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Valid as of version
01.01.00 (Device firmware)

Operating Instructions
Prothermo NMT81

Average temperature device

Endress+Hauser
People for Process Automation

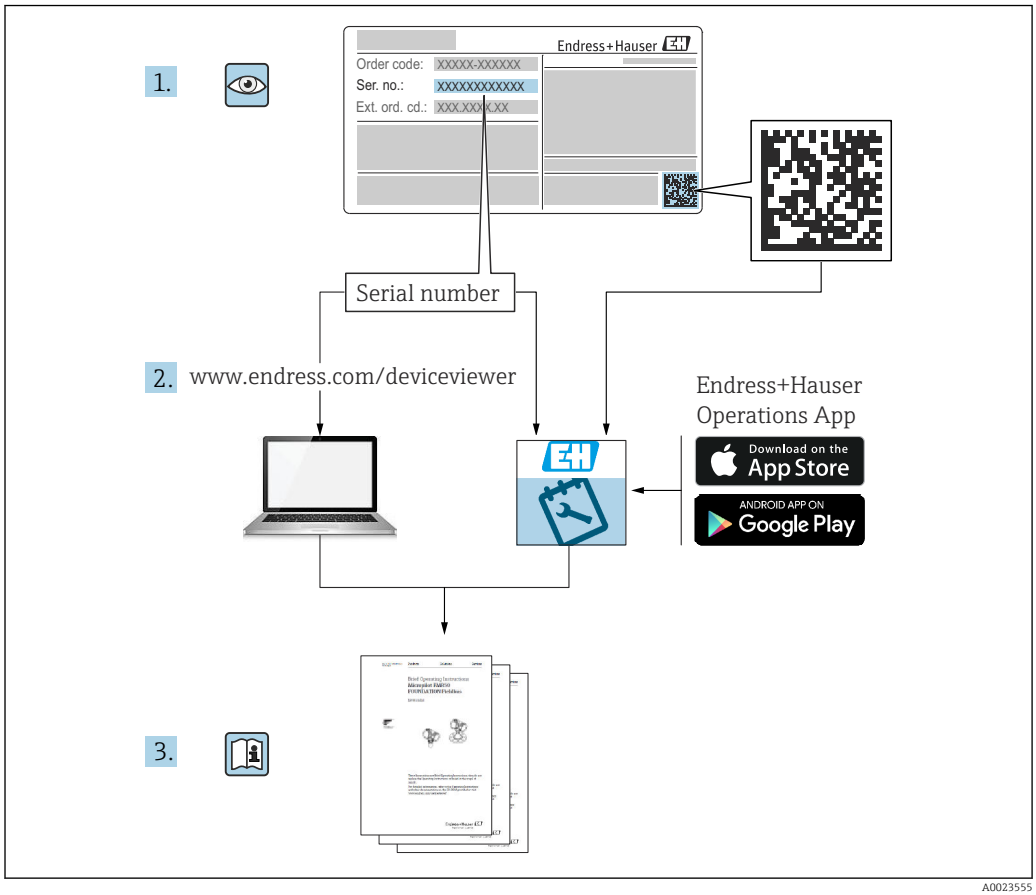

1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX-XXXX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
A0023555

Table of contents

1 About this document 5
1.1 Document function 5
1.2 Document conventions 5
1.3 Documentation 7
1.4 Registered trademarks 8

2 Basic safety instructions 9
2.1 Requirements for the personnel 9
2.2 Intended use 9
2.3 Workplace safety 9
2.4 Operational safety 9
2.5 Product safety 10

3 Product description 11
3.1 Product design 11

4 Incoming acceptance and product identification 12
4.1 Incoming acceptance 12
4.2 Product identification 12
4.3 Manufacturer address 13
4.4 Storage and transport 13

5 Installation 14
5.1 Converter 14
5.2 Option 1: Converter with universal coupling . . 14
5.3 Option 2: Converter with M20 mounting thread 15
5.4 Converter + average temperature probe version 16
5.5 Converter + average temperature probe + water bottom probe 18
5.6 Flange 20
5.7 Element No. 1 position 21
5.8 Element positions 22
5.9 WB probe design 23
5.10 Pre-installation of NMT81 25
5.11 Installation procedure 27
5.12 Mounting NMT81 on a cone roof tank 31
5.13 Mounting NMT81 on a floating roof tank 36
5.14 Mounting NMT81 on a pressurized tank 40

6 Electrical connection 41
6.1 NMT81 (Ex ia) intrinsically safe connection . . 41
6.2 NMT81 transmitter and element connection . 42
6.3 NMS8x/NMR8x/NRF81 (Ex d [ia]) intrinsically safe connection 42
6.4 NMS5 (Ex d [ia]) intrinsically safe connection 43
6.5 NRF590 terminals 44
6.6 Mechanical connection for converter-only version 45
6.7 Wiring connection 47

7 Operability 49
7.1 Overview of the operation options 49
7.2 Structure and function of the operating menu 49
7.3 Operation via HART master connecting with devices 51
7.4 Display of NMT81 51
7.5 Operating keys and DIP switches on the electronic insert 52
7.6 Configuring NMT81 with NMS5/NMS7/ NRF590 56
7.7 Configuring NMT81 with NMS8x/NMR8x/ NRF81 56
7.8 Access to the operating menu via the operating tool 62

8 System integration 64
8.1 Overview of the Device Description files (DTM) 64
8.2 Measured variables via HART protocol 64

9 Commissioning 65
9.1 Terms related to temperature measurement . . 65
9.2 Initial setting 66
9.3 Initial screen 66
9.4 Guidance 68

10 Operation 75
10.1 Compatibility mode of NMT53x and NMT81 . . 75
10.2 Application 76
10.3 System 92

11 Diagnostics and troubleshooting . . . 97
11.1 System error messages 97
11.2 Diagnostic event 97
11.3 Diagnostics 102

12 Maintenance 108
12.1 Maintenance tasks 108
12.2 Endress+Hauser services 108

13 Repair 109
13.1 General information on repairs 109
13.2 Spare parts 110
13.3 Endress+Hauser services 110
13.4 Return 110
13.5 Disposal 110

14 Accessories 111
14.1 Device-specific accessories 111

Index 116

1 About this document

1.1 Document function

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

1.2 Document conventions

1.2.1 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.

1.2.2 Electrical symbols

Alternating current

Direct current and alternating current

Direct current

Ground connection

A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.

Protective earth (PE)

Ground terminals that must be connected to ground prior to establishing any other connections.

The ground terminals are located on the interior and exterior of the device:
- Interior ground terminal: protective earth is connected to the mains supply.
- Exterior ground terminal: device is connected to the plant grounding system.

1.2.3 Tool symbols

Phillips head screwdriver


Flat blade screwdriver


Torx screwdriver


Allen key


Open-ended wrench

1.2.4 Symbols for certain types of information and graphics


Permitted
Procedures, processes or actions that are permitted


Preferred
Procedures, processes or actions that are preferred


Forbidden
Procedures, processes or actions that are forbidden


Tip
Indicates additional information


Reference to documentation


Reference to graphic

▶
Notice or individual step to be observed

1., 2., 3.
Series of steps


Result of a step


Operation via operating tool


Write-protected parameter

1, 2, 3, ...
Item numbers

A, B, C, ...
Views


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

1.3 Documentation

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

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *W@M Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the matrix code on the nameplate

1.3.1 Technical Information (TI)

Planning aid
The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.

1.3.2 Brief Operating Instructions (KA)

Guide that takes you quickly to the 1st measured value
The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

1.3.3 Operating Instructions (BA)

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

1.3.4 Description of Device Parameters (GP)

The Description of Device Parameters provides a detailed explanation of each individual parameter in the operating menu (except the Expert menu). The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.

1.3.5 Safety Instructions (XA)

Depending on the approval, the following Safety Instructions (XA) are supplied with the device. They are an integral part of the Operating Instructions.

The nameplate indicates the Safety Instructions (XA) that are relevant to the device.

1.3.6 Installation instructions (EA)

Installation Instruction are used to replace a faulty unit with a functioning unit of the same type.

1.4 Registered trademarks

FieldCare®
Registered trademark of the Endress+Hauser Process Solutions AG, Reinach, Switzerland

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:
- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- Are authorized by the plant owner/operator.
- Are familiar with federal/national regulations.
- Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:
- Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Follow the instructions in this manual.

2.2 Intended use

Application and measured materials
Measuring devices for use in hazardous areas, in hygienic applications or in applications where there is an increased risk due to process pressure, are labeled accordingly on the nameplate.

To ensure that the measuring device remains in proper condition for the operation time:
- Only use the measuring device in full compliance with the data on the nameplate and the general conditions listed in the Operating Instructions and supplementary documentation.
- Check the nameplate to verify if the device ordered can be put to its intended use in the approval-related area (e.g. explosion protection, pressure vessel safety).
- If the measuring device is not operated at atmospheric temperature, compliance with the relevant basic conditions specified in the associated device documentation is absolutely essential.
- Protect the measuring device permanently against corrosion from environmental influences.
- Observe the limit values in the "Technical Information".

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

2.3 Workplace safety

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

2.4 Operational safety

Risk of injury!
- Operate the device only if it is in proper technical condition, free from errors and faults.
- The operator is responsible for interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers:
- ▶ If modifications are nevertheless required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability:
- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use only original spare parts and accessories from the manufacturer.

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 if the device ordered can be put to its intended use in the hazardous area.
- ▶ Observe the specifications in the separate supplementary documentation that is an integral part of these instructions.

2.5 Product safety

This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate. It meets general safety standards and legal requirements.

NOTICE

Loss of degree of protection by opening of the device in humid environments
- ▶ If the device is opened in a humid environment, the degree of protection indicated on the nameplate is no longer valid. This may also impair the safe operation of the device.

2.5.1 CE mark

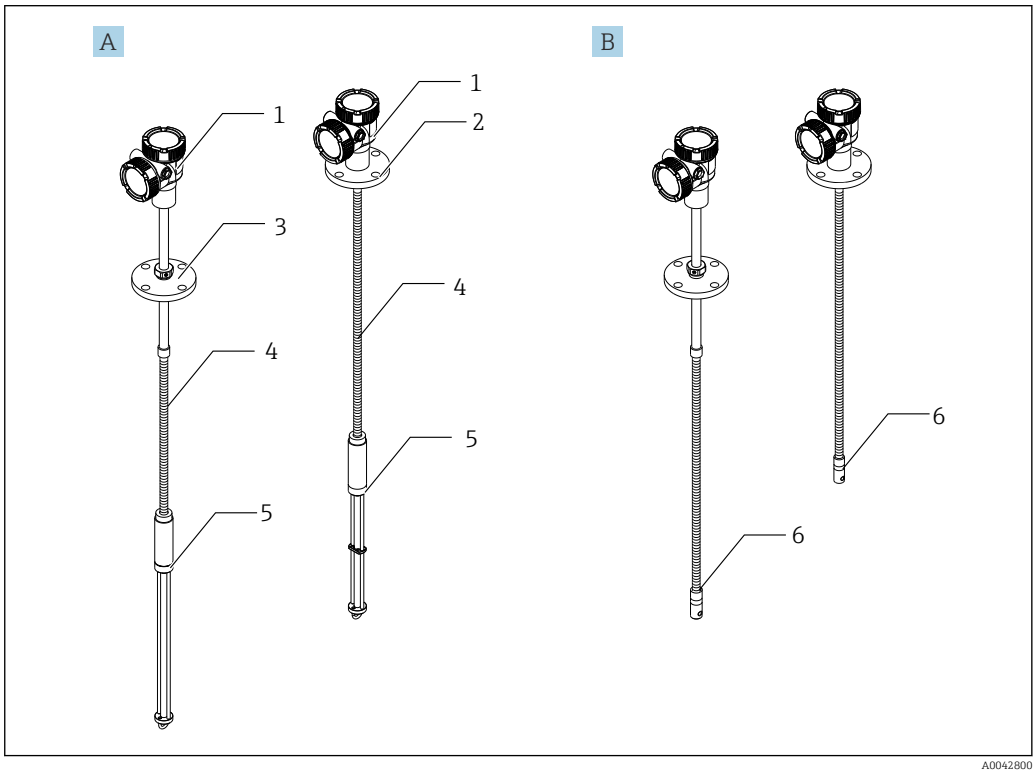
The measuring system meets the legal requirements of the applicable EU Directives. These are listed in the corresponding EU Declaration of Conformity along with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

3 Product description

3.1 Product design

NMT81 converter + average temperature probe version can be equipped with class A IEC 60751/DIN EN 60751 or class 1/10B Pt100 4-wire RTD sensor elements in its protective probe for up to 24 elements. It is able to accurately measure the temperature of each element by measuring its temperature dependent resistance. NMT81 converter + temperature probe version conforms to intrinsic safety standards, and because NMT81 consumes very little power, it guarantees superior safety as an electrical device that is installed in tanks in hazardous locations, and ecological/environmentally friendly as well.



1 *Design of Prothermo NMT81*

A NMT81 with water bottom (WB)
B NMT81 without water bottom (WB)
1 Converter
2 Welded flange
3 Adjustable flange
4 Flexible sensor probe
5 Water bottom (WB) sensor probe
6 Flexible sensor probe without WB

4 Incoming acceptance and product identification

4.1 Incoming acceptance

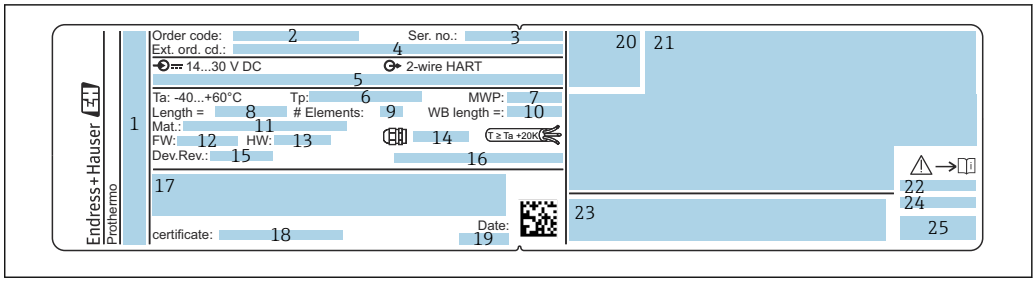
Upon receipt of the goods check the following:
- Are the order codes on the delivery note and the product sticker identical?
- Are the goods undamaged?
- Do the nameplate data match the ordering information on the delivery note?
- If required (see nameplate): Are the Safety Instructions (XA) enclosed?

If one of these conditions is not satisfied, contact your Endress+Hauser Sales Center.

4.2 Product identification

The following options are available for identification of the measuring device:
- Nameplate specifications
- Extended order code with breakdown of the device features on the delivery note
- *W@M Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the matrix code on the nameplate

4.2.1 Nameplate



2 *Nameplate of Prothermo NMT81*

1 *Manufacturer address*
2 *Order code*
3 *Serial number*
4 *Extended order code*
5 *Intrinsically safe parameters*
6 *Process temperature*
7 *Maximum working pressure*
8 *Length of temperature sensor probe*
9 *Number of elements*
10 *Length of Water Bottom (WB)*
11 *Material in contact with process*
12 *Firmware version*
13 *Hardware revision*
14 *Cable entry standard*
15 *Device revision*
16 *Ingress protection*
17 *Additional information of the device version*
18 *PTB certification number (for PTB approval type)*
19 *Manufacturing date*
20 *Certificate symbol*
21 *Data concerning Ex approvals*
22 *Associated Safety Instruction (XA)*
23 *Associated Safety Instruction (XA) for Local language*
24 *Manufacturer info. for local language*
25 *Device data for local language*

4.3 Manufacturer address

Endress+Hauser Yamanashi Co., Ltd.
406-0846
862-1 Mitsukunugi, Sakaigawa-cho, Fuefuki-shi, Yamanashi

4.4 Storage and transport

4.4.1 Storage conditions

- Storage temperature: −40 to 85 °C (−40 to 194 °F)
- Store the device in its original packaging.

4.4.2 Transport

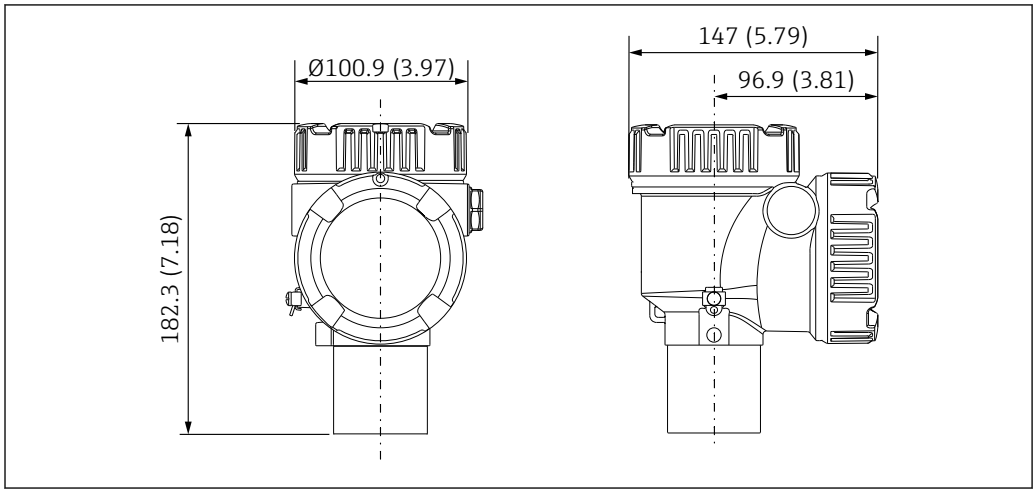
⚠ CAUTION

Risk of injury

- ▶ Follow the safety instructions and transport conditions for devices weighing more than 18 kg (39.69 lb).

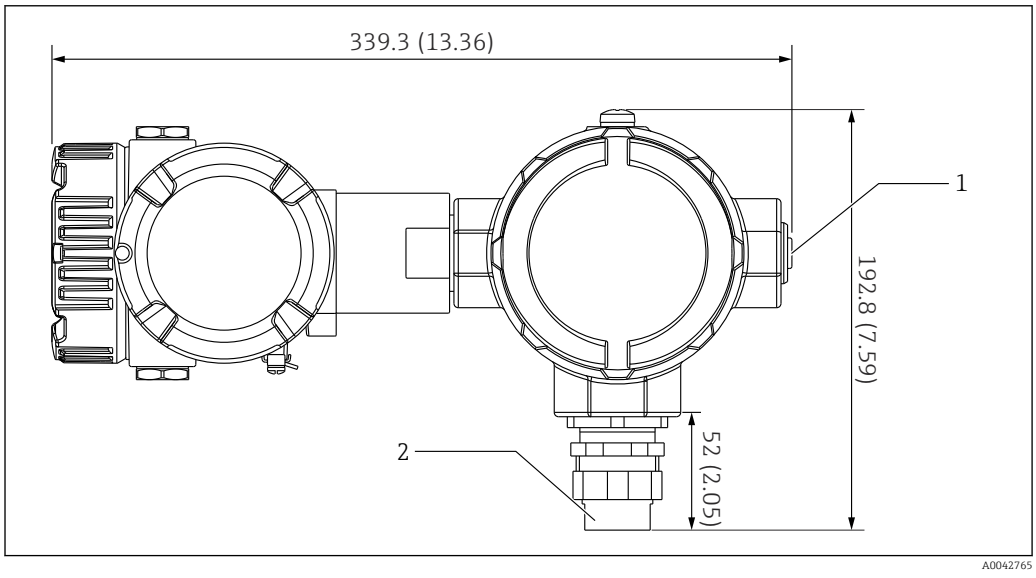
5 Installation

5.1 Converter



3 Standard converter. Unit of measurement mm (in)

5.2 Option 1: Converter with universal coupling



4 Option 1: converter (Standard G3/4 (NPT 3/4) universal coupling connection). Unit of measurement mm (in)

1 G 1/2 Stopping plug
2 G 3/4 thread

5.2.1 Option 1: Measurement functions

Because the software in the converter is equipped with a function that converts elements with different characteristics, it is possible to use other brand's temperature probes.

