voltage then wait for around 20 minutes (dangerous interim circuit voltage!).

2. Remove the cover plate (5 screws).

3. Disconnect the motor plug.

ℹ To make is easier to disassemble the electronics, we recommend you also release the fastener for the motor connecting cable.
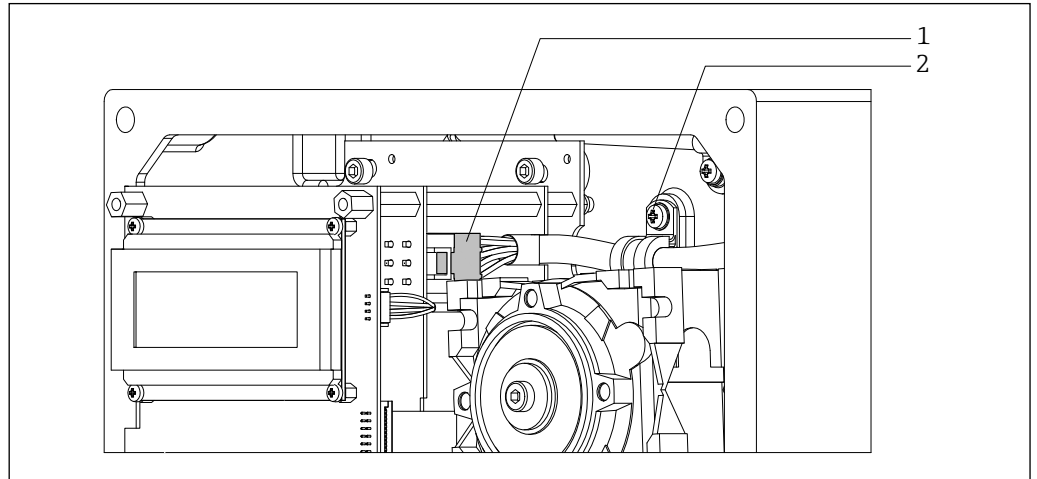
0000000214

🔲43   Position of the motor plug

1   Plug to connect the motor/gearbox combination
2   Fastener for the motor connecting cable

4. Release the plug of the tape switch.
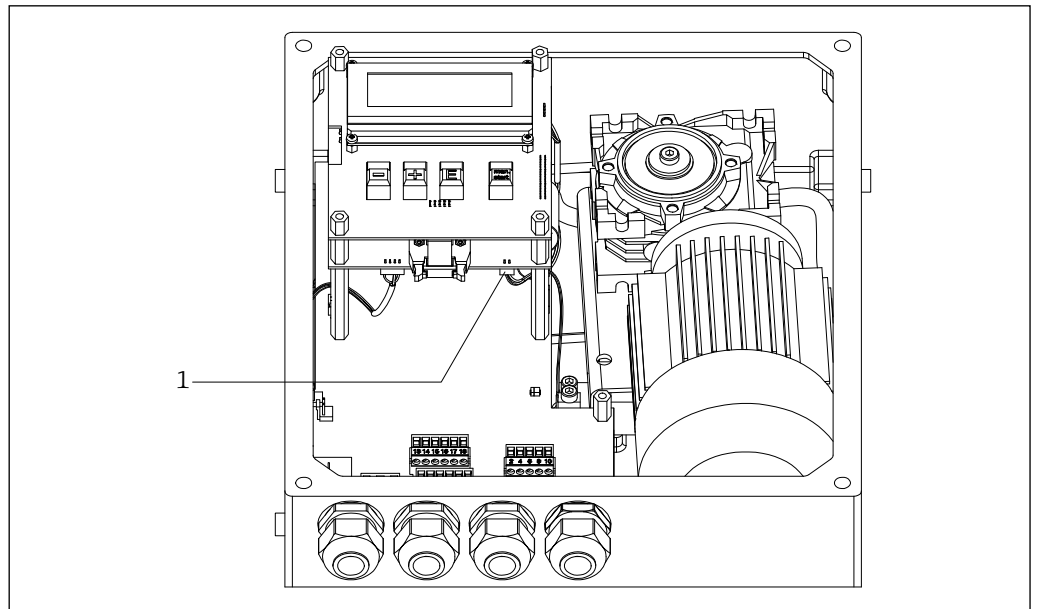
0000000186

🔲44   Position of the tape switch plug

1   Tape switch plug

5. Depending on the device version, also release the plug for the temperature fuse (ATEX) and the device heater plug.

6. The electronics module can only be removed carefully by releasing the 5 Allen screws (4 mm AF).

7. Once the defective electronics module has been replaced, the new module is installed in the reverse order.

12.4   Return

The measuring device must be returned if the wrong device has been ordered or delivered. As an ISO-certified company and also due to legal regulations, Endress+Hauser is obliged to follow certain procedures when handling any returned products that have been in contact with medium. To ensure safe, swift and professional device returns, please refer to the procedure and conditions for returning devices provided on the Endress+Hauser website at
http://www.endress.com/support/return-material

12.5   Disposal

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), our products are marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste.

Such products may not be disposed of as unsorted municipal waste and can be returned to Endress+Hauser for disposal at conditions stipulated in our General Terms and Conditions or as individually agreed.

12.5.1   Removing the measuring device

1. Switch off the measuring device.
2. Carry out the mounting and connection steps from the "Mounting the measuring device" and "Connecting the measuring device" chapters in the logically reverse sequence. Observe the safety instructions when doing so.

⚠ WARNING

Danger to persons from process conditions! Beware of hazardous process conditions such as pressure in the measuring device, high temperatures or aggressive fluids.

12.5.2   Disposing of the measuring device

Observe the following when disposing:
- Observe valid national regulations.
- Ensure proper separation and reuse of the device components.

⚠ WARNING

Danger to personnel and environment from fluids that are hazardous to health! Ensure that the measuring device and all cavities are free of fluid residues that are hazardous to health or the environment, e.g. substances that have permeated into crevices or diffused through plastic.