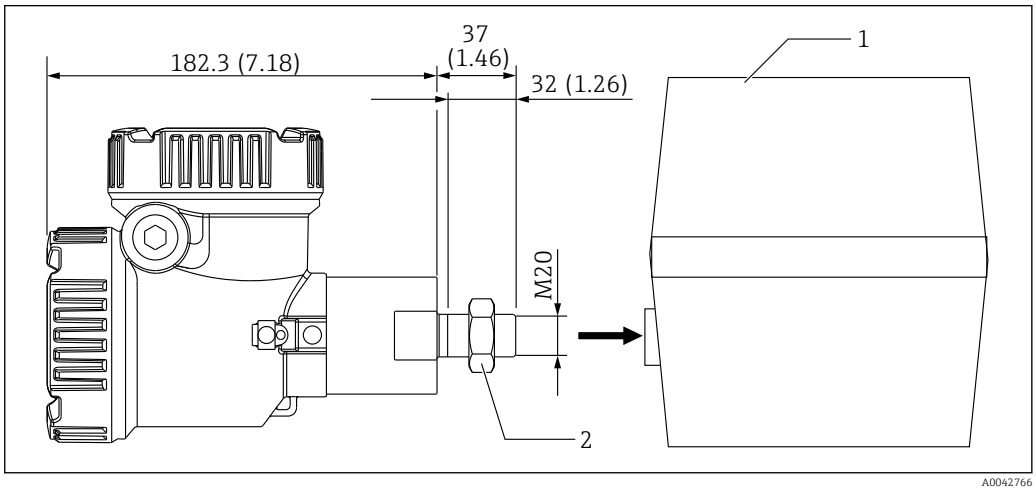
The NMT81 converter only version supports the following element types:

Elements	Standard	Temperature coefficient
Pt100	IEC60751	α=0.00385
Pt100	GOST	α=0.00391
Cu100	GOST	α=0.00428
Ni100	GOST	α=0.00617

- If elements other than the items above are required, contact your Endress+Hauser Sales Center.
- NMT81 is four-wire only with MSTs (Multi-spot thermometers), but it is not compatible with a thermocouple temperature device.
- The physical connection between a probe and NMT81 is completed by a zinc-plated carbon steel G 3/4" (NPT 3/4") universal threaded coupling. If a different thread size is required, Endress+Hauser can provide a solution by adapting a variety of coupling sizes and materials based on existing temperature probe specifications. Contact your Endress+Hauser Sales Center.
- Power supply and data transmission lines are both provided from the host gauge of NMS5, NMS8x, NMR8x, NRF81 or NRF590 through a two-wire local HART loop connection. NMT81 can be configured and operated using FieldCare.

5.3 Option 2: Converter with M20 mounting thread

This option model is designed specifically to connect with a Whessoe Varec 1700 series average temperature probe. WB data is not available because the 1700 series does not have WB.



5 *Option 2: converter (Varec 1700, M20 threaded connection). Unit of measurement mm (in)*

1 *Existing 1700 series RT probe terminal box on-site*
2 *Lock nut*

UK model M20 threaded type and Varec 1700 terminal housing connection procedure

1. Use sealing tape to protect the threaded connection opening, and insert the cable bundle (RTD signal entry cable) into the female threaded connection opening on the terminal box.

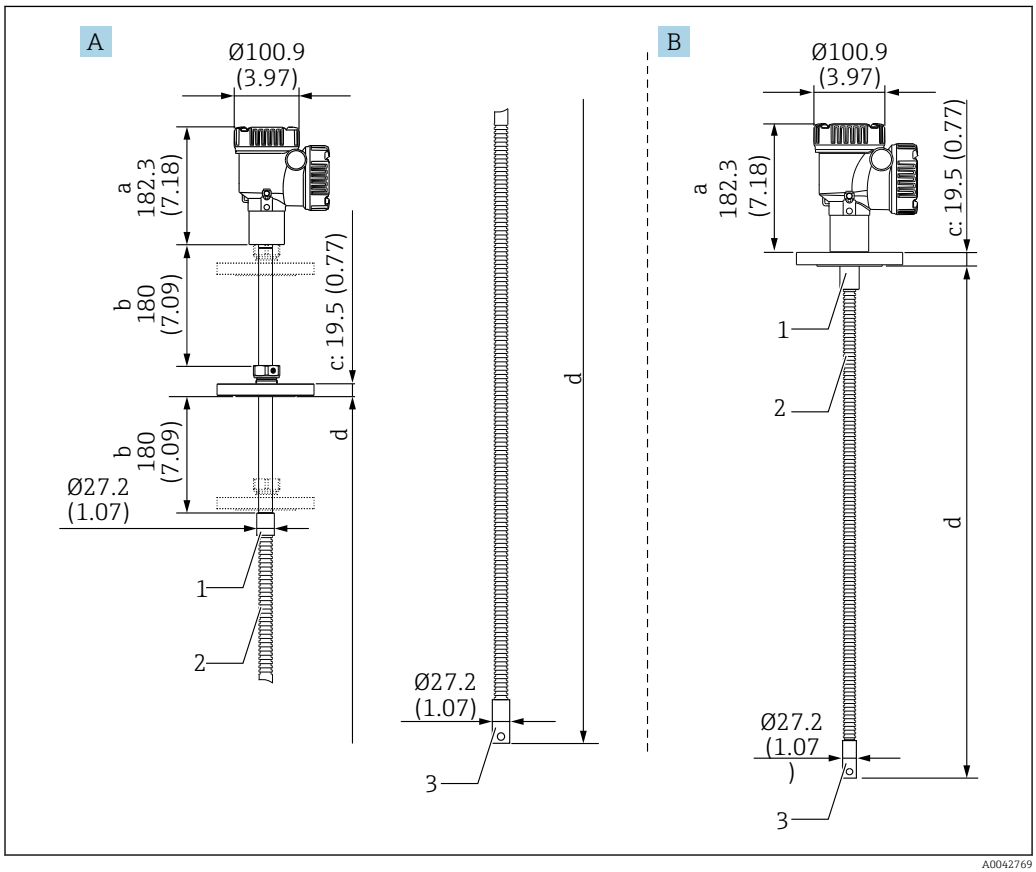
2. Screw on the NMT81 converter by rotating it at least 10 times clockwise, and secure it with a lock nut.
   ↳ A loose connection between NMT81 and Varec1700 terminal housings will lead to malfunction due to ingress of flood and other factors.

This completes the procedure.

5.3.1 Option 2: Measurement functions

Option 2 has the same functions as option 1; however, option 2 is designed so that a special M20 threaded connection opening fits directly in the existing terminal housing of a Varec 1700. The wiring of RTD signals from the probe to NMT81 is done in the terminal box of the Varec 1700 and not on the NMT81 side. For this reason, there is no additional housing provided to NMT81 as in option 1.

5.4 Converter + average temperature probe version



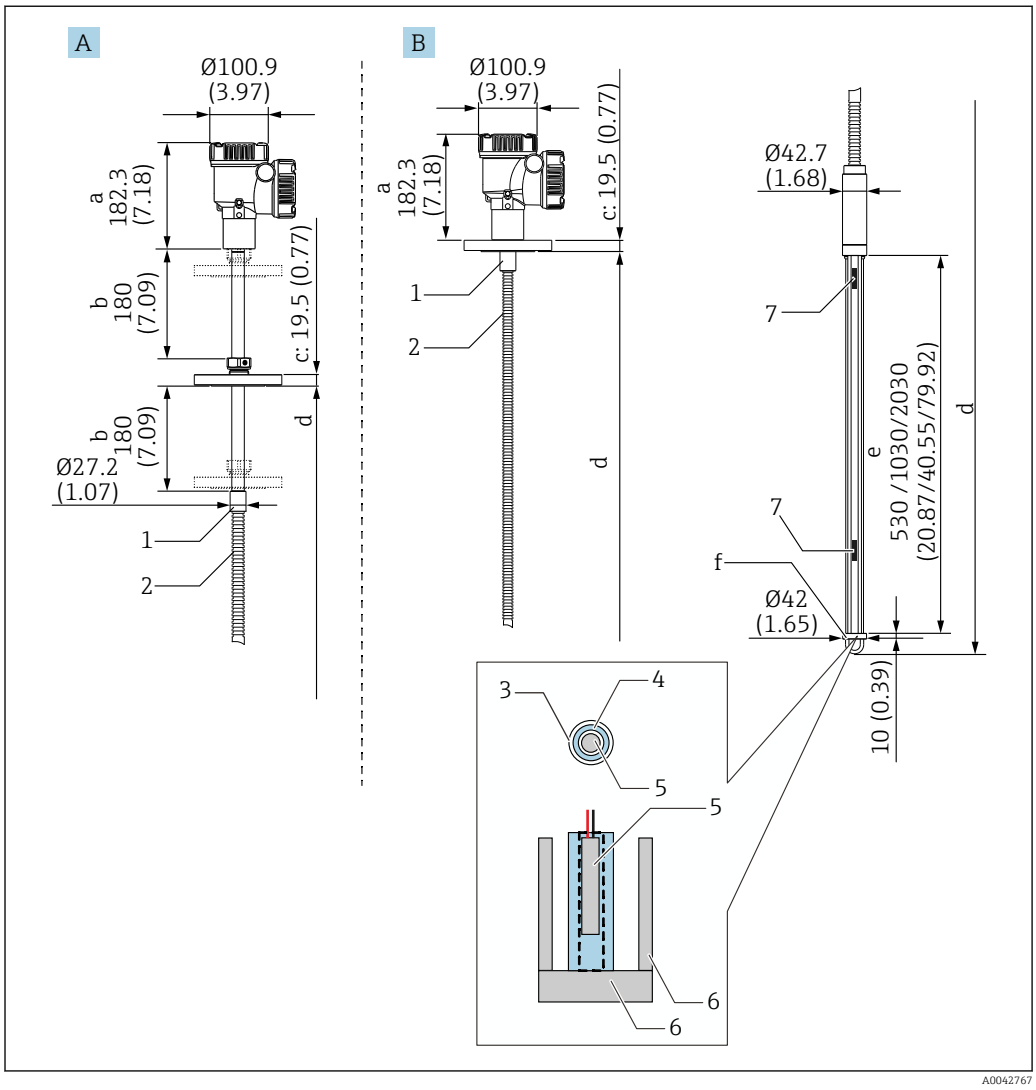
6 *Converter + average temperature probe. Unit of measurement mm (in)*

A Adjustable flange
B Welded flange
a Converter height
b Adjustable installation height
c Based on flange standards
d Temperature probe length (see below)
1 316L
2 316L
3 316L

The following tolerances are applied regardless of an optional WB probe. However, the position of the flange cannot be adjusted in a welded flange type.

Probe length	Tolerance of probe and element positions
1 000 to 25 000 mm (39.37 to 984.25 in)	± 50 mm (1.97 in)
25 001 to 40 000 mm (984.29 to 1 574.80 in)	± 50 mm (1.97 in)
40 001 to 60 000 mm (1 574.84 to 2 362.21 in)	± 100 mm (3.94 in)
60 001 to 100 000 mm (2 362.24 to 3 937.01 in)	± 300 mm (11.81 in)

5.5 Converter + average temperature probe + water bottom probe



7 *Converter + temperature probe + WB probe. Unit of measurement mm (in)*

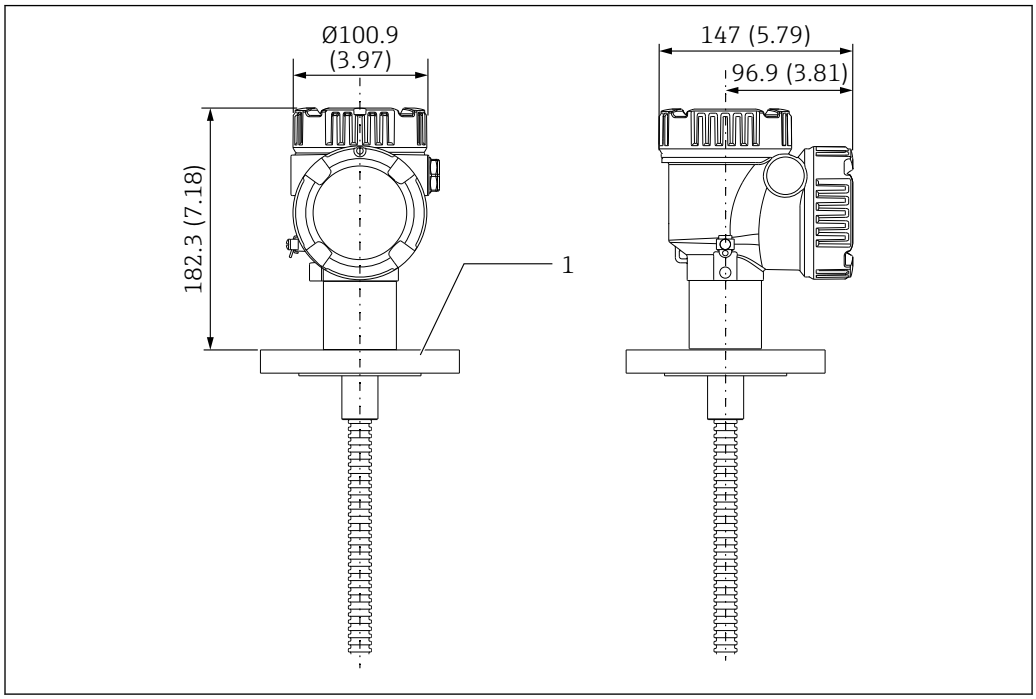
A *Adjustable flange*
B *Welded flange*
a *Converter height*
b *Adjustable installation height*
c *Based on flange standards*
d *Probe length (from flange bottom to the tip of WB probe) (see below)*
e *Capacitance WB probe*
f *Anchor weight hook (316L)*
1 *316L*
2 *316L*
3 *PFA protection tube (thickness 1 mm (0.04 in))*
4 *Sensor pipe (304)*
5 *Pt100 element*
6 *Base plate/side rod (316L)*
7 *Element*

The following tolerances are applied regardless of an optional WB probe. The position of the flange cannot be adjusted in a welding flange type.

Probe length	Tolerance of probe and element positions
1 000 to 25 000 mm (39.37 to 984.25 in)	± 50 mm (1.97 in)
25 001 to 40 000 mm (984.29 to 1 574.80 in)	± 50 mm (1.97 in)
40 001 to 60 000 mm (1 574.84 to 2 362.21 in)	± 100 mm (3.94 in)
60 001 to 100 000 mm (2 362.24 to 3 937.01 in)	± 300 mm (11.81 in)

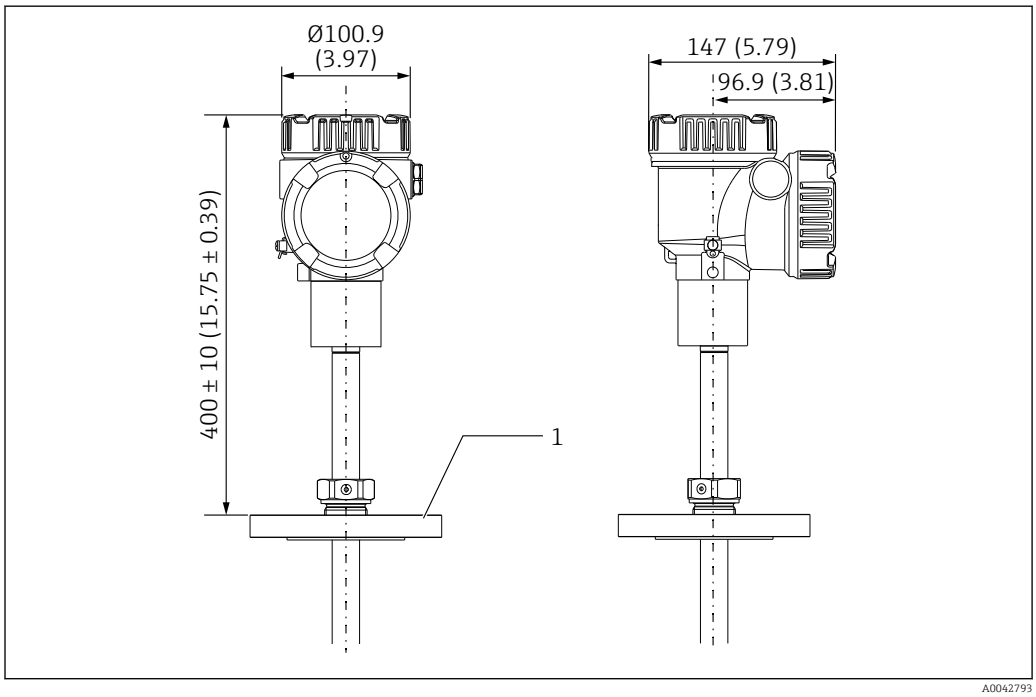
5.6 Flange

Welded flanges are more watertight because the joint is completely welded together. However, the position of welded flanges cannot be adjusted.



8 Welded flange. Unit of measurement mm (in)

1 Flange (JIS, ASME, JPI, DIN)



9 Adjustable flange. Unit of measurement mm (in)

1 Flange (JIS, ASME, JPI, DIN)

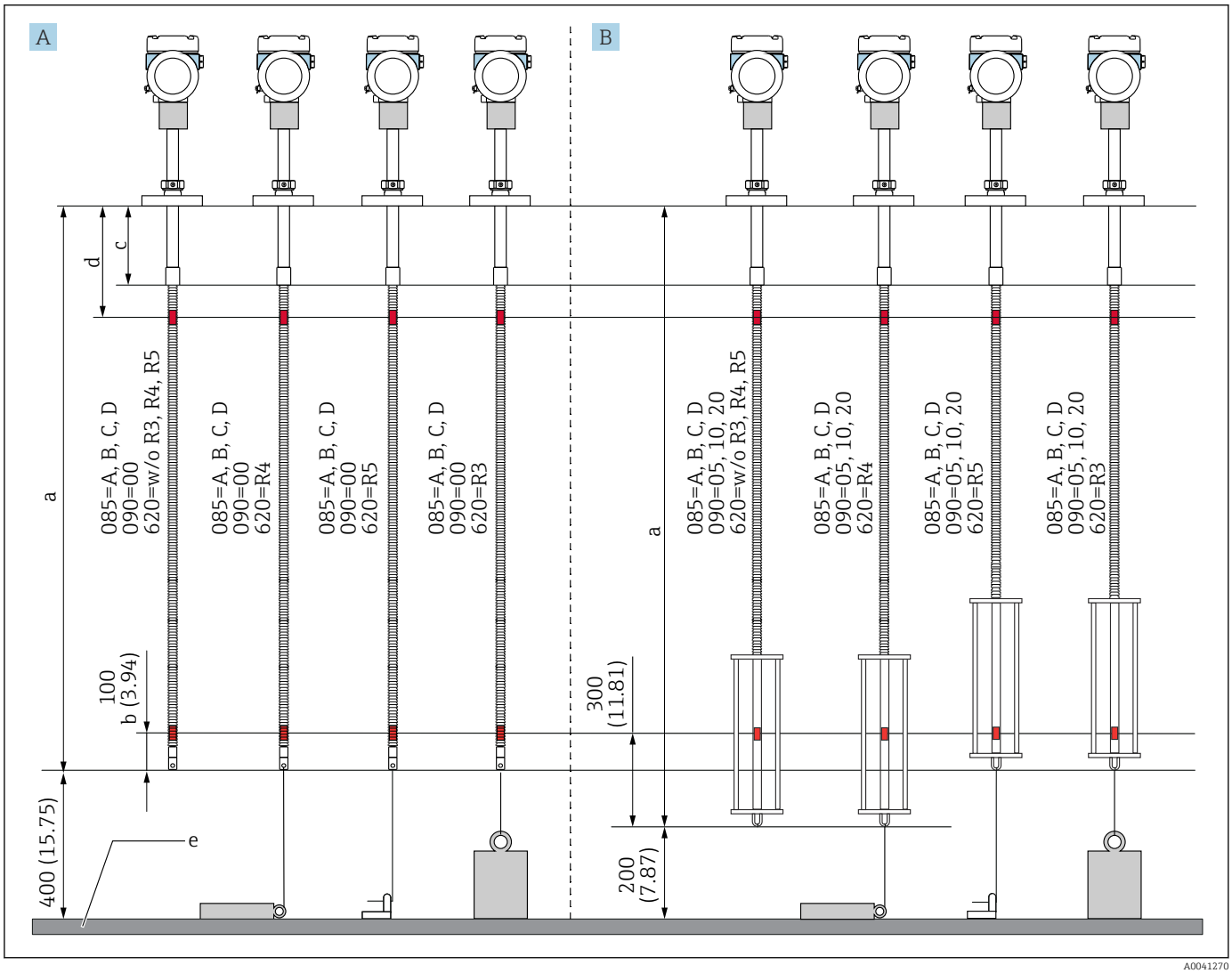
5.7 Element No. 1 position

Element No. 1 is mounted inside the probe according to the combinations of order specifications as described in the figure below. The element No. 1 is usually the element mounted in the lowest position in the tank.