13   Accessories

13.1   Device specific accessories

13.1.1   Weather protection cover
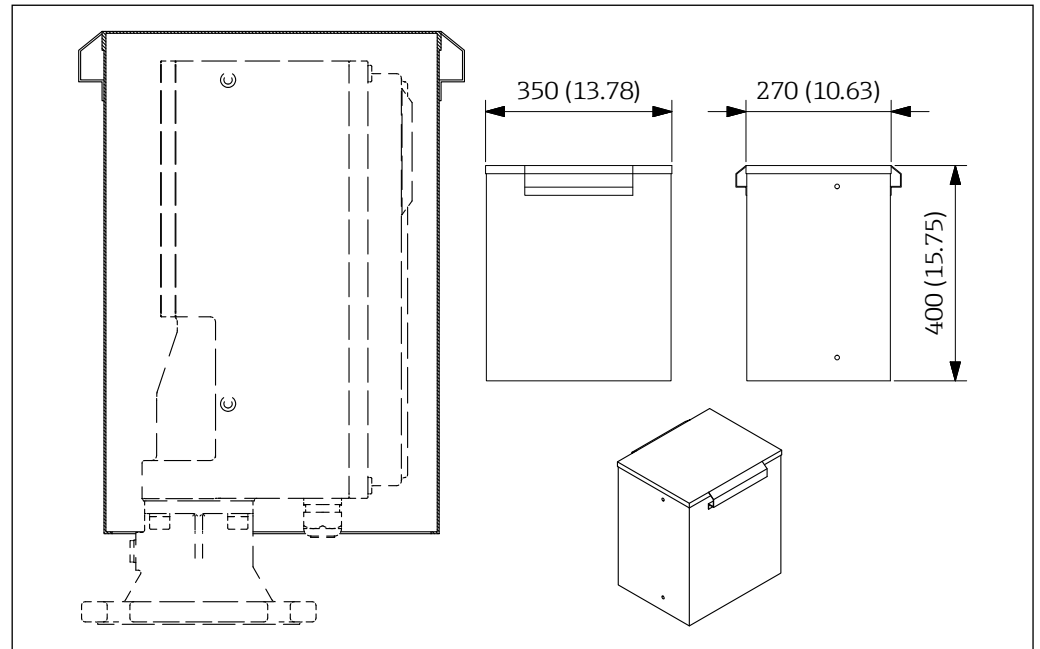
☒45   Weather protection cover. Unit of measurement mm (in)

The weather protection cover is simply fitted over the device once the device is installed and fastened on the device with four screws. You will need a free height of at least 400 mm (15.75 in) above the measuring device for installing and/or dismantling.
- Material: Stainless steel 304 (1.4301)
- Weight: 7.5 kg (16.5 lb)
- Mounting screws enclosed
- Order number: 52027964

13.1.2 Process adapter extension

If process temperatures are between +150 ... +230 ℃ (+302 ... +446 ℉), the following process adapter extensions can be used to reduce the temperature when using the 1000 mm wiper extension:
• Material: Stainless steel 316Ti (1.4571)
• Weight: 16 kg (35.3 lb)
• The delivery contains suitable screws and nuts to secure the measuring device to the process adapter extension.
• Order number: 52028083
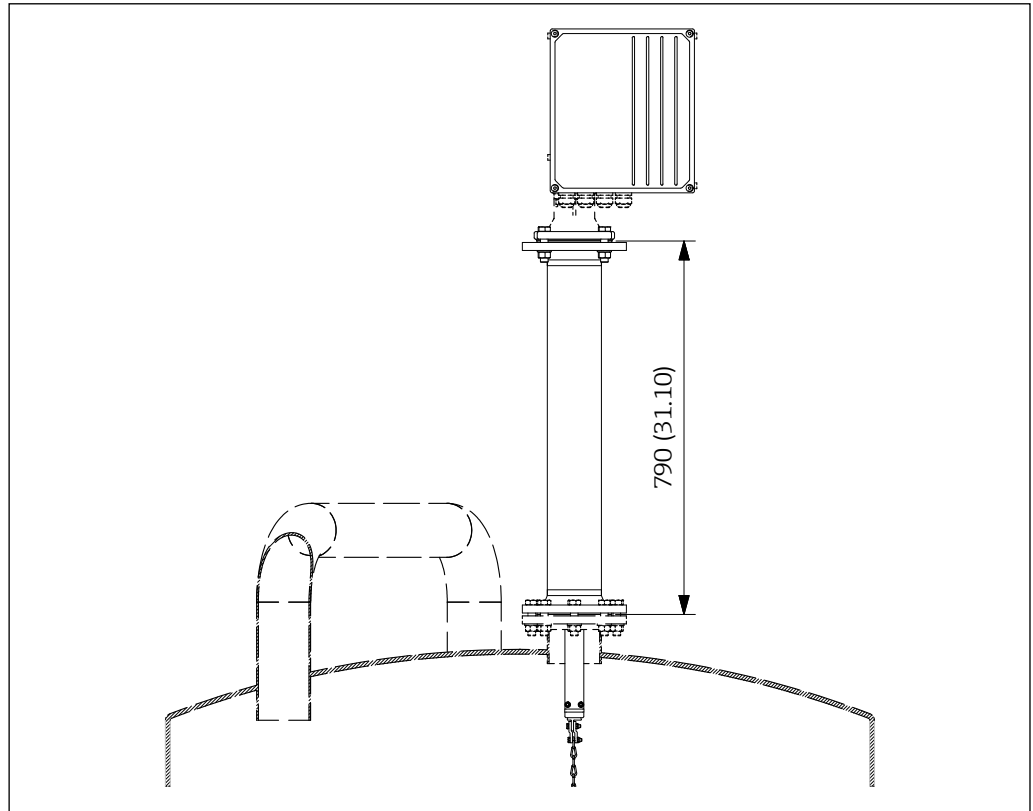
🖾46   Process adapter extension. Unit of measurement mm (in)

13.1.3 Adapter flange

The following adapter flanges can be used to adapt to existing process connections.