When selecting 085 = E (customized positioning) the element No. 1 can be positioned in a range from: 100 mm (3.94 in) (d) measured from end of the probe up to probe length -315 mm (12.40 in) (d)

When selecting 085 = F, the element No. 1 is mounted at the position of 100 mm (3.94 in) from the bottom of the probe (b in the figure), and the element at the highest point is mounted at a position 315 mm (12.40 in) (d in the figure) from the bottom of the flange. All other elements are mounted at a spacing determined by following formula.

Element spacing = (a - b - d) / (number of measuring points - 1)

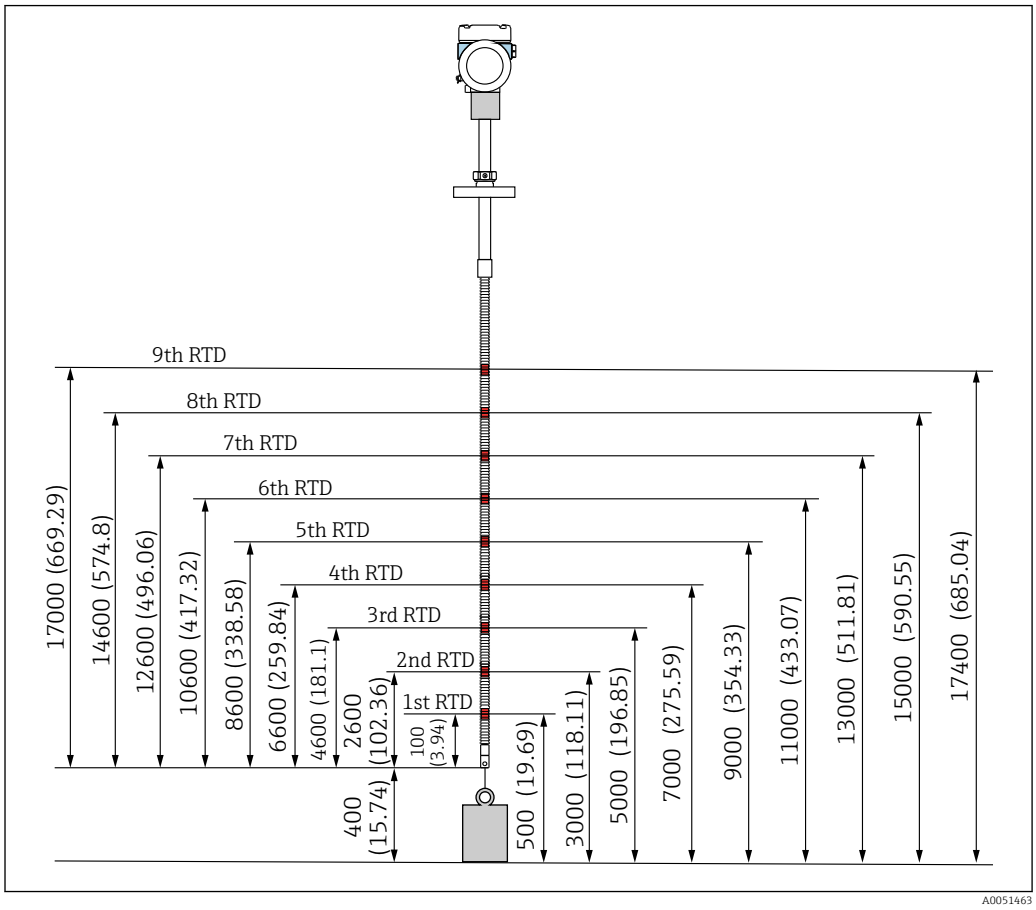


10 *Position of NMT81 element No. 1 based on the installation method. Unit of measurement mm (in)*

A Converter + temperature probe
B Converter + temperature probe + WB probe
a Recommended installation (Probe length)
b Element No.1
c Factory default setting distance from flange bottom to flexible probe: 215 mm (8.46 in)
d Minimum distance from flange bottom to upper element: 315 mm (12.40 in)
e Tank bottom/Datum plate

5.8 Element positions

The order specification of 085 E shows element positions from the probe end. FC data shows element positions from the tank bottom/datum plate.

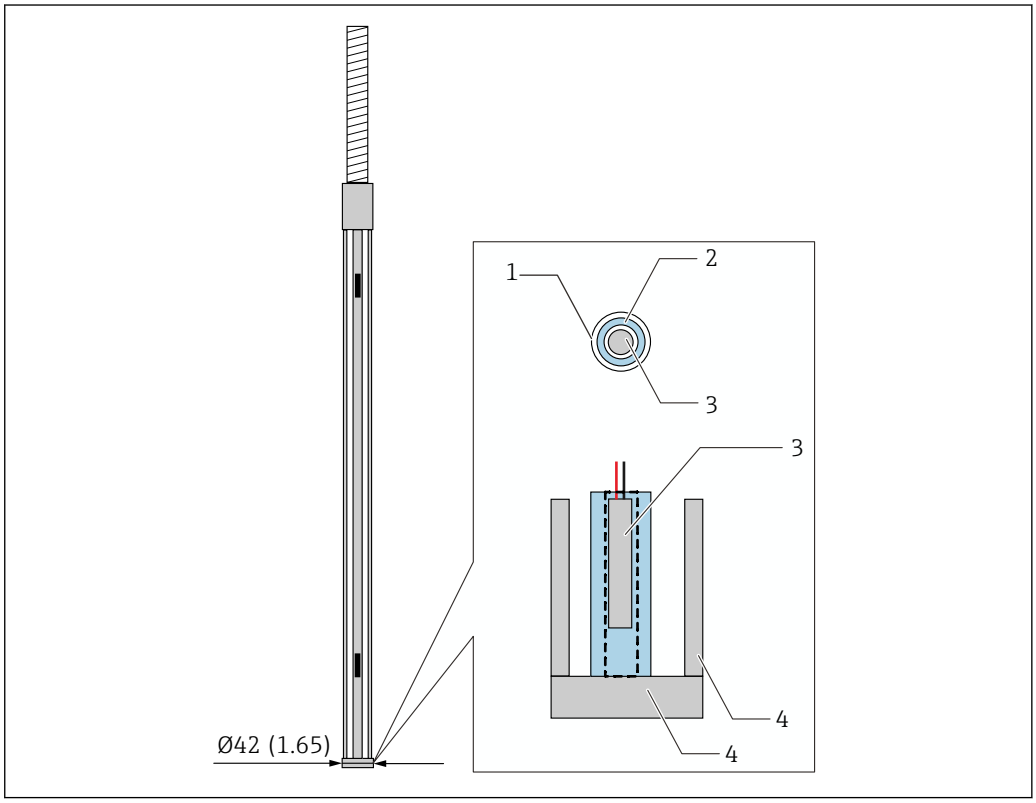


11 Element position. Unit of measurement mm (in)

5.9 WB probe design

The integrated WB sensor (capacitance water interface measurement) is set at the bottom of an average temperature probe. The standard water interface measurement ranges are 500 mm (19.69 in), 1 000 mm (39.37 in), and 2 000 mm (78.74 in). The WB probe is made of 304 stainless pipe protected by 1 mm (0.04 in) thickness PFA tube and a 316L base plate and side rods. Up to two Pt100 temperature elements can be set in the tube. This allows constant temperature measurement near the tank bottom.

- Precise initial calibration of NMT81 is performed in accordance with your options prior to shipping.
- NMT81 cannot measure the water interface if the water inside the tank is frozen. Ensure that the water in the tank does not freeze.



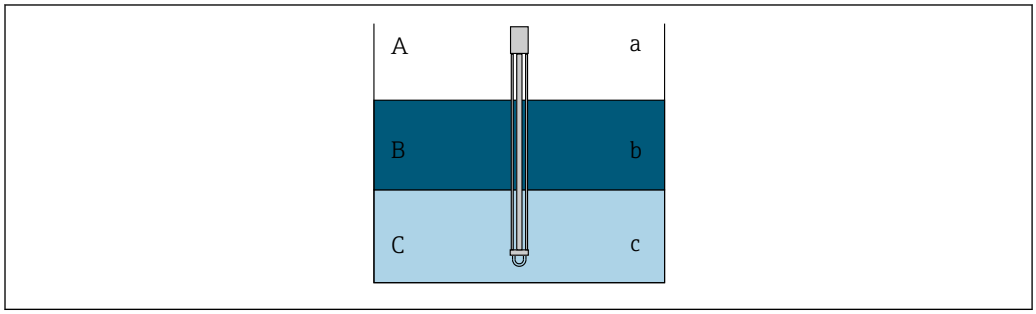
12 *WB probe design. Unit of measurement mm (in)*

1 *PFA protective tube (thickness: 1 mm)*
2 *Sensor pipe (304)*
3 *Pt100 element*
4 *Base plate/side rod (316L)*

5.9.1 Water level measurement in the three layers condition

When measuring the water level with three layers (air, product, and water) present in the range of the water bottom (WB), the accuracy of the water level measurement is negatively influenced by the dielectric difference between air, product, and water.

NMT81 compensates for this influence by comparing the product level from NMS8x or NMR8x. NMT81 also eliminates the influenced dielectric difference with this compensation result so that the water bottom (WB) maintains high probe accuracy and stable measurement.



13 *Water level measurement in three layers*

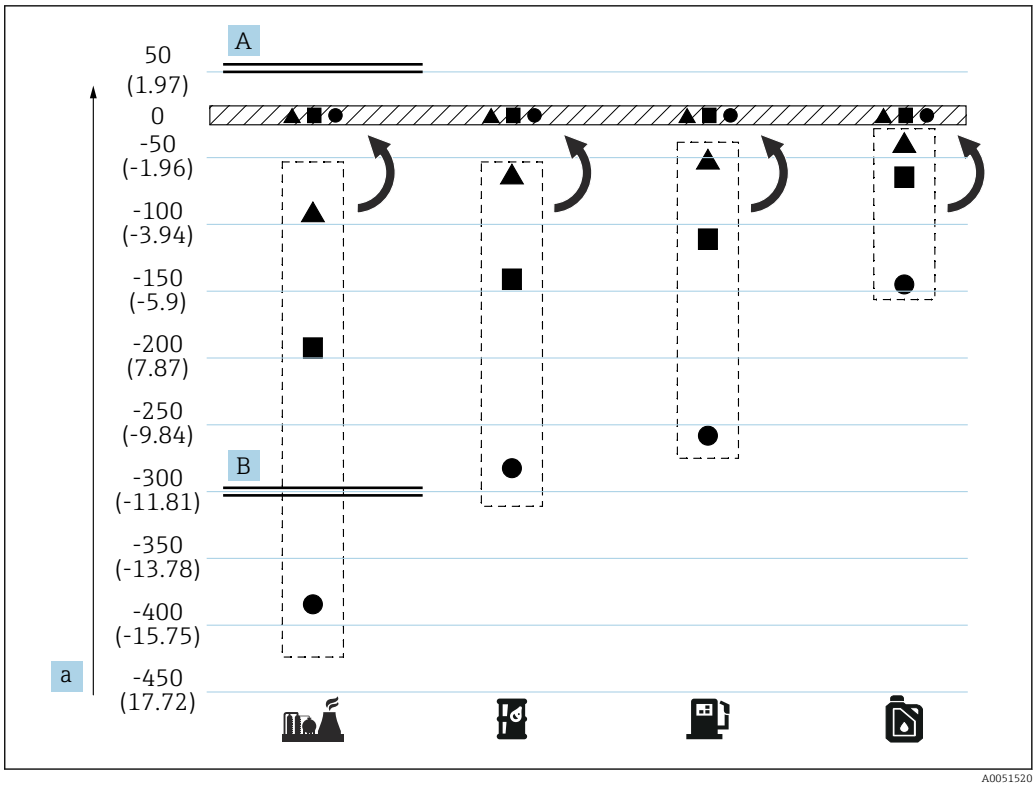
A *Air*
B *Product*
C *Water*
a *Low dielectric*
b *Dielectric*
c *Conductivity*

The relationship between the assumed relative permittivity and the application are as follows.

No	Relative permittivity	Application
1	3.0	Fuel
2	2.5	Crude
3	2.2	Gasoline
4	1.8	Diesel oil, Kerosene
5	1.0	Air

Fuel refers to biodiesel, soybean oil, and such like. By selecting an item that best represents your application from the table above, the measurement error can be approximated to 0 mm (0 in).

If the function of the three-layer compensation is not enabled (no compensation), the error appears on the minus side on the table below. However, three-layer compensation will be available only if the relative permittivity of the application is approximately 3 (fuel) or less.



14 *Effect of the three layers compensation*

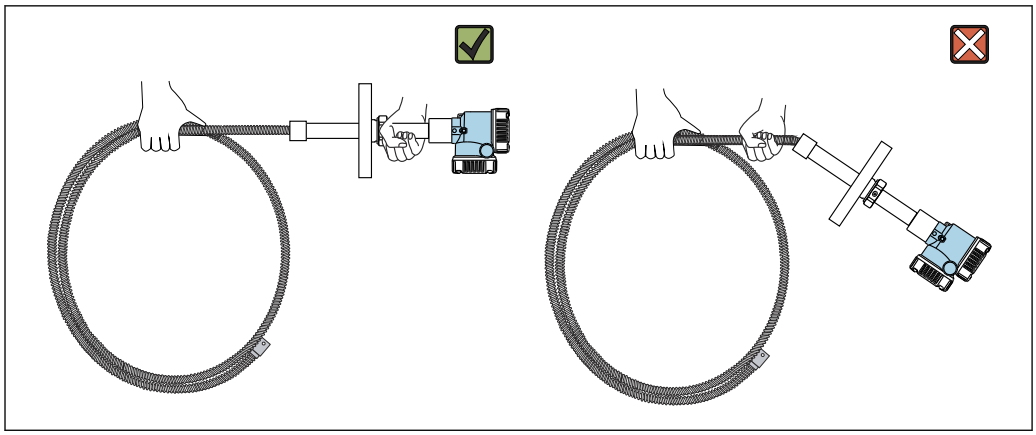
A With compensation
B Without compensation
a Maximum error of water level mm (in)

	Fuel	●	Probe length = 2.0 m (6.56 ft)
	Crude	■	Probe length = 1.0 m (3.28 ft)
	Gasoline	▲	Probe length = 0.5 m (1.64 ft)
	Diesel heating oil, Kerosene		

5.10 Pre-installation of NMT81

5.10.1 Unpacking

Unpack NMT81 with multiple people. If NMT81 is unpacked by one person alone, the temperature probe may become bent or twisted.

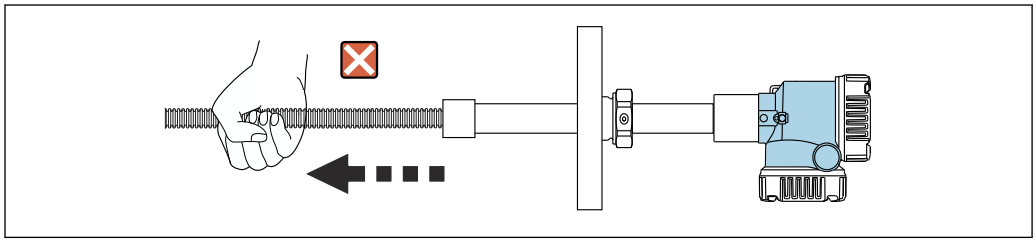


A0042787

15 *Unpacking NMT81*

5.10.2 Temperature probe handling

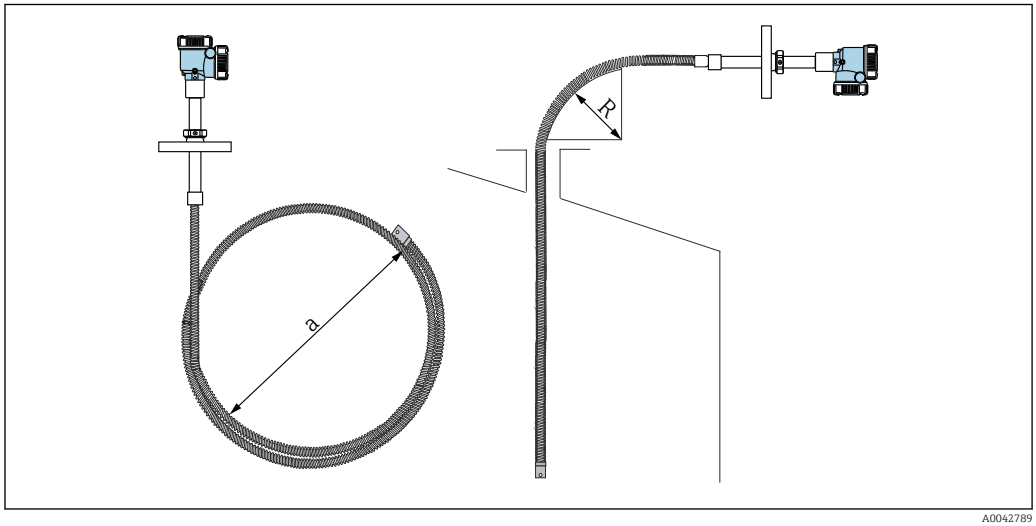
Do not pull the converter while holding onto the temperature probe. This may cause the device to malfunction.



A0042788

16 *Temperature probe handling*

When winding the temperature probe, keep the bending diameter at a minimum of 600 mm (23.62 in). When installing the temperature probe onto a tank or if it is necessary to bend the temperature probe, ensure that the bent portion is at least R = 300 mm (11.81 in).



A0042789

17 *Installation and winding of a temperature probe*

a *600 mm (23.62 in) or more*
R *300 mm (11.81 in) or more*

⚠ CAUTION

If bending the temperature probe with R smaller than 300 mm (11.81 in), it may damage the probe and elements.

▶ Bend the probe 300 mm (11.81 in) or more.

5.10.3 Installation height adjustment

A unique feature of NMT81 is the optional ability to adjust height by approx. ±180 mm (7.09 in) from the original position.

The height adjustment feature is not available for the welded flange type and the converter-only version.

5.11 Installation procedure

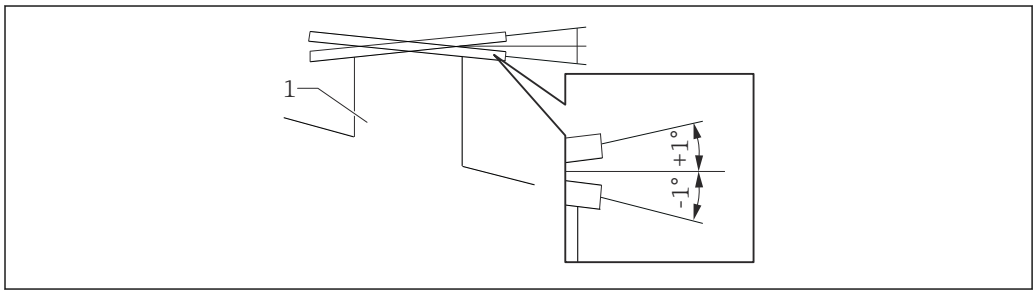
The length of the NMT81 probe is predetermined by the customer. Check the following items before installing.

- Tag number on the device
- Length of the temperature probe
- Number of elements
- Element intervals
- The procedure for installing NMT81 will vary depending on the tank's shape and type. A cone roof tank and a floating roof tank are used for the following examples. The procedure to mount NMT81 flange on a tank nozzle flange is the same regardless of what type of tank is being used.
- The recommended diameter of the installation nozzle is:
  - Temperature only probe: 32A (1-1/4") or more
  - With WB probe: 50A (2") or more

5.11.1 NMT81 Installation

Confirm that the size of the nozzle and the flange is matched prior to mounting NMT81 on the tank. The flange size and the rating of NMT81 vary depending on the customer's specifications.

- Check the flange size of NMT81.
- Mount the flange on the top of the tank. The deviation of the flange from the horizontal plane should not exceed +/- 1 degree.
- Install NMT81 at least 300 mm (11.81 in) or API 7: 1 000 mm (39.4 in) away from the wall. This will ensure that the temperature measurement is not affected by the tank's ambient or wall temperature.



18 *Allowable inclination of mounting flange*

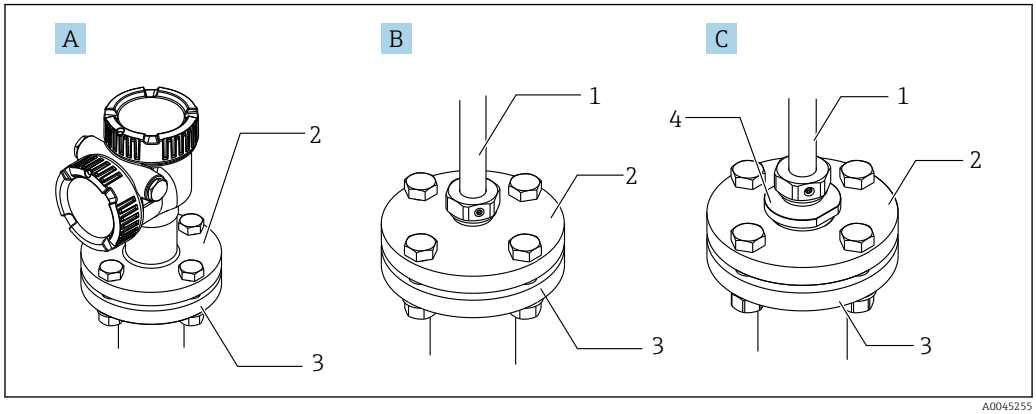
1 Nozzle

Insert the temperature probe and the optional WB probe and low profile anchor weight through the tank nozzle at the top of the tank.

To prevent damage to the temperature probe and WB probe, ensure that they do not touch anything during insertion through the installation nozzle.

Flange types

For NMT81 installation, there are three types of flange adjusters as follows.



19 *flanges*

A Non-height adjuster
B Height adjuster
C Thread type adjuster
1 Adjuster
2 Flange
3 Tank top flange (prepared by a customer)
4 Reducer

Non-height adjuster type mounting procedure

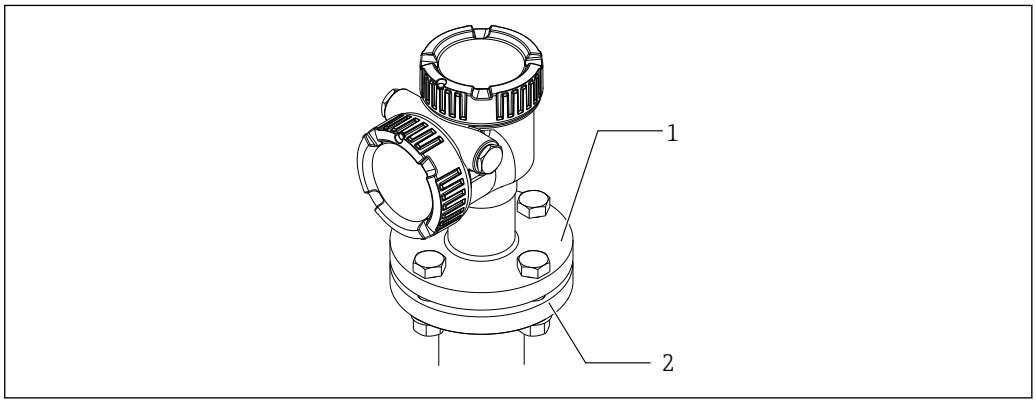
Make sure to align the correct orientation position of the device prior to tightening bolts.

⚠ CAUTION

Cable damage

It may cause the damage of the cable inside.

- ▶ Do not rotate the housing with loosening the socket head cap screw mounted on the side of the converter.

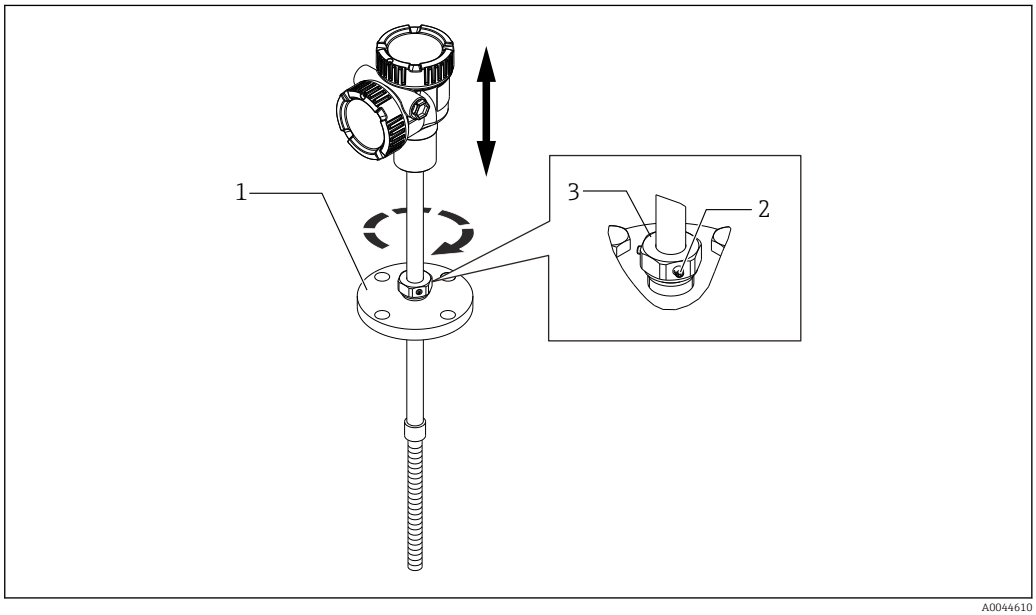


20 *Non-height adjuster type*

1 Flange (NMT81 side)
2 Tank top flange (prepared by a customer)

Height adjuster type mounting procedure

1. Loosen the hexagonal socket set screws [2].
2. Loosen the bush [3].
3. Adjust the height and align the orientation position of NMT81.
4. Tighten the bush.
   ↳ Tightening torque: 60 Nm
5. Tighten the hexagonal socket set screws securely.
   ↳ Tightening torque: 4 Nm

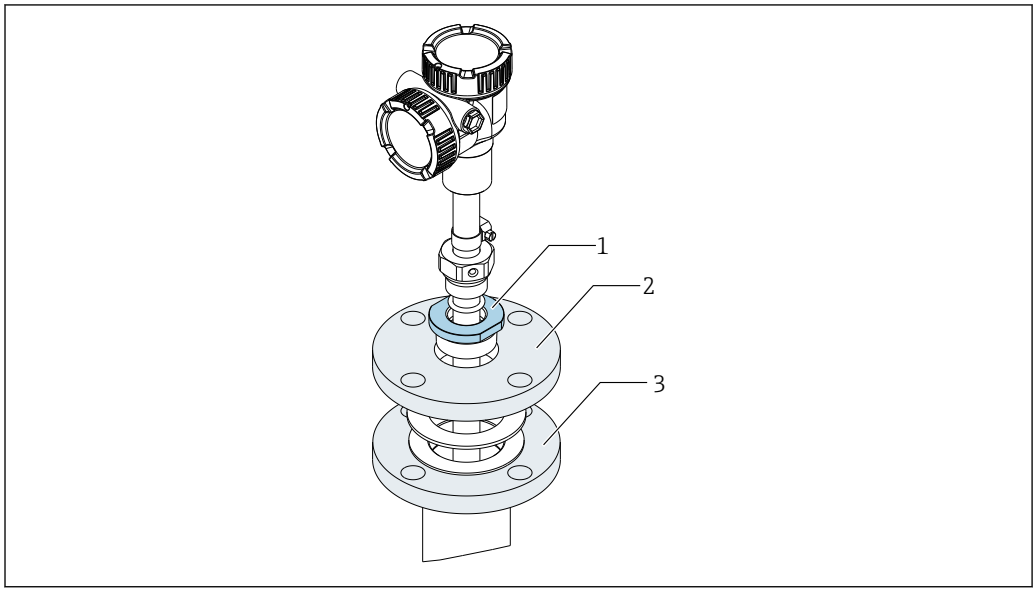


21 *Height adjust type of NMT81*

1 Flange
2 Hexagonal socket set screw
3 Bush

Thread type adjuster mounting procedure

- ▶ Tighten the reducer securely [1].
  - ↳ Tightening torque for NPT1-1/2: 255 Nm
    Tightening torque for NPT2: 316 Nm



22 *Thread type adjuster*

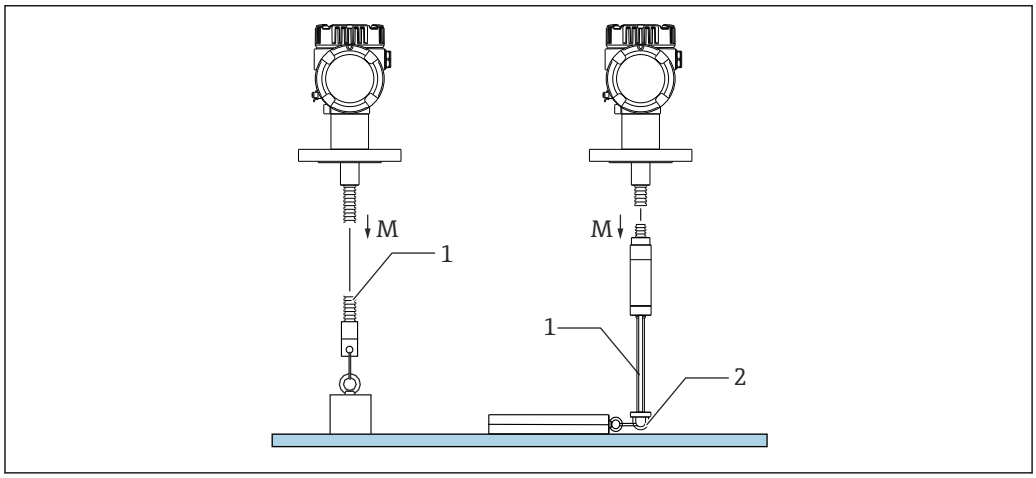
1 Reducer
2 Flange (prepared by a customer)
3 Tank top flange (prepared by a customer)

⚠ CAUTION

Precautions regarding stranded wire on anchor weight and top anchor

Applying tension of more than 6 kg (13.23 lb) may cause internal damage in the temperature probe.

- ▶ Ensure that the tension during and after installation is no more than 6 kg (13.23 lb).



23 *Installation of anchor weight*

M During/after installation: M ≤ 6 kg (13.23 lb)
1 Lowest temperature element position
2 Hook

5.12 Mounting NMT81 on a cone roof tank

When installing a WB probe, check "zero point" (reference position) on the WB probe by comparing it to a manual dipping reference.

There are three ways to install NMT81 onto a cone roof tank:

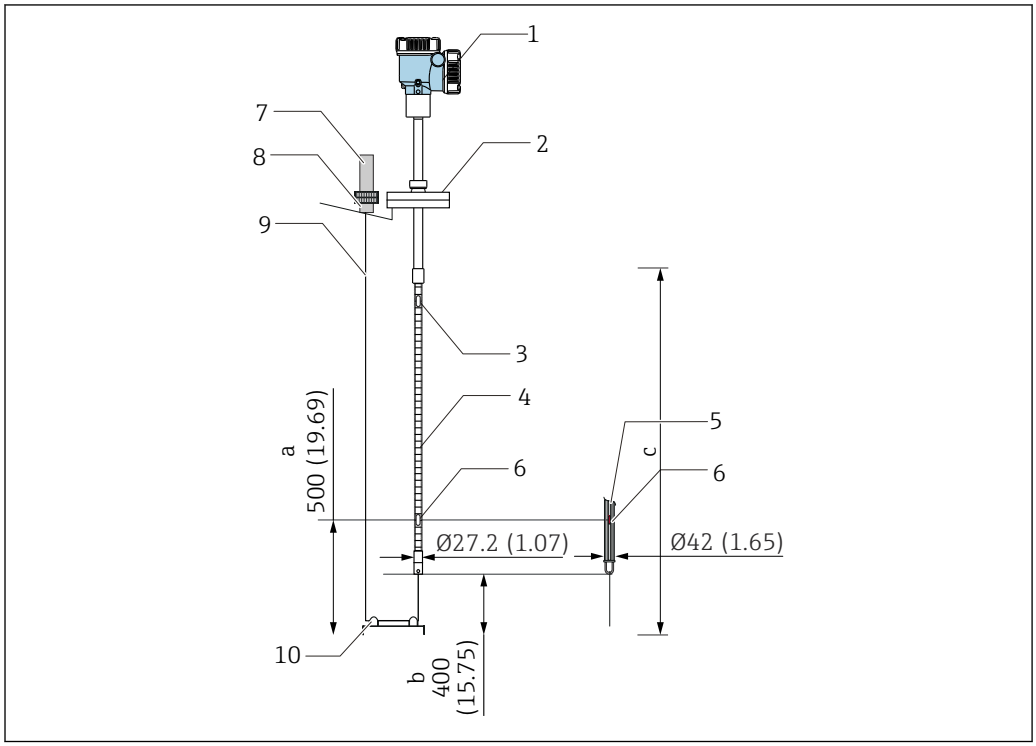
- Top anchor method
- Stilling well method
- Anchor weight method

If a heating coil is attached to the bottom of the tank, install NMT81 so that the bottom of the temperature probe or WB probe is not too close to the heating coil (distance varies depending on the type of heating coil).

5.12.1 Top anchor method

In this method, the temperature probe or the WB probe is secured using a wire hook and a top anchor.

To prevent damage to temperature probe and WB probe, ensure that they do not touch anything during insertion through the installation nozzle.



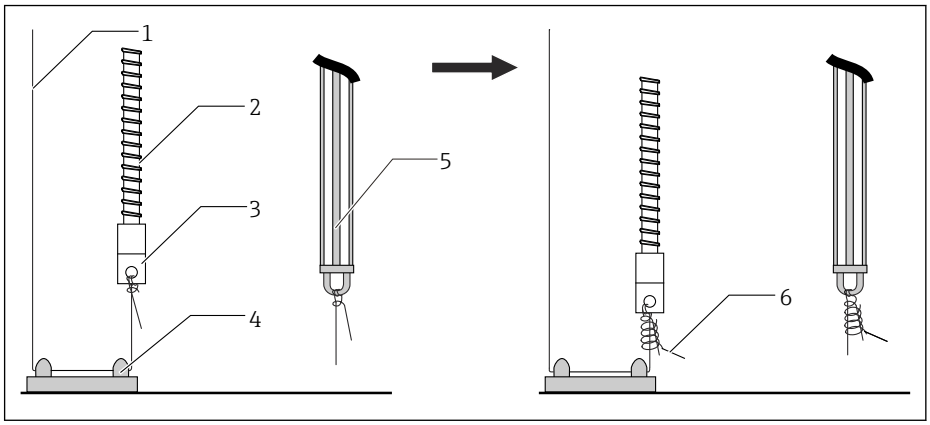
24 *Top anchor method. Unit of measurement mm (in)*

a From the tank bottom to the lowest element
b From the tank bottom to the probe bottom
c Tank height
1 Converter (electrical compartment)
2 Flange
3 Highest temperature element
4 Temperature probe
5 WB probe
6 Element position No.1 (lowest element)
7 Top anchor
8 Socket
9 Stranded wire
10 Wire hook

Top anchor installation procedure

1. Suspend the stranded wire from the top anchor at the top of the tank and temporarily secure its end to the top anchor.
2. Pass the stranded wire through the wire hook at the bottom of the tank.
3. Feed the stranded wire through the eye bolts of the bottom wire hook.

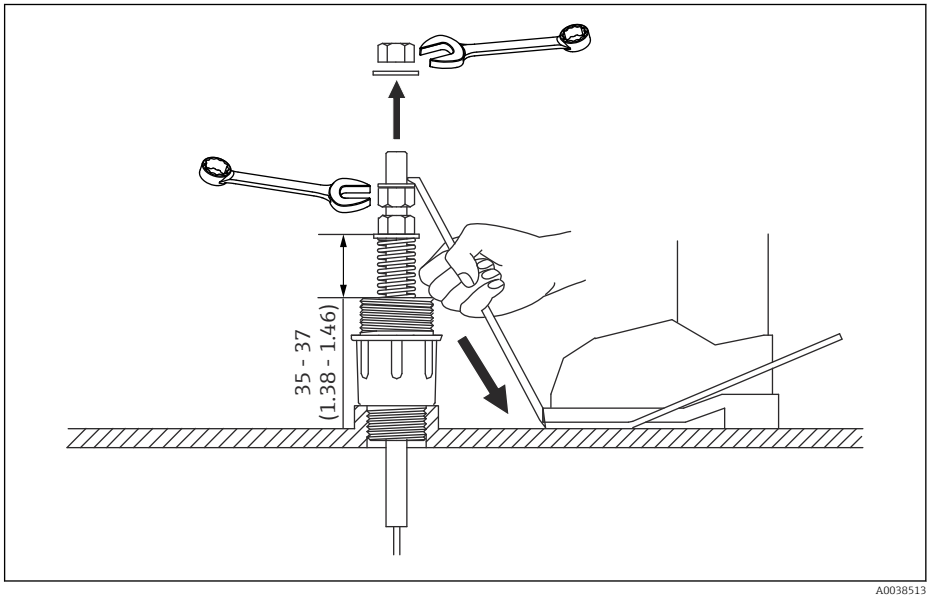
4. Tie the stranded wire, and then bundle the knot with the provided securing wire.



25 *Top anchor installation 1*

1 *Stranded wire (Specified length of the probe + 2 000 mm (78.74 in)/φ3 mm (0.12 in))*
2 *Temperature probe*
3 *Probe bottom hook (wire suspension)*
4 *Wire hook*
5 *WB probe*
6 *Provided securing wire (2 000 mm (78.74 in)/φ0.5 mm (0.02 in))*

5. Secure the stranded wire to the top anchor while drawing it by holding it down with a foot or a hand.
6. Wrap the end of the stranded wire once around the top anchor's axis, and tighten it using two nuts.
7. Cut the excess stranded wire.
8. Rotate the nuts clockwise until the top anchor's spring is 35 to 37 mm (1.38 to 1.46 in).