13.1.3.1 Adapter flange for lower pressure ratings

The adapter flange is mounted between the process connection of the device and the application. As the flange is not very high, the clearance needed for the device is only marginally increased.
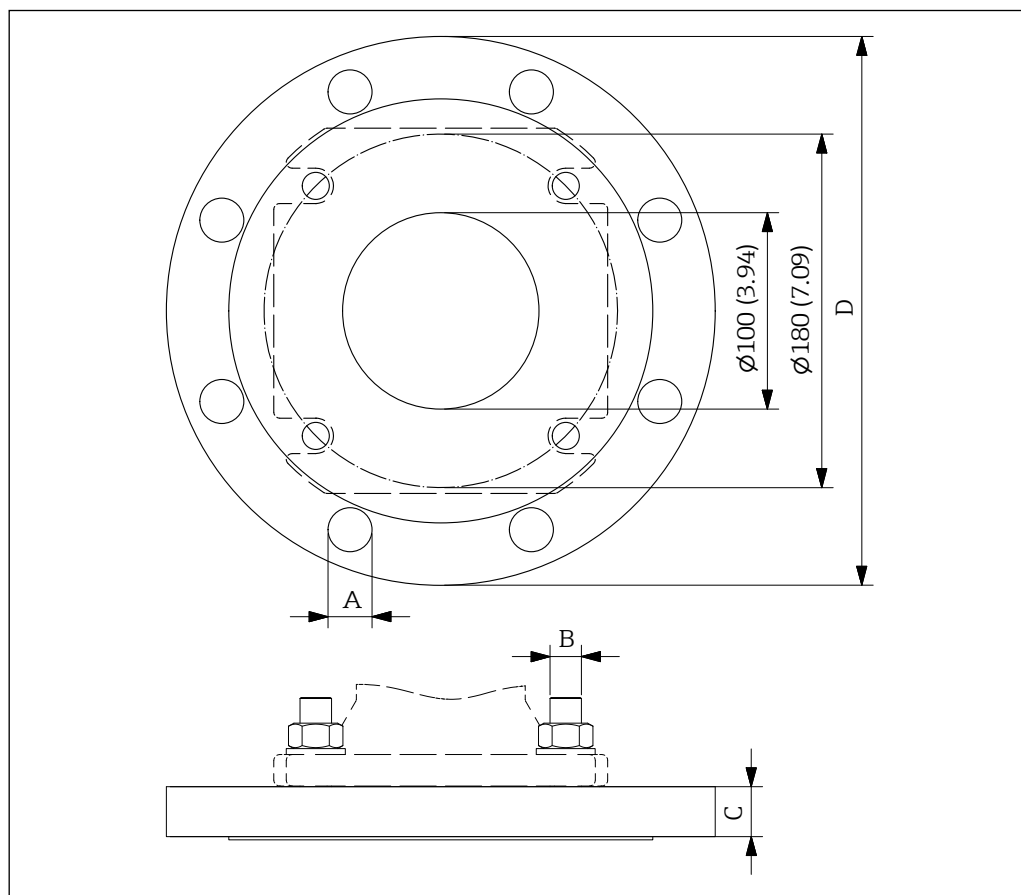
47   Adapter flange (example ASME B16.5 6" 150 lbs). Unit of measurement mm (in)

- Order number:
  71301820 (DN150, PN16, EN1092-1, stainless steel 316Ti, 9 kg (19.8 lb))
  71301821 (DN150, PN16, EN1092-1, steel, 9 kg (19.8 lb))
  71301822 (DN200, PN16, EN1092-1, stainless steel 316Ti, 15 kg (33.1 lb))
  71301824 (DN200, PN16, EN1092-1, steel, 15 kg (33.1 lb))
  71301811 (6", 150lbs, ASME B16.5, stainless steel 316Ti, 10 kg (22 lb))
  71301815 (6", 150lbs, ASME B16.5, steel, 10 kg (22 lb))
  71301816 (8", 150lbs, ASME B16.5, stainless steel 316Ti, 18 kg (39.7 lb))
  71301817 (8", 150lbs, ASME B16.5, steel, 18 kg (39.7 lb))
- Dimension (mm (in)):

Order number	Holes	A	B	C	D
71301820	8	22 (0.87)	M16	22 (0.87)	285 (11.22)
71301821					
71301822	12	22 (0.87)		24 (0.94)	340 (13.39)
71301824					
71301811	8	22.4 (0.88)	UNC 5/8"	25.4 (1)	279.4 (11)
71301815					
71301816				28.6 (1.13)	342.9 (13.5)
71301817					

- The delivery contains suitable nuts to secure the measuring device to the adapter flange.