26 *Top anchor installation 2. Unit of measurement mm (in)*

9. Cover the top anchor.

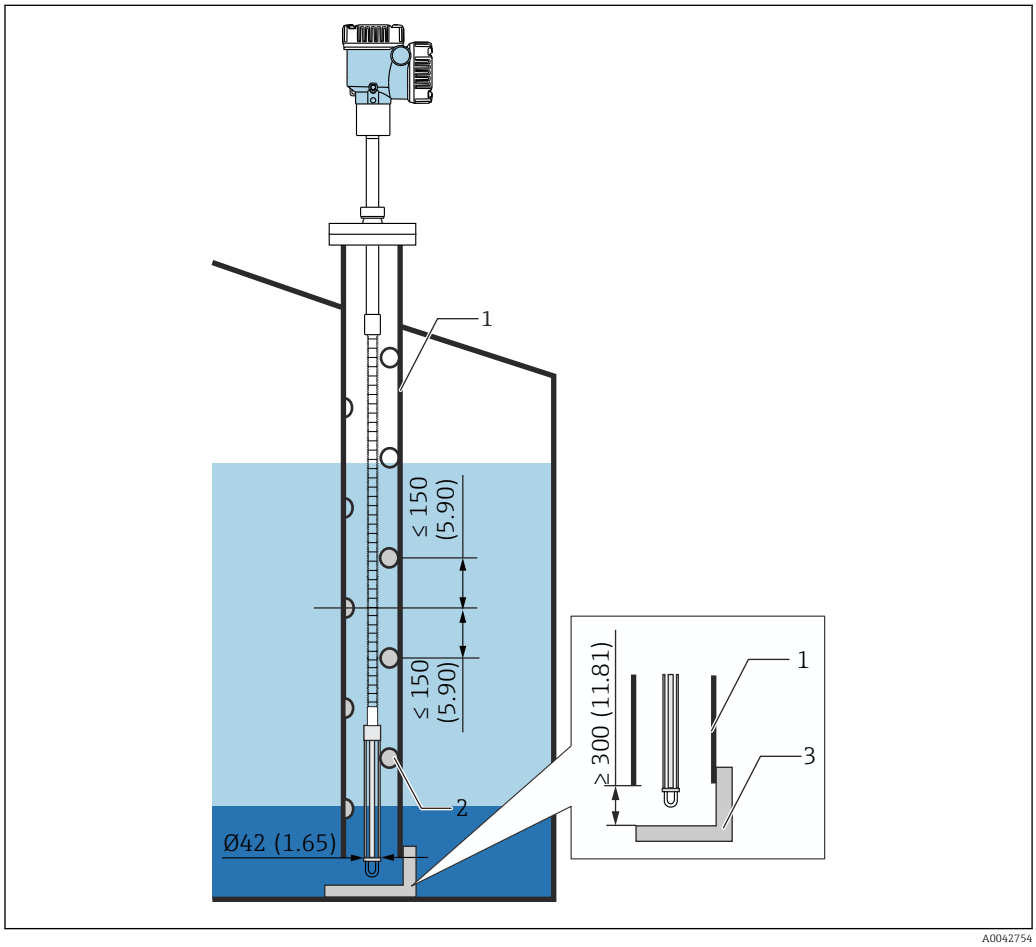
This completes the procedure for installing a top anchor.

5.12.2 Stilling well method

Prepare the stilling well that is larger than the diameter of the measuring probe when installing it.

When using an anchor weight, use a pipe that is 100A (4") (JIS, ASME) or larger. If an anchor weight is not being used in the stilling well method, install the WB probe so that its end is below the bottom of the stilling well. This will allow the pipe to be filled with liquid.

To prevent damage to temperature probe and WB probe, ensure that they do not touch anything during insertion through the installation nozzle.



27 *Stilling well. Unit of measurement mm (in)*

1 *Stilling well*
2 *Hole (φ 25 mm (0.98 in))*
3 *Base plate/datum plate*

Stilling well installation procedure

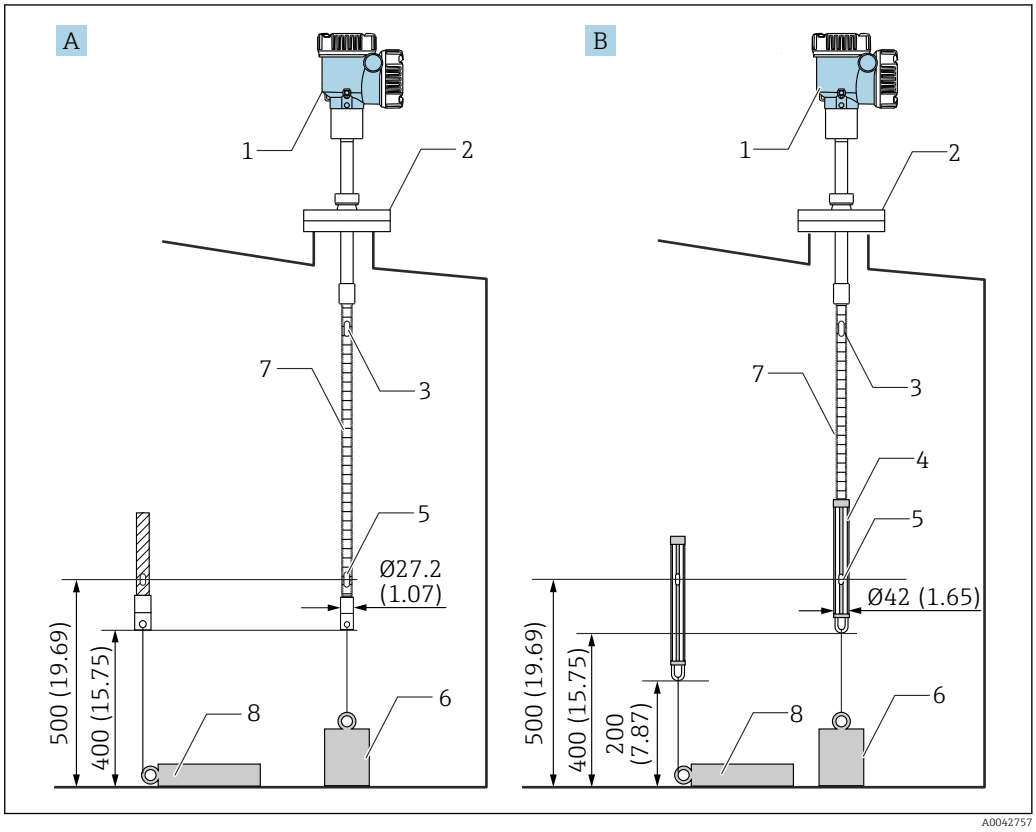
1. Pass the temperature probe and the WB probe through a gasket and insert them from the installation nozzle at the top of the tank.
2. Use bolts to secure the flange of NMT81 to the installation nozzle on top of the tank.

This completes the procedure for installing a stilling well.

5.12.3 Anchor weight method

This method secures a temperature probe using an anchor weight.

To prevent damage to temperature probe and WB probe, ensure that they do not touch anything during insertion through the installation nozzle.



28 *Anchor weight method. Unit of measurement mm (in)*

A Without WB probe
B With WB probe
1 Converter (electrical compartment)
2 Flange
3 Top element
4 WB probe
5 Element No.1 (lowest element)
6 Anchor weight (high profile)
7 Temperature probe
8 Anchor weight (low profile)

⚠ CAUTION

Installation of an anchor weight

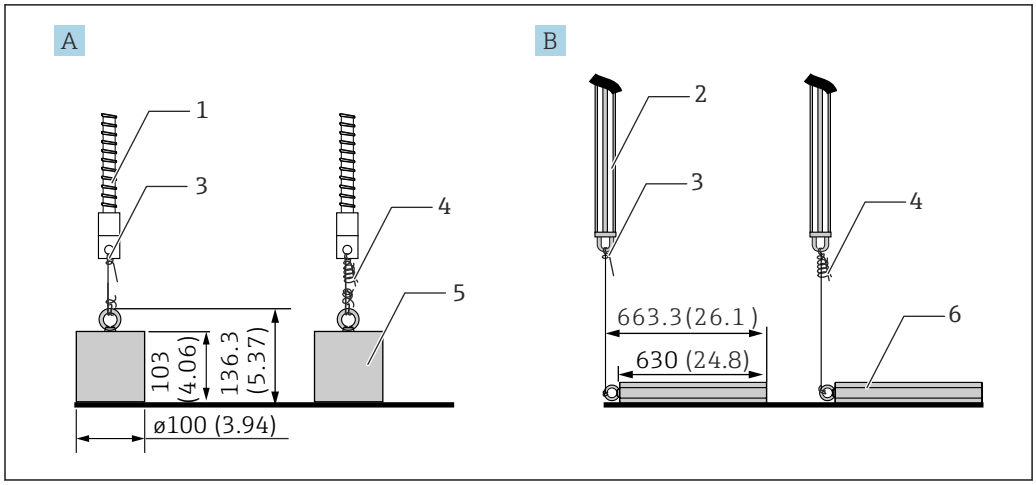
Using an anchor weight that is heavier than 6 kg (13.23 lb) may cause internal damage to the temperature probe.

- ▶ Ensure that the anchor weight is stable at the bottom of the tank. When installing NMT81 with a suspended anchor weight, use an anchor weight that weighs 6 kg (13.23 lb) or less.

Anchor weight installation procedure

1. Tie the bottom hook of the temperature probe or the WB probe to the anchor weight's ring using a stranded wire.
2. Wrap the stranded wire twice around the bottom hook. Pull it downwards and tie it down, and then bundle it with the provided securing wire.
3. Using bolts, secure the flange of NMT81 to the nozzle at the top of the tank.

This completes the procedure for installing an anchor weight.



29 *Anchor weight installation*

A Probe without WB
B Probe with WB
1 Temperature probe
2 WB probe
3 Bottom hook
4 Provided securing wire (1 300 mm (51.12 in)/φ0.5 mm (0.02 in))
5 Anchor weight (high profile)
6 Anchor weight (low profile)

5.13 Mounting NMT81 on a floating roof tank

There are three ways to mount NMT81 on to a floating roof tank.

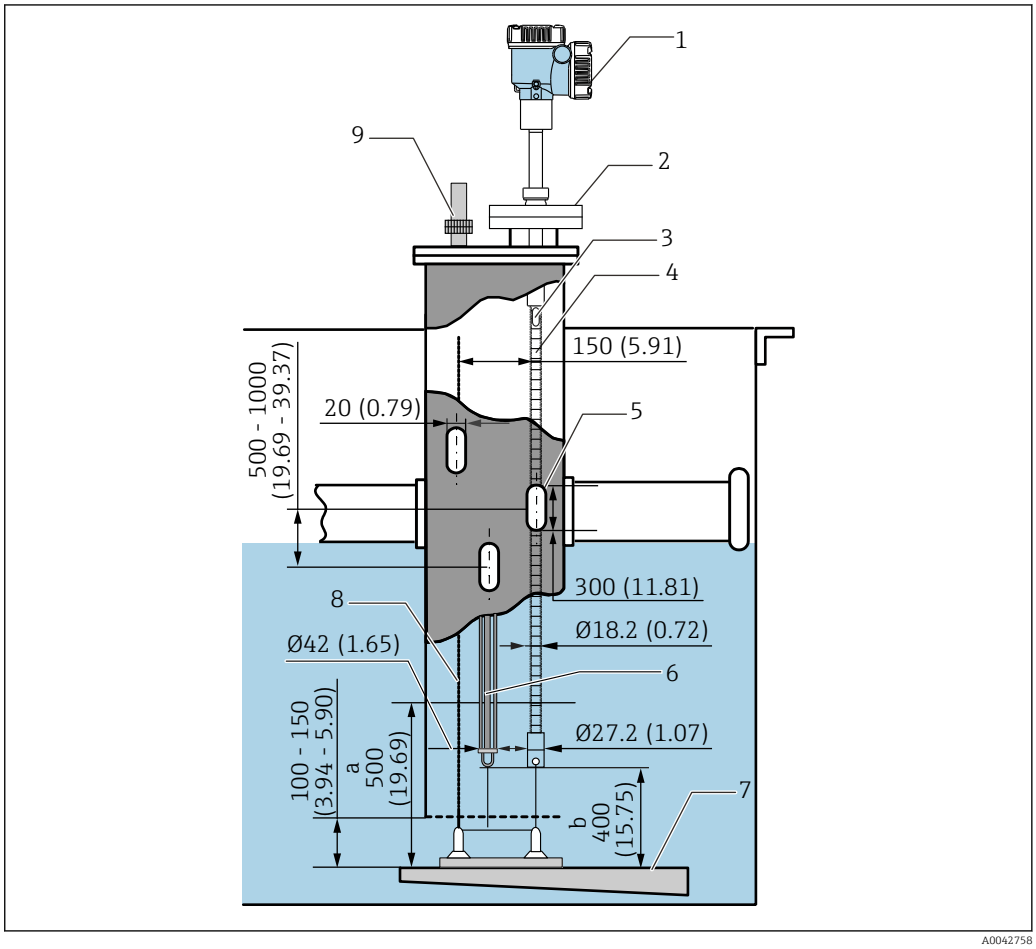
- Top anchor method
- Stilling well method
- Guide ring and anchor weight method

If a heating coil is attached to the bottom of the tank, install NMT81 so that the bottom hook of a temperature probe or a WB probe is not too close to the heating coil.

5.13.1 Top anchor method

Insert a temperature probe or a WB probe into a fixed pipe and secure it with a top anchor.

To prevent damage to temperature probe and WB probe, ensure that they do not touch anything during insertion through the installation nozzle.



30 *Top anchor method. Unit of measurement mm (in)*

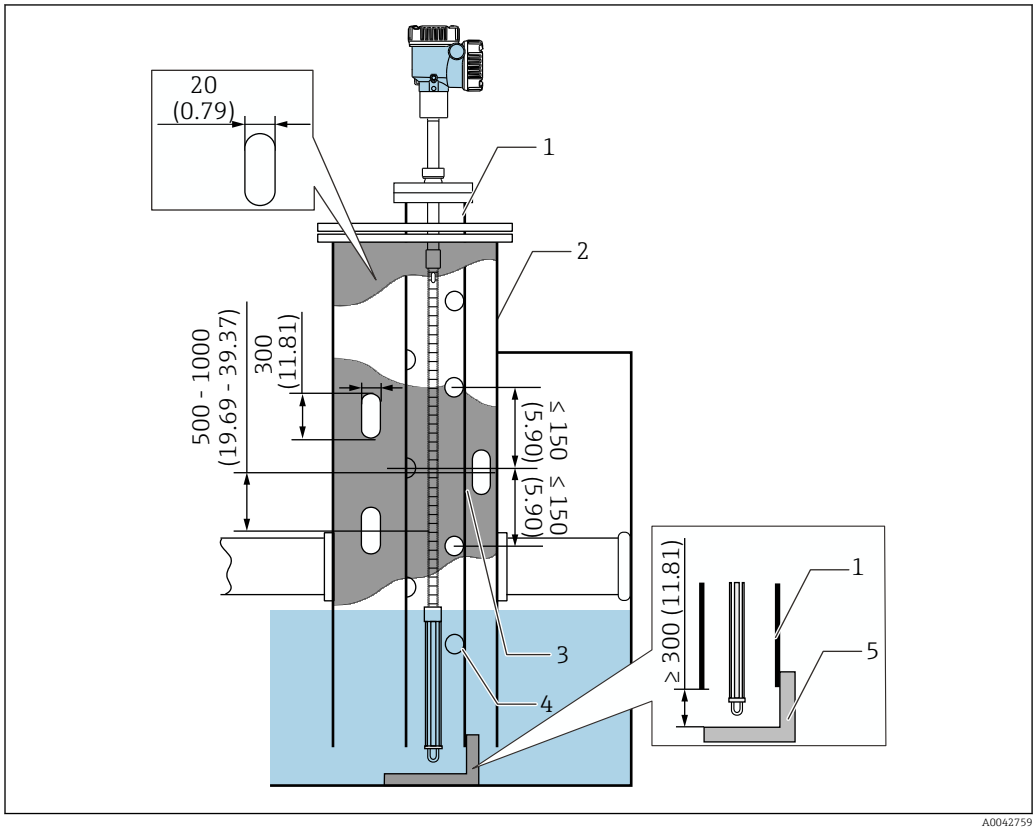
a Distance between the base plate and the temperature probe
b Distance between the base plate and the WB probe
1 Converter (electrical compartment)
2 Flange
3 Top element
4 Temperature probe (without WB probe)
5 Stilling well hole
6 Temperature probe (with WB probe)
7 Base plate/datum plate
8 Stranded wire
9 Top anchor

For the detailed installation procedure of top anchor, → 31

5.13.2 Stilling well method

Insert a temperature probe and a WB probe into a stilling well that is 50A (2") or larger. The installation procedure is same for only temperature version.

To prevent damage to temperature probe and WB probe, ensure that they do not touch anything during insertion through the installation nozzle.



31 *Stilling well method. Unit of measurement mm (in)*

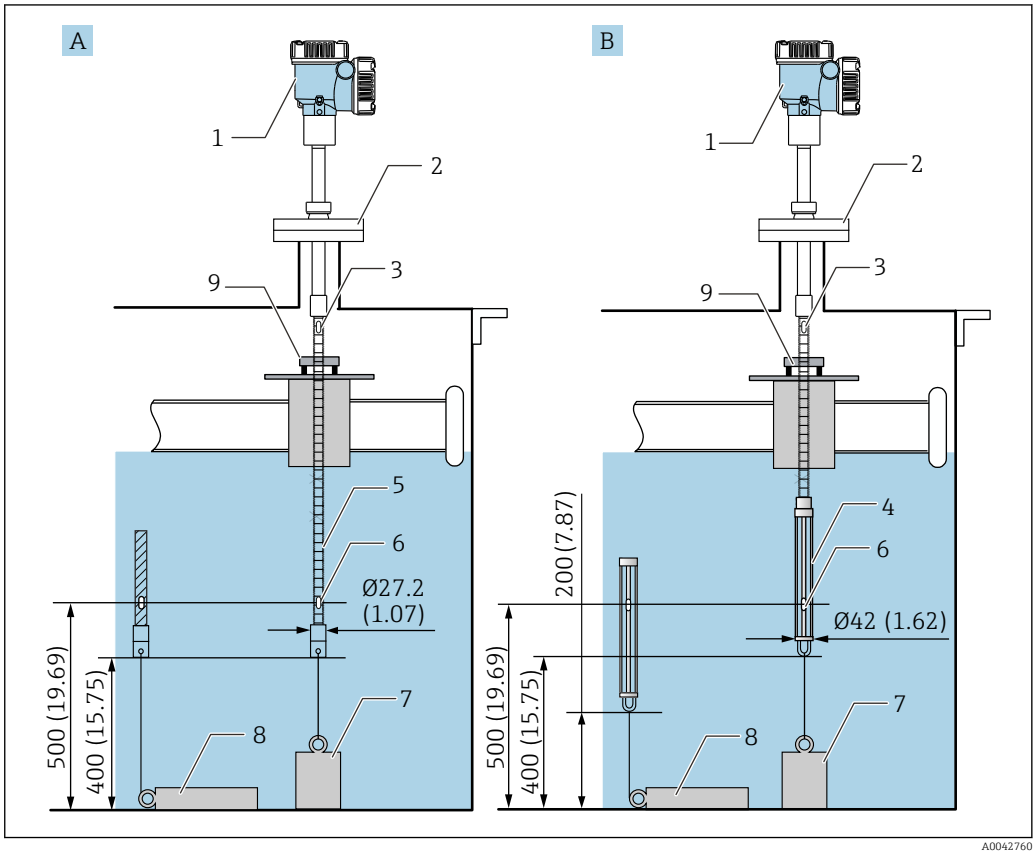
1 *Stilling well*
2 *Fixed pipe*
3 *Fixed pipe hole*
4 *Stilling well hole (φ 25 mm (0.98 in))*
5 *Base plate/datum plate*

For the detailed installation procedure of stilling well, → 31

5.13.3 Guide ring and anchor weight method

Secure a temperature probe or a WB probe using a guide ring and an anchor weight.

To prevent damage to temperature probe and WB probe, ensure that they do not touch anything during insertion through the installation nozzle.



32 *Guide ring and anchor weight method. Unit of measurement mm (in)*

A Without WB probe
B With WB probe
1 Converter (electrical compartment)
2 Flange
3 Top element
4 WB probe
5 Temperature probe
6 Element No.1 (lowest element)
7 Anchor weight (high profile)
8 Anchor weight (low profile)
9 Guide ring (not supplied, see NOTE.)

Guide ring must be prepared by a customer or contact your Endress +Hauser Sales Center for further information.