13.1.3.2 Adapter flange with studs for higher pressure ratings

0000000241
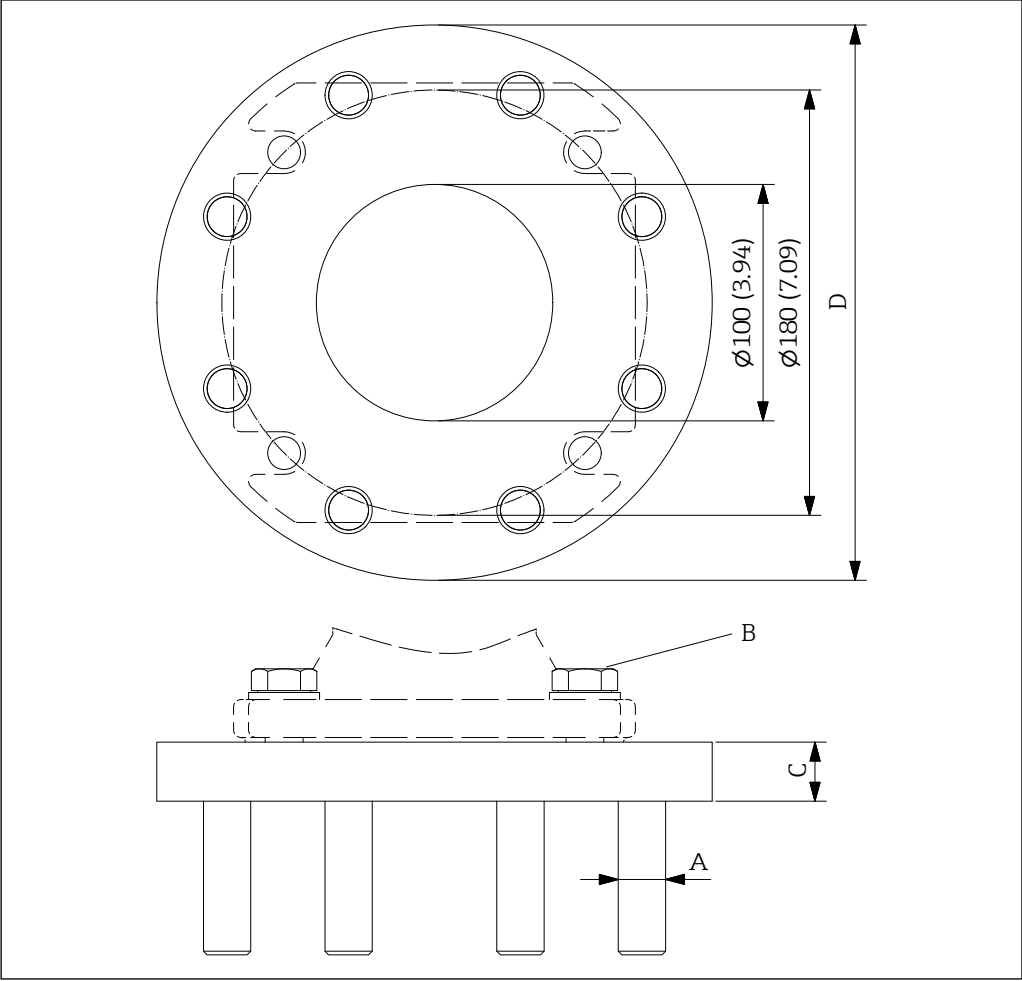
🖼 *48   Adapter flange (example DN100 PN25/40). Unit of measurement mm (in)*

- Order number:
  71301826 (DN100, PN25/40, EN1092-1, stainless steel 316Ti, 7 kg (15.4 lb))
  71301829 (DN100, PN25/40, EN1092-1, steel, 7 kg (15.4 lb))
  71301831 (4", 300lbs, ASME B16.5, stainless steel 316Ti, 11 kg (24.3 lb))
  71301833 (4", 300lbs, ASME B16.5, steel, 11 kg (24.3 lb))
  71301834 (4", 600lbs, ASME B16.5, stainless steel 316Ti, 16 kg (35.3 lb))
  71301835 (4", 600lbs, ASME B16.5, steel, 16 kg (35.3 lb))
- Dimension (mm (in)):

Order number	Stud bolts	A	B	C	D
71301826	8	M22	M16	25 (0.98)	235 (9.25)
71301829					
71301831		UNC 3/4"	UNC 5/8"	31.8 (1.25)	254 (10)
71301833					
71301834				38.1 (1.5)	273.1 (10.75)
71301835					

- The delivery suitable screws to secure the measuring device to the adapter flange.

13.1.4 Process adapter

13.1.4.1 Process adapters for smaller nominal diameters
The following process adapters can be used to adapt to existing process connections with smaller nominal diameters (< DN100).
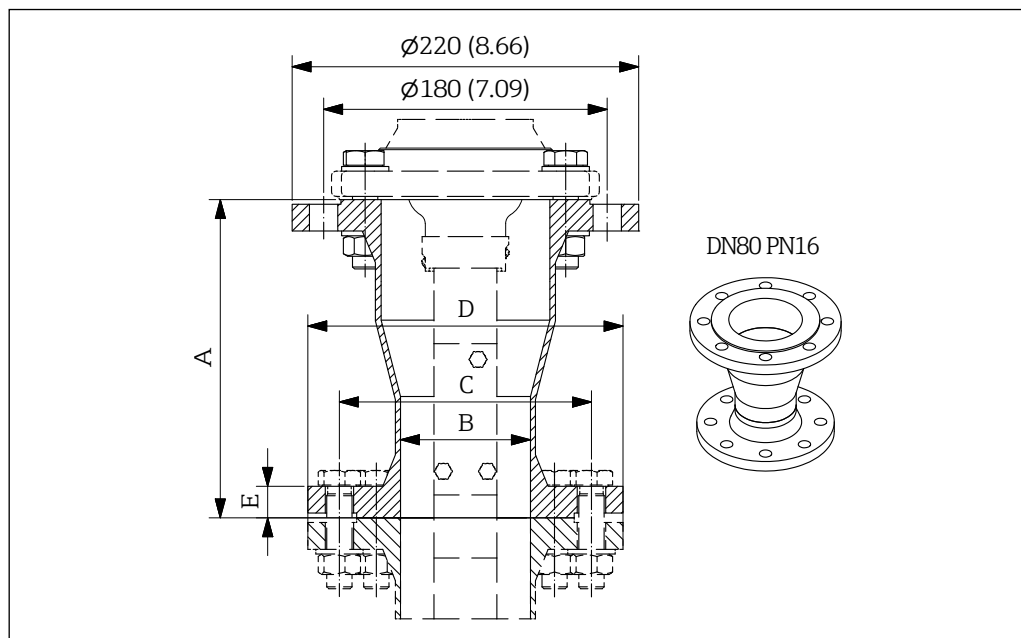
 49   Process adapter (example DN80 PN16). Unit of measurement mm (in)

- Order number:
  71301837 (DN50, PN16, EN1092-1, stainless steel 316Ti, 10.5 kg (23.1 lb))
  71301839 (DN50, PN16, EN1092-1, steel, 10.5 kg (23.1 lb))
  71301841 (DN65, PN16, EN1092-1, stainless steel 316Ti, 11 kg (24.3 lb))
  71301843 (DN65, PN16, EN1092-1, steel, 11 kg (24.3 lb))
  71301844 (DN80, PN16, EN1092-1, stainless steel 316Ti, 10 kg (22 lb))
  71301857 (DN80, PN16, EN1092-1, steel, 10 kg (22 lb))
  71301858 (2", 150lbs, ASME B16.5, stainless steel 316Ti, 11 kg (24.3 lb))
  71301859 (2", 150lbs, ASME B16.5, steel, 11 kg (24.3 lb))
  71301861 (3", 150lbs, ASME B16.5, stainless steel 316Ti, 11.5 kg (25.3 lb))
  71301864 (3", 150lbs, ASME B16.5, steel, 11.5 kg (25.3 lb))
  71301867 (4", 150lbs, ASME B16.5, stainless steel 316Ti, 12.5 kg (27.6 lb))
  71301868 (4", 150lbs, ASME B16.5, steel, 12.5 kg (27.6 lb))
- Dimension (mm (in)):

Order number	A	B	C	D	E
71301837	400 (15.75)	54.5 (2.15)	125 (4.92)	165 (6.50)	18 (0.71)
71301839					
71301841		70.3 (2.77)	145 (5.71)	185 (7.28)	
71301843					
71301844	200 (7.87)	82.5 (3.25)	160 (6.30)	200 (7.87)	200 (7.87)
71301857					
71301858	420 (16.54)	52.6 (2.07)	120.7 (4.75)	152.4 (6.00)	19.1 (0.75)
71301859					
71301861	220 (8.66)	78 (3.07)	152.4 (6.00)	190.5 (7.50)	23.9 (0.94)
71301864					
71301867	128 (5.04)	102.4 (4.03)	190.5 (7.50)	228.6 (9.00)	
71301868					

- The delivery contains suitable screws and nuts to secure the measuring device to the process adapter extension.

ℹ️ To prevent incorrect measurements if the sensing weights swings, the lower edge of the wiper should project out of the reduced area (diameter **B**).

13.1.4.2 Process adapter as replacement for the standard adapter

The standard process adapter can be replaced by one of the following adapters to adapt to existing process connections.
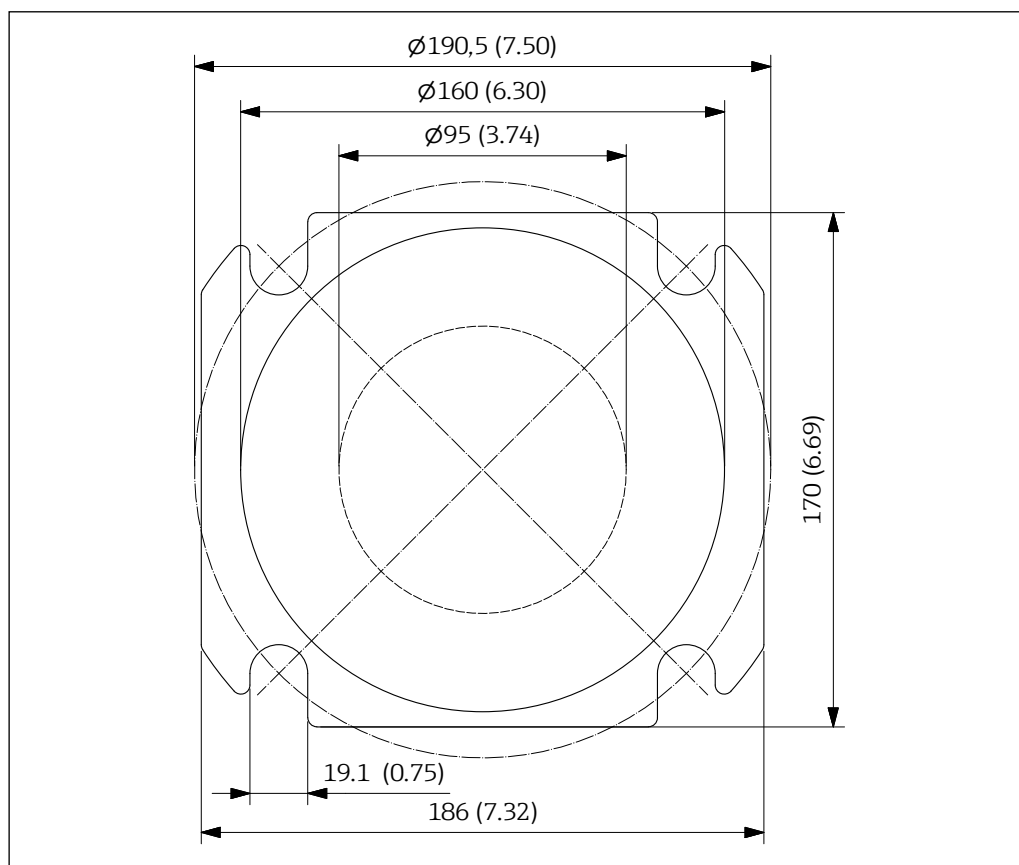
50   Process adapter as replacement for the standard adapter. Unit of measurement mm (in)

- Order number:
  71301870 (150 lbs, ASME, RF 4", aluminum)
  71301872 (150 lbs, ASME, RF 4", aluminum, coated)

13.1.4.3 Process adapter with spray water cleaning

The following process adapter can be used with spray water cleaning to prevent any damage from chemical substances that can enter the measuring device via the measuring tape.