CAUTION

Installation of an anchor weight

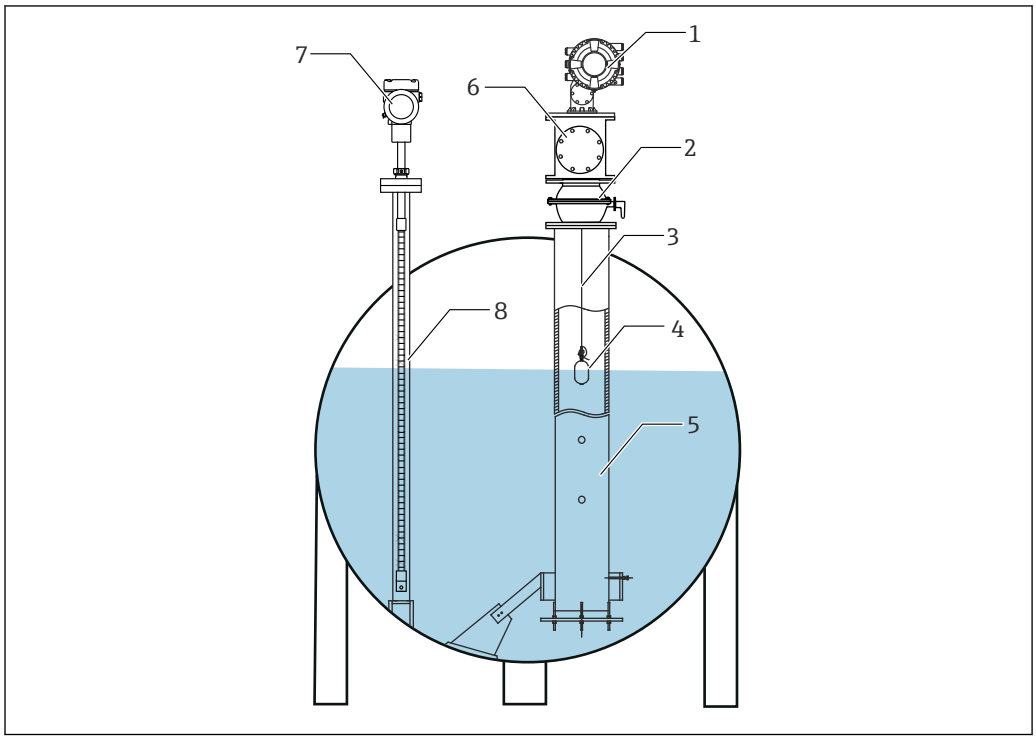
Using an anchor weight that is heavier than 6 kg (13.23 lb) may cause internal damage to the temperature probe.

- Ensure that the anchor weight is stable at the bottom of the tank. When installing NMT81 with a suspended anchor weight, use an anchor weight that weighs 6 kg (13.23 lb) or less.

5.14 Mounting NMT81 on a pressurized tank

In a pressurized tank, a protective pipe or a thermowell without any holes, slits, nor an open end must be installed in order to protect the probes from pressure.

To prevent damage to temperature probe and WB probe, ensure that they do not touch anything during insertion through the installation nozzle.

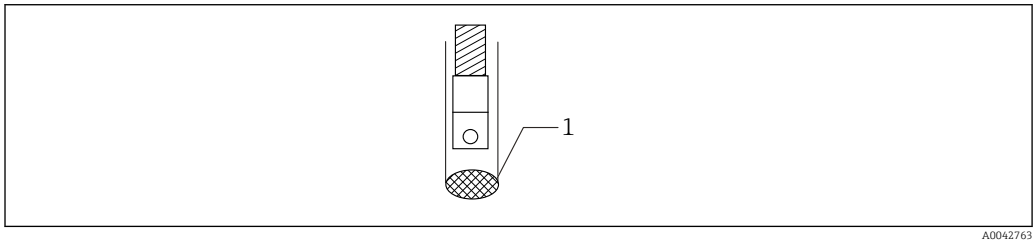


33 *Thermowell for a pressurized tank*

1 *NMS8x/NMS5*
2 *Ball valve*
3 *Measuring wire*
4 *Displacer*
5 *Stilling well*
6 *Maintenance chamber*
7 *NMT81*
8 *Thermowell*

If the pressure inside a tank exceeds the pressure limit, install a thermowell with no holes or slits surrounding NMT81 to protect NMT81 from the application (process) pressure. However, NMS8x requires a stilling well with holes and slits.

The thermowell is installed from the top of the tank nozzle. Cover the bottom of the thermowell and weld it to protect the probe from the pressure.



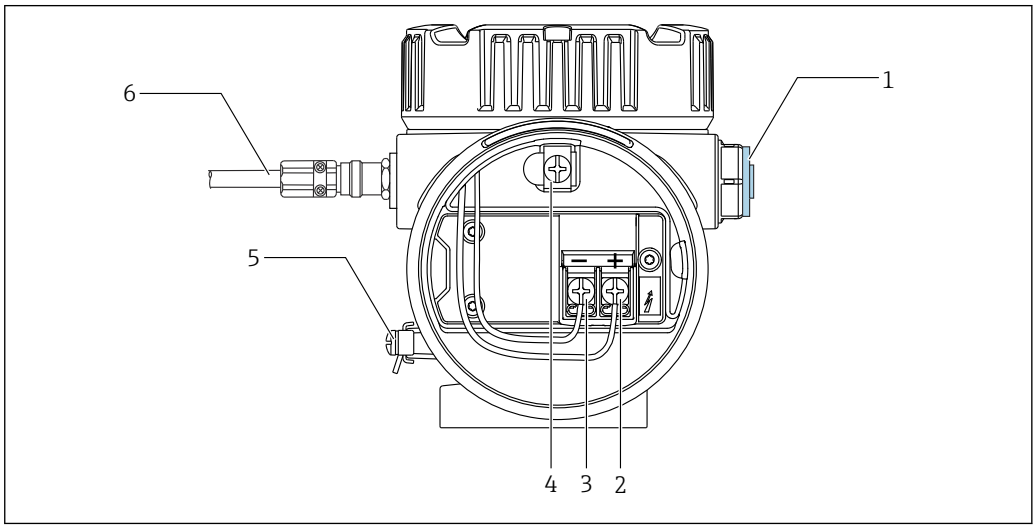
34 *Thermowell welding*

1 *Welding point*

6 Electrical connection

6.1 NMT81 (Ex ia) intrinsically safe connection

NMT81, which uses intrinsically safe HART communication, must be connected to the device's intrinsically safe terminal. Refer to the intrinsic safety regulations for establishing wiring and field device layout.



35 *NMT81 terminal (ATEX・Ex ia)*

1 *Stopping plug (Non-Ex)*
2 *+ terminal (see Information)*
3 *- terminal (see Information)*
4 *Internal ground terminal for the cable shield*
5 *External ground terminal*
6 *Shielded twisted pair wire or steel-armored wire*

- Only a metal cable gland may be used. The shielded wire on the HART communication line must be grounded.
- The plug is also mounted at the side of [6] in the figure above prior to shipping. The material of plug (aluminum or 316L) varies depending on the type of the transmitter housing material.

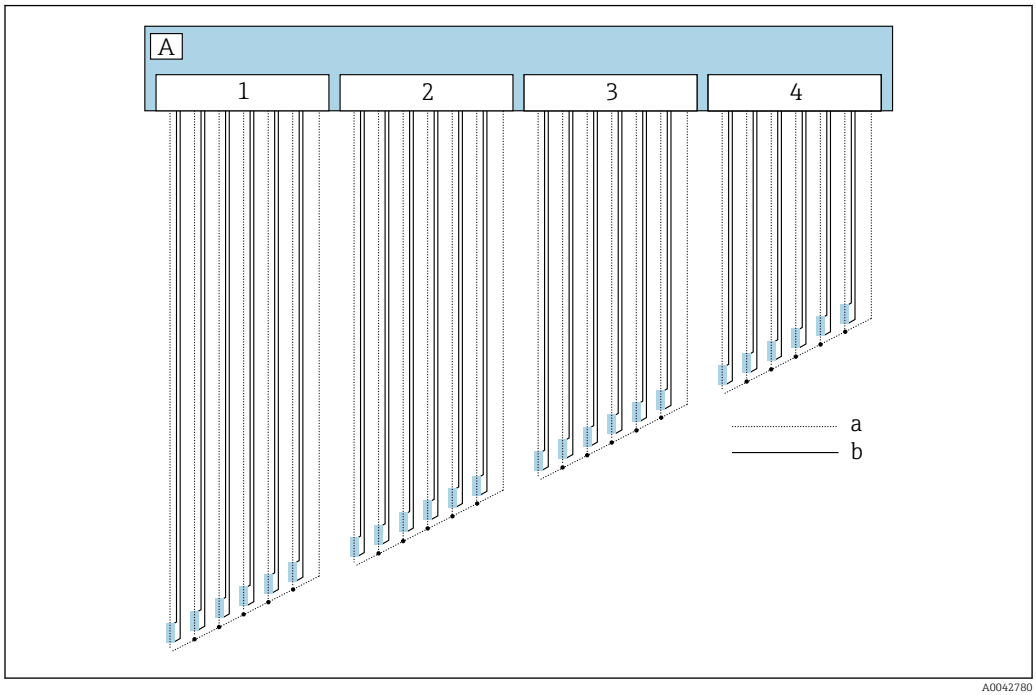
Connection table

Connection to NRF590		Connection to NMS5		Connection to NMS8x/NMR8x/NRF81 [1)]	
+ Terminal	24, 26, 28	+ Terminal	24	+ Terminal	E1
- Terminal	25, 27, 29	- Terminal	25	- Terminal	E2

1) If an analog Ex i/IS 4 to 20 mA HART module is installed, NMT81 can be connected to slot B2, B3 or C2, C3.

6.2 NMT81 transmitter and element connection

Four-wire common return enables the highest accuracy in the narrowest probe in a limited tank nozzle opening. The wiring diagram shows the configuration as follows.

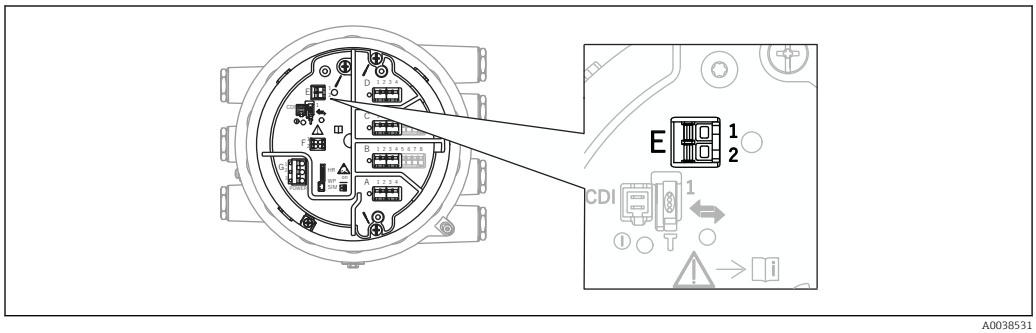


36 *Four-wire connection diagram*

A Sensor unit
a Current flow
b Voltage measurement
1 Connector 1
2 Connector 2
3 Connector 3
4 Connector 4

6.3 NMS8x/NMR8x/NRF81 (Ex d [ia]) intrinsically safe connection

To connect an intrinsically safe NMT81, E1 and E2 are used to connect with NMS8x, NMR8x and NRF81.

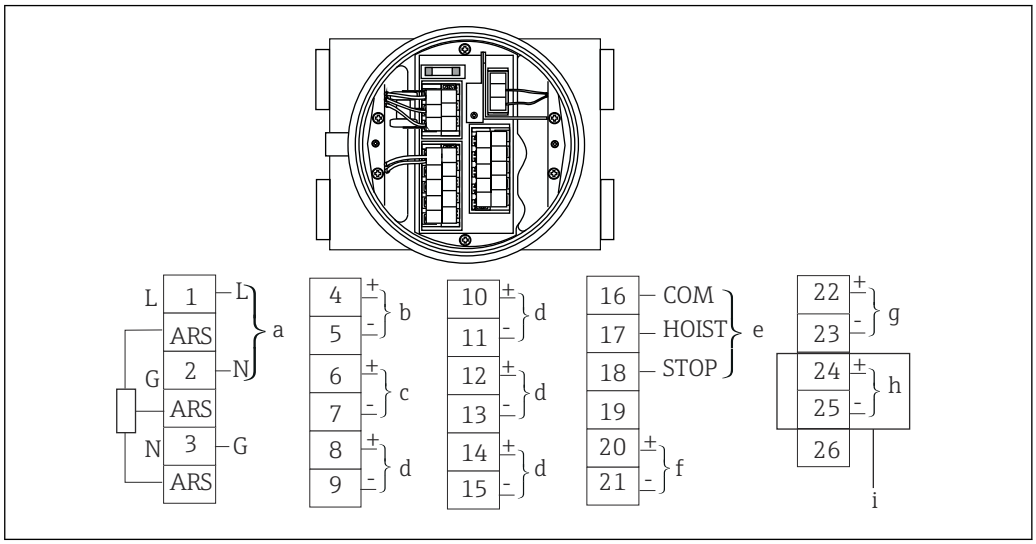


37 *NMS8x terminal for NMT81*

E1 + terminal
E2 - terminal

6.4 NMS5 (Ex d [ia]) intrinsically safe connection

The intrinsically safe NMT81 must be connected to the intrinsically safe HART terminal on NMS5.



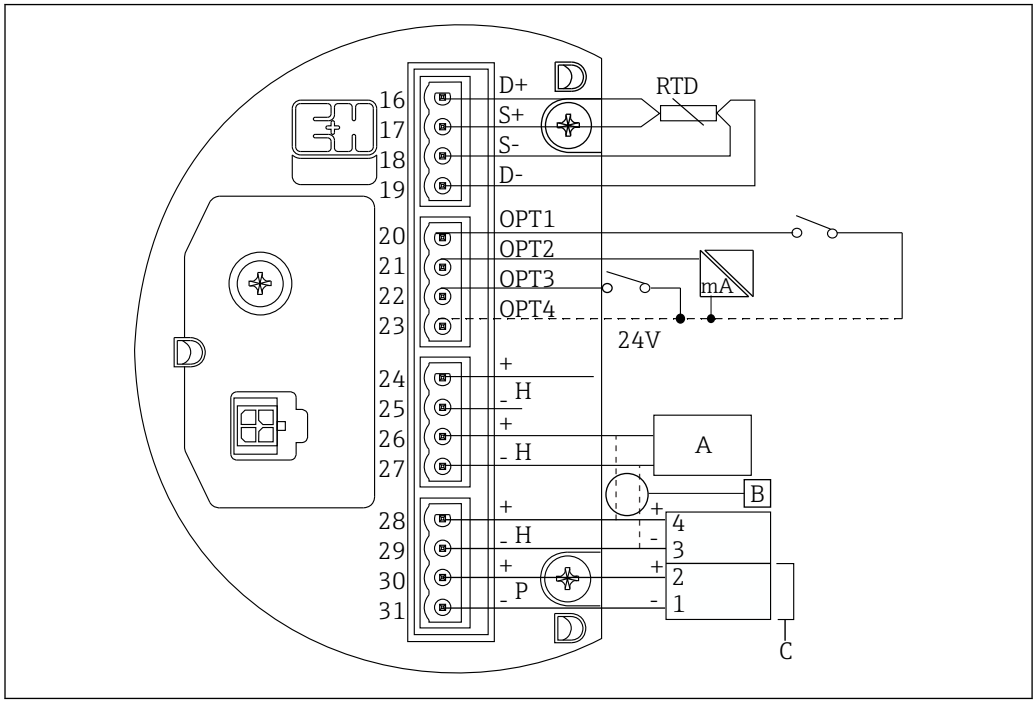
38 *NMS5 terminal*

a *Power supply*
b *Non-intrinsically safe HART communication: NRF, etc.*
c *Digital output Modbus, RS485 serial pulse or HART*
d *Alarm contact point*
e *Operation contact point input*
f *4 to 20 mA channel 1*
g *4 to 20 mA channel 2*
h *Intrinsically safe HART*
i *From NMT81 Ex ia*

Do not connect NMT81 HART communication cable to terminals 4 and 5 on NMS5/ NMS7. These terminals are designed to connect to Ex d HART communication.

6.5 NRF590 terminals

NRF590 has three sets of intrinsically safe local HART terminals.



39 *NRF590 (intrinsically safe) terminals*

A HART sensor (mutually connected as a single HART fieldbus loop on the inside)
B Fieldbus loop
C Only in Micropilot S series

A signal HART line cannot be connected from NMT81 to terminals 30 and 31. These terminals are an intrinsically safe 24 V_{DC} power supply for the Micropilot S Series (FMR53x, FMR540).

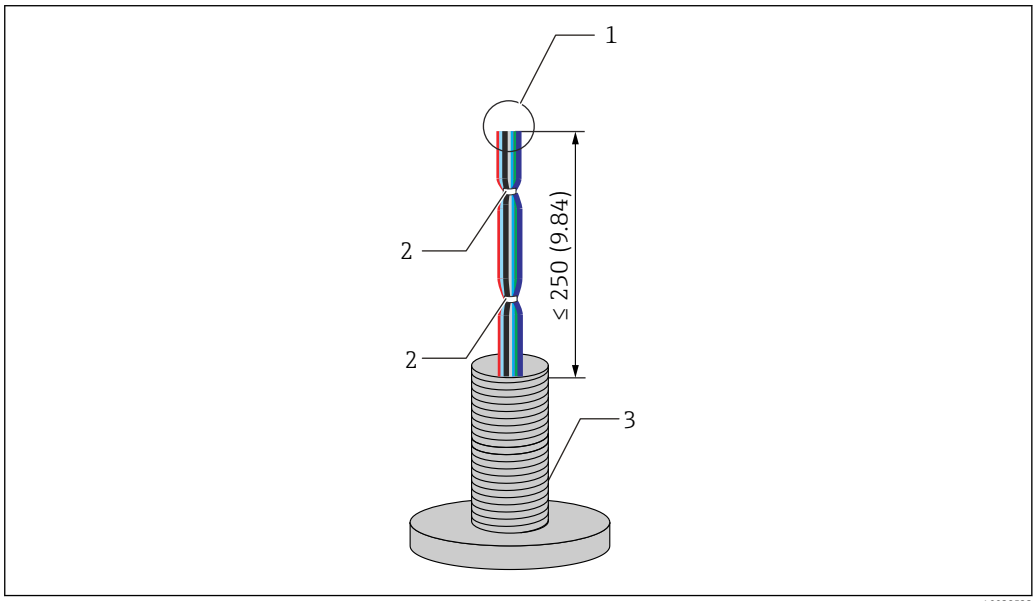
6.6 Mechanical connection for converter-only version

Preparation of mechanical connection

Check the following items prior to replacing an existing RTD temperature converter.

- Number of elements
- Presence/absence of additional tank bottom and vapor phase spot temperature elements other than average temperature elements
- Lowest element position
- Element interval
- Cable color for each element

Before installing NMT81, bundle all RTD cables from a temperature probe temporarily using a zip tie or a short string so that the cables do not become damaged during the mechanical connection process.