ℹ️ - The process adapter is mounted between the process connection of the measuring device and the application.
- Filtered water should only be used for spray water cleaning as otherwise the nozzles could clog.
- The amount of water needed is between 1 l/min (1 bar) and 3 l/min (6 bar).
- Use the adapter only for pressureless processes.
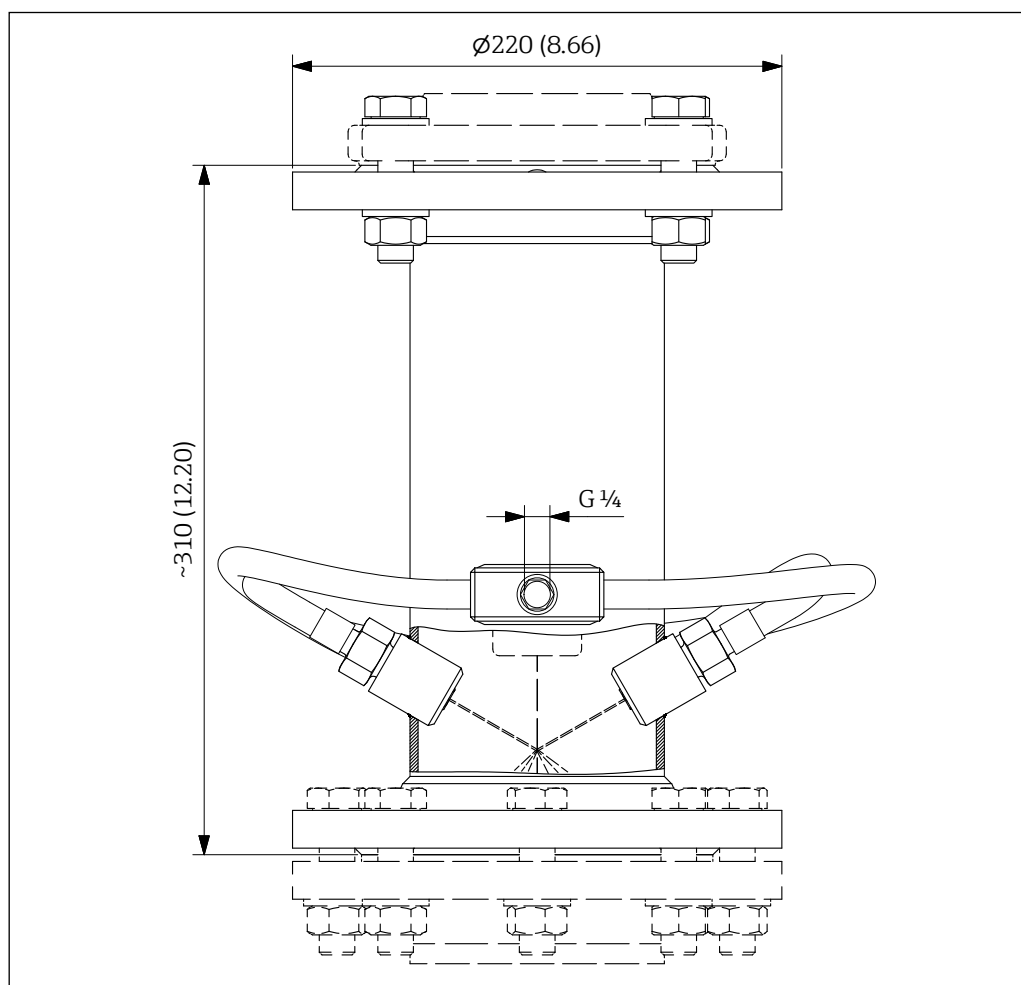
0000000218

⊡*51   Process adapter with spray water cleaning. Unit of measurement mm (in)*

- DN100 PN16 (Connection dimensions according to DIN EN 1092-1)
- Material: 316Ti (1.4571)
- Weight: 15 kg (33.1 lb)
- Order number: 71301886
- Mounting screws enclosed
- For pressureless processes only!

13.1.5 Sensing weights for interface measurement
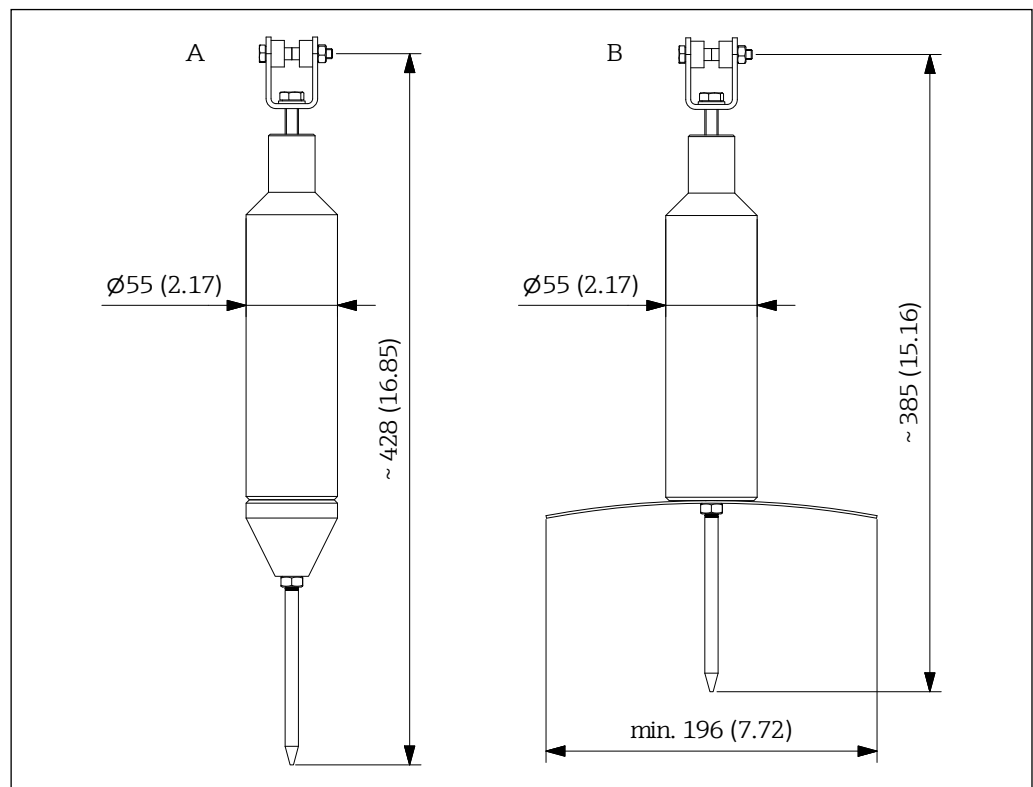
⊡52   Sensing weights for interface measurement. Unit of measurement mm (in)

A   Sensing weight for interface measurement in liquids with a significant difference in density
B   Sensing weight for interface measurement in liquids with a minor difference in density

13.1.5.1 Sensing weight for interface measurement in liquids with a significant difference in density

- Order number:
  71301873 (316Ti (1.4571))
  71301875 (316Ti (1.4571), coated)
- Weight: 4 kg (8.82 lb)

The deviating block distance must be observed!
→ 🗎 31

13.1.5.2 Sensing weight for interface measurement in liquids with a minor difference in density

- Order number:
  71301876 (316Ti (1.4571))
  71301877 (316Ti (1.4571), coated)
- Weight: 4 kg (8.82 lb)

13.1.6 Chain to increase the block distance

The following chain can increase the block distance by a maximum distance of 2 m in the event of longer connections which the sensing weight should not enter into:
→ 🖾 16

If the sensing weights sway significantly, we recommend the use of the extended wiper.

- Order number: 71301880
- Material: Stainless steel316
- Length: 2 m (78.74 in)
- Weight: 0.3 kg (0.66 lb)

13.2   Device-specific tool
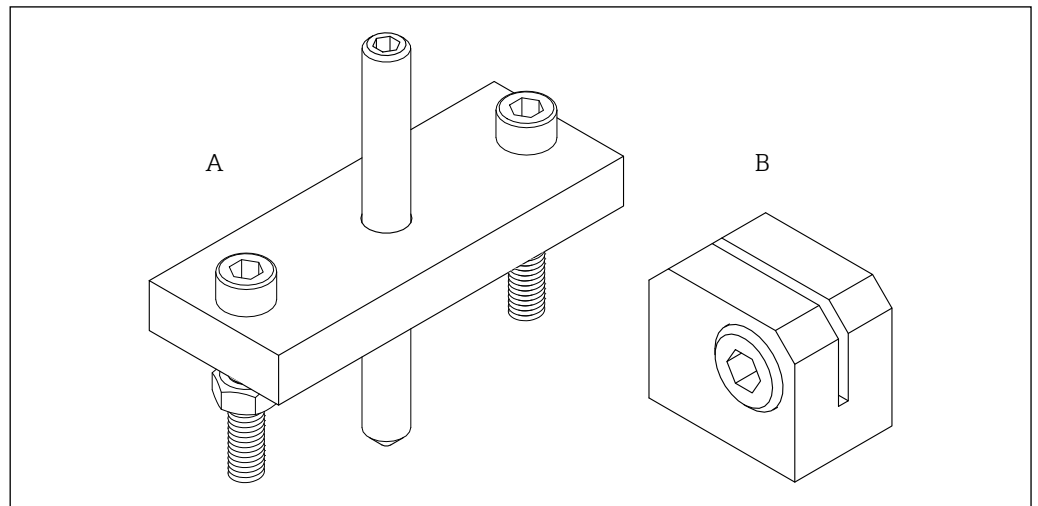
🖻 53   Device-specific tool

A   Removal tool → 🖻 66
B   Tape stopper → 🖻 69

13.2.1   Removal tool

For a change of the measuring tape and the gear motor, the following removal tool is available, the operation is carried out with an Allen key 5 mm AF.

- Order number: 71001353
- Material: Steel

13.2.2   Tape stopper

The following measuring tape stopper is available for a change of the gear motor in the application, the operation is done with an Allen key 6 mm AF.

- Order number: 71001352
- Material: Steel and brass

14   Technical data

14.1   Input

14.1.1   Measured variable

- **Direct measured variable**
  Level (in selectable units)
- **Calculated measured variable**
  Volume (in selectable units, if the linearization function is used also for a non-linear relationship between the level and volume)

14.1.2 Measuring range

- FMM50-***6********: 15 m (590.6 in)
- FMM50-***1********: 25 m (984.3 in)
- FMM50-***2********: 35 m (1378.0 in)
- FMM50-***3********: 50 m (1968.5 in)
- FMM50-***4********: 70 m (2755.9 in)
- FMM50-***5********: 90 m (3543.3 in)

14.1.3 Block distance

Sensing weight	Wiper		
	230 mm	500 mm	1000 mm
B, C, D, E, L	0.80 m (31.50 in)	1.10 m (43.31 in)	1.60 m (63.00 in)
G	1.20 m (47.24 in)	1.50 m (59.06 in)	2.00 m (78.74 in)
J	0.86 m (33.86 in)	1.16 m (45.67 in)	1.66 m (65.35 in)
M	0.65 m (25.59 in)	0.95 m (37.40 in)	1.45 m (57.09 in)
N	0.63 m (24.80 in)	0.93 m (36.61 in)	1.43 m (56.30 in)
71301873 / 71301875	0.85 m (33.46 in)	1.15 m (45.28 in)	1.65 m (64.96 in)

14.1.4 Input signal

2 signal inputs (start measurement, bolting)
- active: 12 to 24 V
- passive: switching contact max. 30 V DC / 300 mW
- Start pulse length: min. 200 ms

14.2 Output

14.2.1 Output signal

- Current output 0 - 20 mA / 4 - 20 mA
  - active
  - max. load: 600 Ω
- 2/6 Relay outputs
  - Contact load: max. 250 V AC / 6 A

14.2.2 Signal on alarm

- Error symbol, error code and description in plain text on the on-site display
- Current output, configurable → 🗎34
- Relay outputs (alarm)

14.3 Performance characteristics

Measured error: ±5 cm

14.4 Minimum time for one measurement cycle
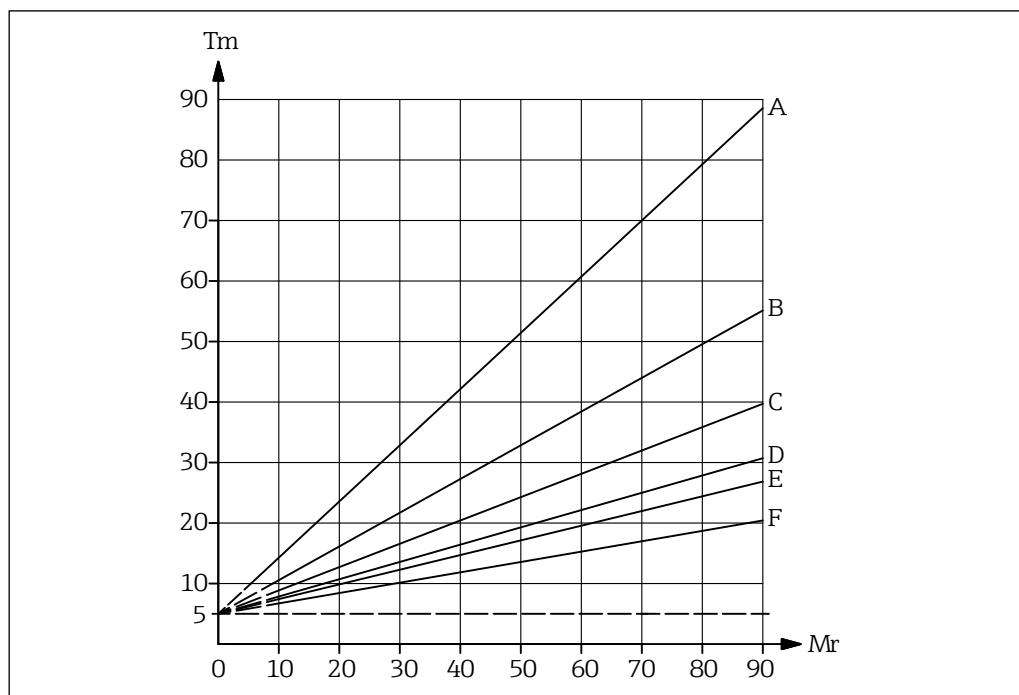
🖼 *54   Minimum time for one measurement cycle*