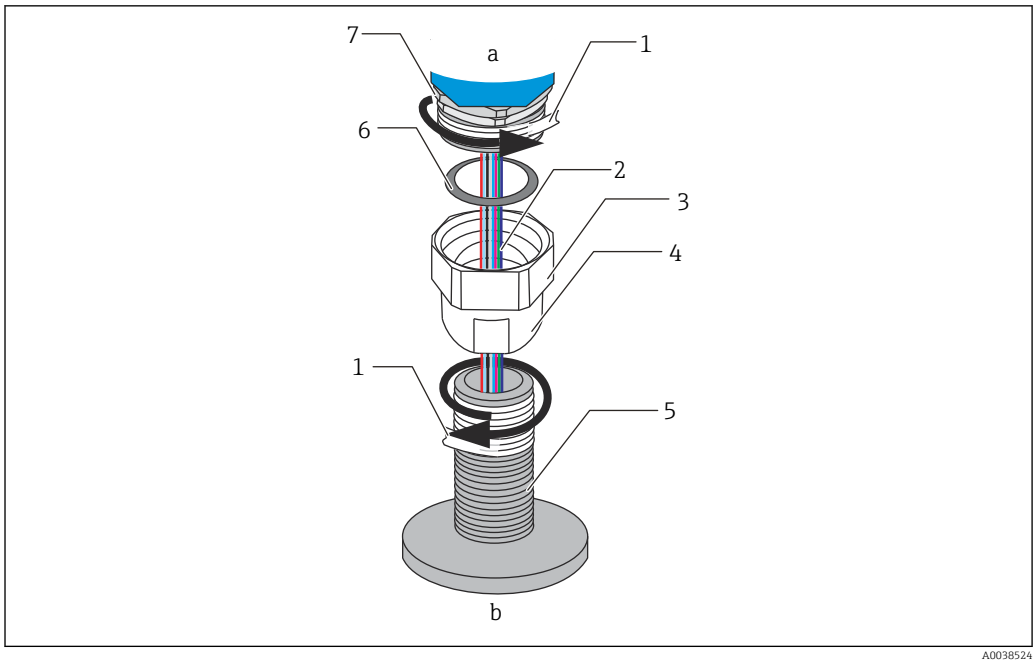
40 *Cable handling*

1 Cable end
2 Cable ties
3 Temperature probe

Cable handling procedure

1. Cut the ends of the cables so that they are the same length for connecting to NMT81.
2. Temporarily tie all the cables together to protect them against damages during the mechanical connection process.
3. Maintain at least 250 mm (9.84 in) between the edge of the G3/4 screw connector and the cable ends.

This completes the cable handling procedure.



41 *Threaded connection*

a NMT81 connection side
b Temperature probe connection side (to RTD elements)
1 Sealing tape (not included)
2 RTD cables
3 Female thread connector
4 Union
5 Tread connection (temperature probe side)
6 Sealing (packing)
7 M20 male thread connector

Loosen the G3/4 female thread connector, and place it on the temperature probe and align them to ensure that each thread can be connected smoothly.

Threaded connection procedure

1. Wrap the G3/4 thread connection with sealing tape.
2. Screw on the union to the G3/4 thread connection part and make sure that it is secure.
3. Wrap the male thread connector with sealing tape.
4. Insert the packing in the union, and install NMT81.
5. Tighten the union by hand until it is fully screwed in.
6. Remove the cover and confirm that both sides of the cables have enough length to be connected.
7. After connecting the cables and adjusting the position of NMT81, tighten the union by hand and then make a 1/8 rotation with a wrench to secure it in place.

This completes the threaded connection procedure.

CAUTION

Cable handling

This may cause the inside of the cable, where temperature cannot be measured, to malfunction or to become damaged.

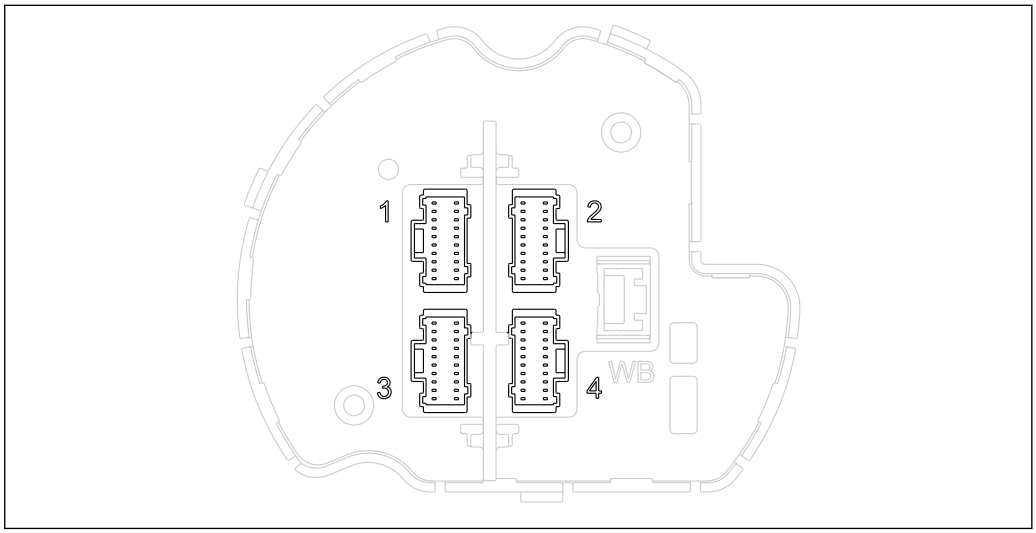
▶ Do not pull the sides of cables or subject them to over-tension during this process.

6.7 Wiring connection

Procedure for connecting temperature signal cable

A temperature signal cable is connected to the NMT81 input cable with the provided terminal connector.

The temperature elements are divided into four connectors according to the element numbers (see the following figure).



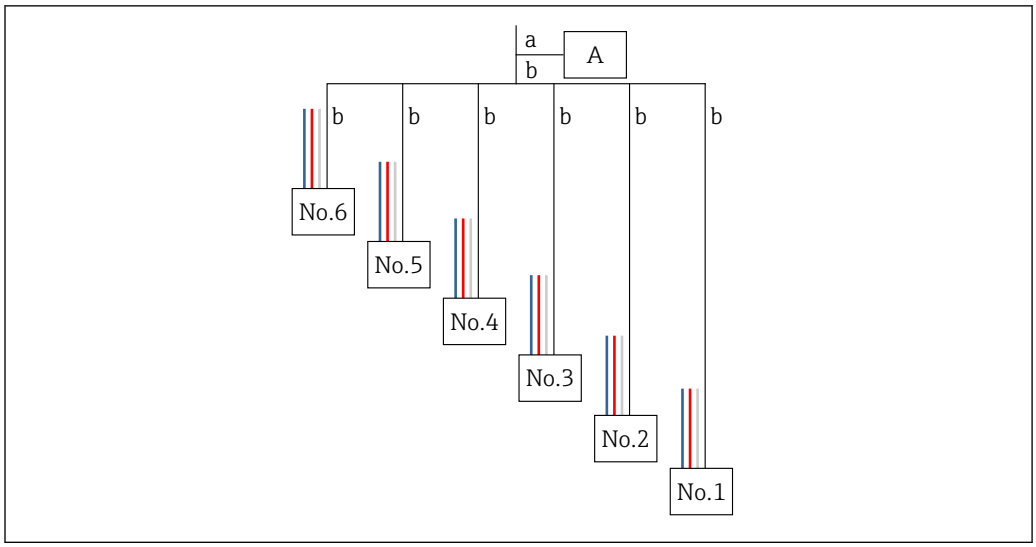
42 *Terminal connectors for temperature elements*

Pin assignment for terminal connectors

No.	Standard elements	Redundant elements
1	Element 1 to 6 + Common wire	Element 1A, 2A, 3A, 4A, 5A, 6A + common wire
2	Element 7 to 12 + Common wire	Element 7A, 8A, 9A, 10A, 11A, 12A + common wire
3	Element 13 to 18 + Common wire	Element 1B, 2B, 3B, 4B, 5B, 6B + common wire
4	Element 19 to 24 + Common wire	Element 7B, 8B, 9B, 10B, 11B, 12B + common wire

For each element, there are three colored wires (blue, red and white) and a common wire (black) for each connector.

No.	Color	Wire size	Description
1	Red	AWG30	Current source
2	Blue	AWG30	Voltage sens positive
3	White	AWG30	Voltage sens negative
4	Black	AWG30	Common return



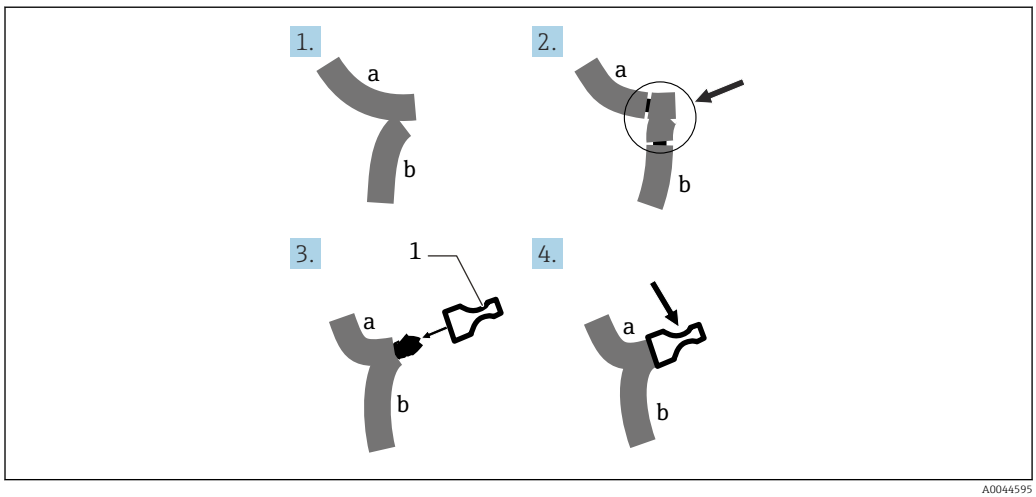
43 *Four-wire structure*

A Terminal connector
a Wire from NMT81
b Wire from the temperature probe

1. Select a pair of wires (blue, red, white, and black).
2. Strip off 5 mm (0.2 in)
3. Twist both ends together and insert them into the crimp terminal [1]
4. Crimp the connected terminal with a crimp tool, a plier, or any other connection tools.

This completes the procedure for connecting temperature signal wires.

If there are special handling requirements for the temperature probe, follow them accordingly.



44 *Wire connection*

a Wire from NMT81
b Wire from the temperature probe
1 Crimp terminal

NMT81 uses one common wire per connector. If your temperature probe has additional common wires, combine them into one wire before inserting into the crimp terminal.

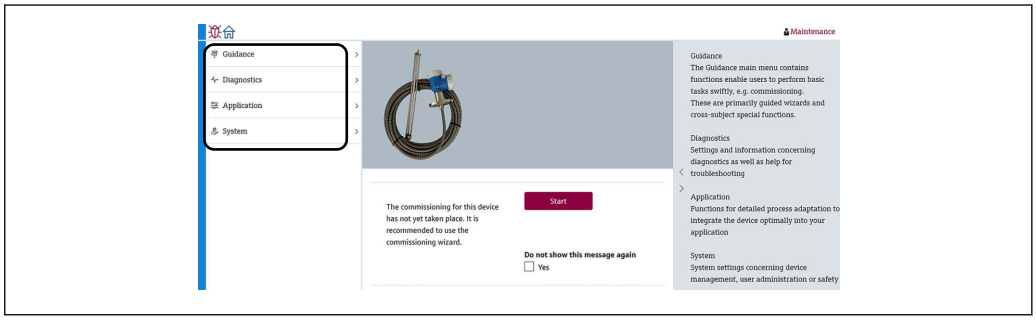
7 Operability

7.1 Overview of the operation options

NMT81 can be operated via:

- Operating keys and DIP switches on the electronic insert
- Operating tool (Endress+Hauser FieldCare/DeviceCare)
- HART Master connecting with devices (NMS8x, NMR8x, NRF8x)

7.2 Structure and function of the operating menu



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45 *Structure view via FieldCare*

Menu	Submenu / parameter	Meaning
Guidance (→ 68)	Commissioning (→ 65)	Initial settings of the measurement
	Calibration	Calibration for the sensor electronics unit Calibration is set prior to shipping.
	Import / Export (→ 71)	▪ Saves parameters which have been set to PC ▪ Reads parameters which have been saved from devices and applies for device settings. ▪ Exports the parameters which have been set in the device.
	Compare (→ 73)	Compares: ▪ offline with online ▪ offline with save/restore file ▪ online with save/restore file ▪ two save/restore files
Diagnostics (→ 102)	Active diagnostics (→ 103)	Contains: ▪ Active diagnostic message (highest priority diagnostic event) ▪ Last rectified diagnostic message ▪ Restart (when was the last restart, optional) ▪ Overall operating time (lifetime)
	Diagnostic list (→ 98)	Indicates only one error which can be the highest priority.
	Event logbook (→ 102)	Records all events occurred in the diagnosis and device operation.
	Minimum/maximum values (→ 104)	Shows minimum and maximum terminal voltages, electronics temperatures, sensor temperatures.

Menu	Submenu / parameter	Meaning
	Simulation (→ 🖹 105)	Used to simulate measured values or output values.
	Diagnostic settings (→ 🖹 105)	Permits specific diagnosis settings. Ex-factory to every event a certain diagnostic behavior is allocated.
	Sensor diagnostics (→ 🖹 107)	Indicates: ▪ Open elements/Short elements ▪ Electronics temperature
Application (→ 🖹 76)	Measured values (→ 🖹 76)	Indicates: Measured values from sensors ▪ Vapor temperature ▪ Liquid temperature ▪ Product temperature ▪ Water temperature (if WB is installed) ▪ Water level (if WB is installed)
	Measuring Units (→ 🖹 79)	Set temperature unit and distance unit.
	Sensor (→ 🖹 80)	Contains all parameters required for sensor adjustment.
	HART output (→ 🖹 90)	Changes: ▪ System polling address ▪ HART short tag ▪ Device tag ▪ No. of preambles ▪ Loop current mode
System (→ 🖹 92)	Device management (→ 🖹 93)	Contains the settings of the overall system which are not specific to the measuring path, like measuring point name, configuration counter, define welcome page, reset (e.g. factory settings)
	User management (→ 🖹 94)	Contains the complete settings of the offered user administration (role-based or/and named user access concept) like administration/set-up of the personal access permissions.
	Display (→ 🖹 95) (Option)	Shows: ▪ Value 1, 2, 3, 4 display ▪ Decimal places 1, 2, 3, 4
	Geolocation (→ 🖹 95)	Settings and information of the location and may the localization be arranged
	Information (→ 🖹 91)	Offers users general information concerning the device and versions in a clearly arranged manner.
	Software configuration (→ 🖹 96)	Shows W&M calibration CRC.

7.3 Operation via HART master connecting with devices

The local display of NMT81 is an option to display measured values, faults and notice messages. The display cannot be used for operation. Operation can be done by the local HART master device (e.g. NMS8x), the remote display (e.g. DKX001). The scope of operation depends on each device. Refer to the respective operating manual for further assistance.

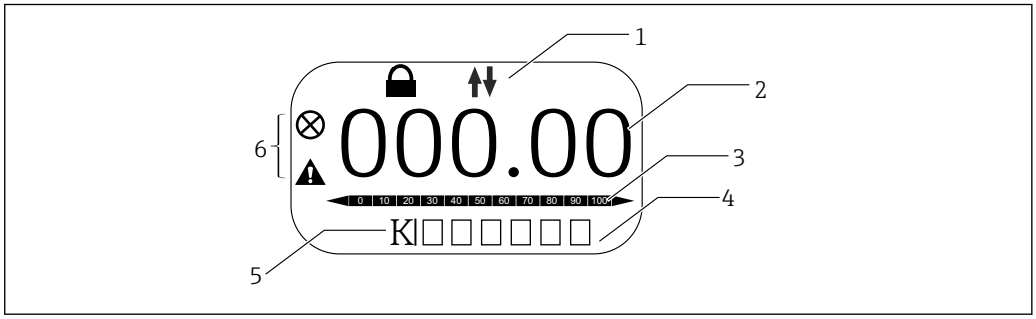
- Establishing the connection between the local HART master devices, remote display, or FieldCare and the NMT81
- Setting via the local HART master devices, remote display, and FieldCare
- Operating via the local HART master devices, remote display, and FieldCare

Remote display can connect to the HART master devices when the devices are either of NMS8x, NMR8x, and NRF81 however remote display cannot connect directly to the NMT81.

7.4 Display of NMT81

The device has an illuminated liquid crystal display (LCD/option) that shows measured values.

The following shows standard view of NMT81 and meanings of icons.



46 *Standard view*

1 *Status area*
2 *Measured value*
3 *Status area of output value as a percentage (%)(see NOTE.)*
4 *Error number status area*
5 *Measuring unit status area*
6 *Alarm status area*

The status area of output value [3] shows measuring value (liquid, product, or water temperature) as a percentage (%) which is selected by PV selector based on the parameters of Temperature Lower Range Value and Temperature Upper Range Value.

(e.g.) When selecting liquid temperature in PV selector, it shows 0 (low range value) if the liquid temperature is −40 °C (−40 °F) and shows 100 (upper range value) if the liquid temperature is 70 °C (158 °F).

Status symbols

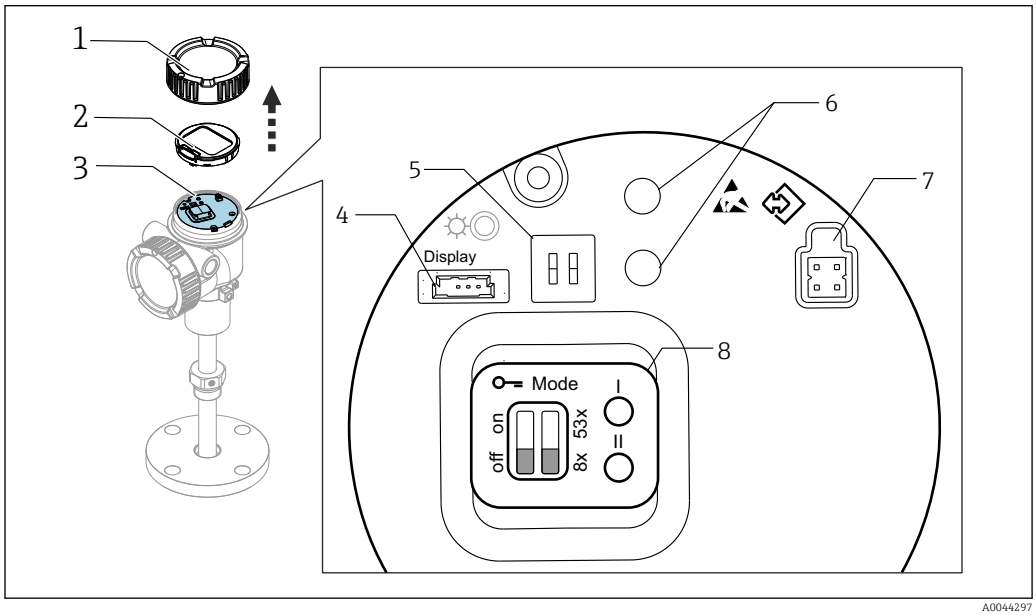
Symbol	Meaning
 A0042797	**HART communication** Flashing when communicating via HART
 A0042796	**Device locked** The device is locked via software

Symbol	Meaning
 A0042795	**Status "Alarm"** The measurement is interrupted. The output assumes the defined alarm value. A diagnostic message is generated. Display color changes to red.
 A0042798	**Status "Warning"** The device continues measuring. A diagnostic message is generated.

7.5 Operating keys and DIP switches on the electronic insert

The main unit has several connectors and switches to change the device settings.

Unscrew the housing cover and remove the display (option). The electrical module is located under the display.



47 *Electrical module*

1 *Housing cover*
2 *Display (option)*
3 *Main unit*
4 *Display connector*
5 *DIP switches*
6 *Operating keys*
7 *FieldCare connector*
8 *Label for the explanation of the connectors and switches respectively*

The No.8 shown above just shows the locations and the functions of each switch and connector. The physical connectors and switches are No.4 to 7.

Descriptions of connectors and switches

Connector or switch	Description
Connector for display	The display is an option.
Connector for FieldCare	CDI port for FieldCare connection by Commubox FXA291 FXA195 can be used when connecting HART line.
DIP switches (left): Write protection switch	Parameter write access can be locked by a hardware switch.