A   Ambient temperature 70 ℃ (158 ℉)
B   Ambient temperature 60 ℃ (140 ℉)
C   Ambient temperature 50 ℃ (122 ℉)
D   Ambient temperature 40 ℃ (104 ℉)
E   Ambient temperature 30 ℃ (86 ℉)
F   Ambient temperature 20 ℃ (68 ℉)
Tm Minimum time for one measurement cycle
Mr Measuring range

14.5 Running speed

Tape running speed: 0.21 to 0.35 m/s

14.6 Power supply

14.6.1 Supply voltage

- FMM50-*****1******: 180 to 253 V AC, 50/60 Hz
- FMM50-*****2******: 90 to 127 V AC, 50/60 Hz
- Ieff = 8 A (115 V) for 40 ms / 4.4 A (230 V) for 20 ms
- Imax = 16 A
- In accordance with IEC/EN61010 a suitable circuit breaker must be provided for the measuring device.

14.6.2 Power consumption

- 230 VA (without device heating)
- 250 VA (with integrated device heating)

14.6.3   Cable entries

- M25x1.5
- Ø 10 to 17 mm (0.39 to 0.67 in)
- Material:
  - Plastic, Grey (Ex-free area)
  - Plastic, black (Ex approval)
- Quantity:
  - 4 piece (not additionally equipped with external start button)
  - 3 piece (additionally equipped with external start button)

14.7   Environment

14.7.1   Ambient temperature

- FMM50-*******A/C****: -20 to +70 °C (-4 to +158 °F)
- FMM50-*******B/D****: -40 to +70 °C (-40 to +158 °F)
- For outdoor operation in strong sunlight: Use weather protection cover

14.7.2   Storage temperature

-40 to +80 °C (-40 to +176 °F)

14.7.3   Degree of protection

- With closed housing: IP67
- With closed housing and with the use of the external start button: IP65
- With open housing: IP20

14.7.4   Electromagnetic compatibility

- Interference emission to EN 61326, Electrical Equipment Class B
- Interference immunity to EN 61326, Appendix A (Industrial)
- A normal installation cable is sufficient for the wiring.

14.8   Process

14.8.1   Process temperature

- FMM50-********1***: -20 to +70 °C (-4 to +158 °F)
  (Restriction for FMM50-********1*M*: 0 to +60 °C (+32 to +140 °F))
- FMM50-********2***: -20 to +150 °C (-4 to +302 °F)
- FMM50-********1***: -20 to +230 °C (-4 to +446 °F)

14.8.2   Process pressure

- FMM50-*********1**: 0.8 to 1.1 bar (12 to 16 psi) absolute
- FMM50-*********2**: 0.8 to 3.0 bar (12 to 43 psi) absolute

14.9   Additional technical data

Latest technical information: Endress+Hauser website:
www.endress.com → Downloads

15   Appendix

The following tables provide an aid to documentation (for example, in the event of replacement of the electronics).

15.1   User parameters

Basic setup	Default	User setting
001 Empty calibration	Length of measuring tape	
002 Block distance	→ 🗎82	
003 Full calibration	001 - 002	

Inputs and outputs	Default	User setting
010 Input 1	not used	
011 Polarity input 1	NO contact	
012 Input 2	not used	
013 Polarity input 2	NO contact	
014 Relay output 1	alarm	
015 Pulse weight	1	
016 Pulse length	50 ms	
017 Threshold	60 %	
018 Hysteresis	3 %	
019 Reset pulse	300 ms	
01A Relay output 2	service interval	
01B Relay output 3	measuring	
01C Relay output 4	threshold	
01D Relay output 5	reset pulse	
01E Relay output 6	band return	

Measurement paramameter	Default	User setting
020 Measurement type	single cycle	
021 Time interval	1	
022 Time unit	Hour(s)	
023 Normal or short	normal	
024 Service interval	45000	
028 Run-up length	1 m	

Current output	Default	User setting
030 Current mode	normal	
031 0/4mA value	0	
032 20mA value	(Full calibration)	
033 Current range	4-20mA	

Safety settings	Default	User setting
040 Output on alarm	MIN (0/3.6mA)	
041 Output on alarm	3.60 mA	
042 Safety distance	0 m	
043 Security distance	0 m	
044 In security distance	warning	
045 In safety distance	alarm	

Linearization	Default	User setting
050 Level/volume	level CU	
051 Linearization	linear	
056 Customer unit	%	
057 Maximum scale	100 %	

Display	Default	User setting
060 Language	English	
061 Back to home	100 s	
062 No. of decimals	x.xx	

Diagnostics	Default	User setting
074 Unlock parameter	100	

System parameters	Default	User setting
080 Device tag	---------------	
083 Distance unit	m	

15.2　Linearization table

TabNr	Level	Volume	TabNr	Level	Volume
1			17		
2			18		
3			19		
4			20		
5			21		
6			22		
7			23		
8			24		
9			25		
10			26		
11			27		
12			28		
13			29		
14			30		
15			31		
16			32		

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