Connector or switch	Description
DIP switches (right): Compatibility mode of NMT53x	ON: NMT53x compatibility mode OFF: NMT81 mode Default setting: OFF For more details, → 75
Operating keys	▪ For factory reset ▪ For unit (mm, inches, Celsius, Fahrenheit) setting ▪ For increment/decrement of level value

7.5.1 Hardware locking or unlocking

The parameter write access can be locked by the DIP switch (left) on the electronic insert.

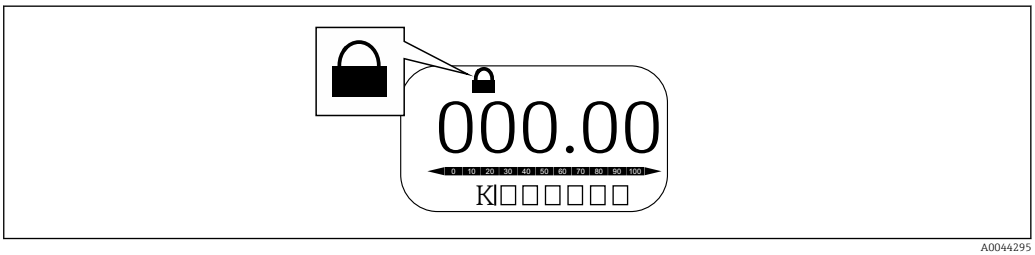
In this locking state, all parameters are read only and the key symbol appears on the local display.

If operation is locked by means of the DIP switch, the operation is only unlocked again by means of DIP switch.

1. Unscrew the housing cover.
2. Set the write protection switch (left) into the desired position.
   ↳ ON: operating menu is locked; OFF: operating menu is unlocked.
3. Put the display module onto the connection compartment, screw the cover closed.

This completes the write protection on/off procedure.

Indication of the locking state



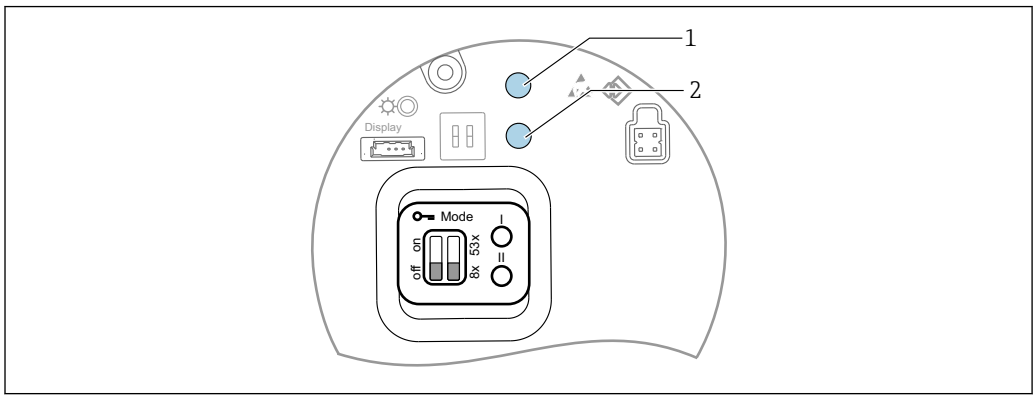
A0044295

48 Write protection symbol in the header of the display

Write protection via locking switch is indicated as follows:
- **Locking status** = **Hardware locked**
- appears in the header of the display.

7.5.2 Factory reset key

Press and hold the both operating keys simultaneously for twelve seconds. All settings return to the factory default values.



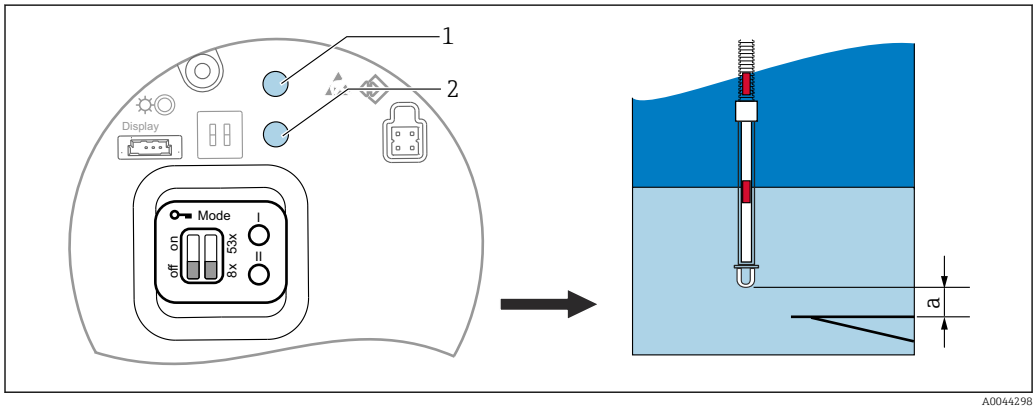
49 *Factory reset*

1 *Key I*
2 *Key II*

7.5.3 Unit setting (metric (mm) and Celsius (°C))

The display must be connected to the device. This action automatically sets all values to metric (mm) unit.

Setting level value (a) to unit Metric (mm) procedure



50 *Level setting*

a End of probe to zero distance
1 Key I
2 Key II

1. Press and hold the I key [1] for 3 seconds.
   ↳ All digits on the display are blinking.
   The metric unit (mm) is displayed.
2. Push the I key to increase the value of level or the II key [2] to decrease the value of level.
   ↳ When the value is increased 1 mm, the height of liquid level will move in a negative direction.
3. Press and hold the key for 2 seconds or more.
   ↳ This will start automatic increase or decrease mode.
4. Hold down the key until the desired value is shown.

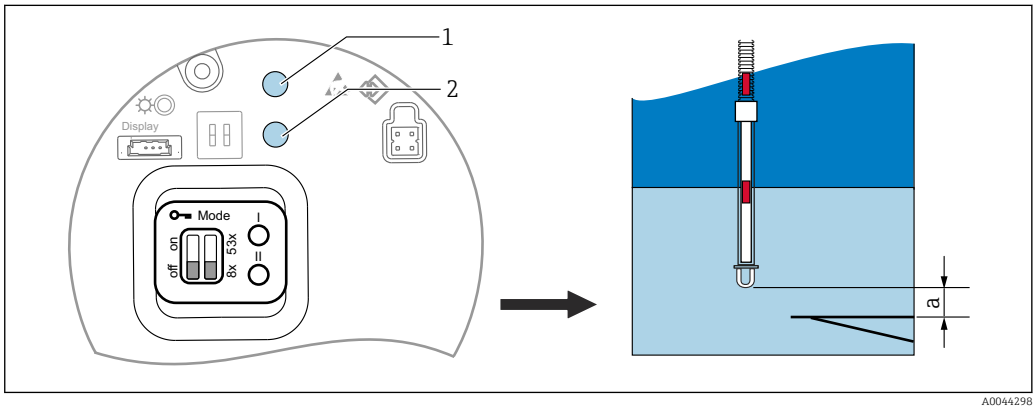
5. Press and hold both the I and II keys simultaneously for 3 seconds or more to complete the adjustment.
   ↳ If there is no operation for more than 30 seconds, the adjustment mode will end automatically, and the actual value will be saved.

This completes setting procedure.

7.5.4 Unit Setting (inch (in) and Fahrenheit (°F))

The display must be connected to the device. This action automatically sets all values to inch (in) unit.

Setting level value (a) to unit Inch (in) Fahrenheit (°F) and procedure



51 *Level setting*

a End of probe to zero distance
1 Key I
2 Key II

1. Press and hold II key [2] for 3 seconds.
   ↳ All digits on the display are blinking.
   The inch unit (in) is displayed.
2. Push the I key to increase the value of level or the II key [2] to decrease the value of level.
   ↳ When the value is increased 0.05 in, the height of liquid level will move in a negative direction.
3. Press and hold the key for 2 seconds or more.
   ↳ This will start automatic increase or decrease mode.
4. Hold down the key until the desired value is shown.
5. Press and hold both the I and II keys simultaneously for 3 seconds or more to complete the adjustment.
   ↳ If there is no operation for more than 30 seconds, the adjustment mode will end automatically, and the actual value will be saved.

This completes setting procedure.

7.6 Configuring NMT81 with NMS5/NMS7/NRF590

Before connecting the NMT81 device physically to NMS5/NMS7/NRF590, make sure that the compatibility mode is switched on. This ensures that the HART master will recognize the device. Operation of NMT81 in compatibility mode is limited.

- NRF590: Connect the loop-powered local HART communication cable from NRF590 (intrinsically safe side compartment) to NMT81. NRF590 has been designed to recognize NMT81 as a specific Endress +Hauser local HART device.
- NMS5/NMS7: HART master of the NMS5 and NMS7 is designed to recognize NMT81 as HART device. Terminals 24 and 25 of NMS5/NMS7 and NMT81 are connected with a local HART cable.

7.6.1 HART scanner of NRF590

Once NMT81 and NRF590 have been wired together, all HART devices will be scanned automatically when NRF590 is turned on, however not all NRF590 are fully compatible for recognizing NMT81. Contact your Endress +Hauser Sales Center for information on NRF590 software and hardware version compatibility.

7.6.2 Parameters of NMS5/NMS7/NRF590

The configuration of NMT81 parameters displayed on devices depends on the installed software and hardware versions of their devices. For further assistance, contact your Endress +Hauser Sales Center.

7.7 Configuring NMT81 with NMS8x/NMR8x/NRF81

HART master of the NMS8x, NMR8x and NRF81 is designed to recognize NMT81 as HART device. Terminals E1 and E2 of NMR8x, NRF81 and NMS8x are connected to NMT81 with a local HART cable.

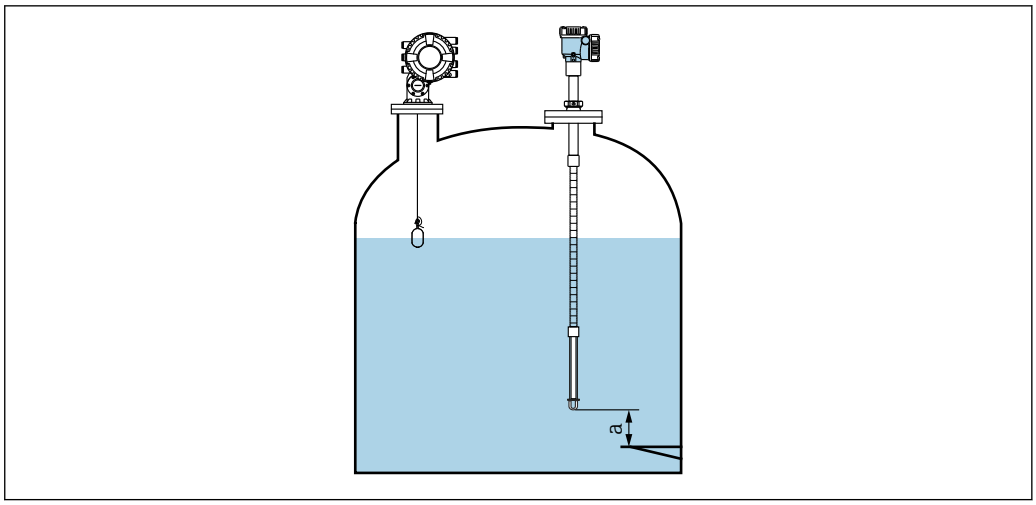
7.7.1 Preparation for configuring NMS8x/NMR8x/NRF81

Setting procedure

This procedure is only available for the DTM corresponding to FW 1.05 or later.

1. Make sure that the DIP switches turn OFF.
2. Expert → Input/output → HART devices → HART Device(s) → NMT device config
3. Select Yes for Configure Device?
4. Enter the distance between the end of water bottom probe and the 0 mm level point (reference datum plate) in the tank.

This completes the setting procedure.



52 *Position of the bottom-point temperature element*

a distance between the end of water bottom probe and the 0 mm level point (reference datum plate)

The position of "a" in the figure varies depending on customer's specifications, however this can be configured if necessary.

Liquid temperature

Item	Details
Navigation	Operation → Temperature → Liquid temperature
Description	Shows the average or spot temperature of the measured liquid.
Additional information	Read access: Operator
	Write access: -

When obtaining data of Liquid temperature via NMT81:

Navigate to: Setup → Advanced setup → Application → Tank configuration → Temperature → Liquid temp source

Set the source to HART device (NMT81).

NMT element values

Item	Details
Navigation	Operation → Temperature → NMT element values → Element temperature
Description	Displays the NMT element temperature.
Additional information	Read access: Operator
	Write access: -

Level source

Item	Details
Navigation	Setup → Advanced setup → Application → Tank configuration → Level → Level source
Description	Defines the source of the level value.
Selection	No input value
	HART device 1 … 15 level
	Level SR (see Note)

Item	Details
	Level (see Note)
	Displacer position (see Note)
	AIO B1-3 value (see Note)
	AIO C1-3 value (see Note)
	AIP B4-8 value (see Note)
	AIP C4-8 value (see Note)
Factory setting	Dependent on the device version
Additional information	Read access: Operator
	Write access: Maintenance

Visibility depends on order options or device settings

Water level source

Item	Details
Navigation	Setup → Advanced setup → Application → Tank configuration → Level → Water level source
Description	Defines the source of the bottom water level.
Selection	Manual value
	HART device 1 ... 15 level
	AIO B1-3 value
	AIO C1-3 value
	AIP B4-8 value
	AIP C4-8 value
Factory setting	The setting is different depending on the device.
Additional information	Read access: Operator
	Write access: Maintenance

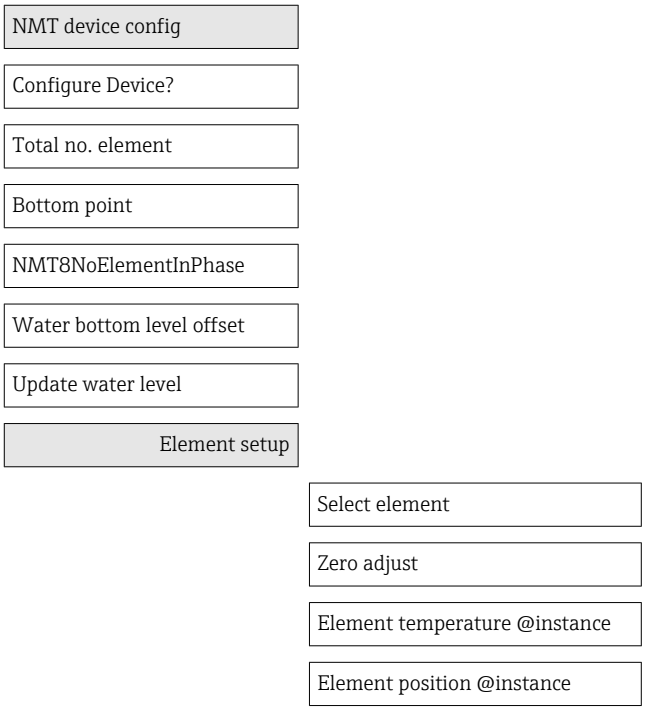
The display will be different depending on the selected options and equipment settings.

7.7.2 NMT81 configuration via NMS8x/NMR8x/NRF81

The following configuration is NMT81-related parameters. For details on the operation of NMS8x, NMR8x and NRF81, see their respective operating instructions.

The following parameters can be checked from the display accessed through the Main Menu: Expert → Input/output → HART devices → HART Device(s) → NMT device config [MenuName].

Parameter configuration



Configure Device?

Item	Details
Navigation	Expert → Input/output → HART devices → HART Device(s) → NMT device config → Configure Device?
Description	Configures the NMT device.
Selection	Yes (Setting can be configured.)
	No (No changes in settings. It will be set back to "No" after completion of configuration.)
Factory setting	No
Additional information	Read access: Operator
	Write access: Maintenance

Total no. element

Item	Details
Navigation	Expert → Input/output → HART devices → HART Device(s) → NMT device config → Total no. element
Description	Displays the total number of elements that can be configured.
Additional information	Read access: Operator
	Write access: -

Bottom point

Item	Details
Navigation	Expert → Input/output → HART devices → HART Device(s) → NMT device config → Bottom point
Description	Displays the bottom-point temperature element.
Input unit	Numerical value (mm)
Factory setting	-
Additional information	Read access: Operator
	Write access: Maintenance

NMT8NoElementInPhase

Item	Details
Navigation	Expert → Input/output → HART devices → HART Device(s) → NMT device config → NMT8NoElementInPhase
Description	Alarm setting for detecting the situation when the none of elements are positioned in either of vapor, product, nor water phase.
Factory setting	Logbook entry only
Additional information	Read access: Operator
	Write access: Maintenance

Water bottom level offset

Item	Details
Navigation	Expert → Input/output → HART devices → HART Device(s) → NMT device config → Water bottom level offset
Description	Enter an offset to adjust the output value of the water bottom probe.
Factory setting	0
Additional information	Read access: Operator
	Write access: Maintenance

Update water level

Item	Details
Navigation	Expert → Input/output → HART devices → HART Device(s) → NMT device config → Update water level
Description	Determines whether or not the measured value of the water level via NMS8 is reflected to NMT81. ▪ Enable ▪ Disable (when installing WB)
Factory setting	Disable
Additional information	Read access: Operator
	Write access: Maintenance

Select element

Item	Details
Navigation	Expert → Input/output → HART devices → HART Device(s) → NMT device config → Element setup → Select element
Description	The element to be configured is manually selected.
Input unit	1-24
Factory setting	1
Additional information	Read access: Operator
	Write access: Maintenance

Zero adjust

Item	Details
Navigation	Expert → Input/output → HART devices → HART Device(s) → NMT device config → Element setup → Zero adjust
Description	Adjusts the offset of the selected element.
Input unit	Numerical value
Factory setting	0 (None)
Additional information	Read access: Operator
	Write access: Service

Element temperature 1 to 24

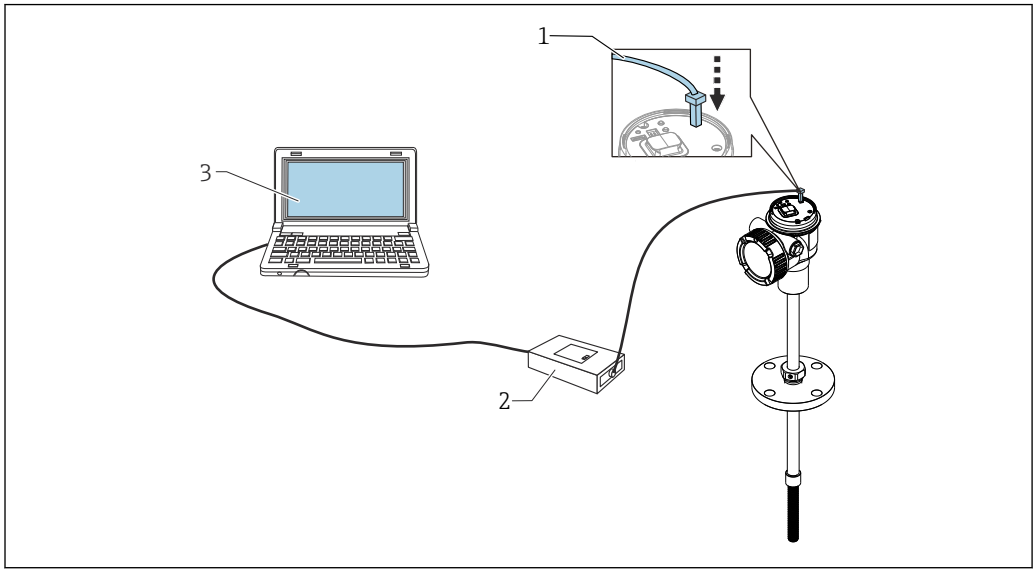
Item	Details
Navigation	Expert → Input/output → HART devices → HART Device(s) → NMT device config → Element setup → Element temperature 1 to 24
Description	Displays the element temperature.
Additional information	Read access: Operator
	Write access: -

Element 1 to 24 position

Item	Details
Navigation	Expert → Input/output → HART devices → HART Device(s) → NMT device config → Element setup → Element 1 to 24 position
Description	Adjusts the element position.
Input unit	Numerical value
Factory setting	-
Additional information	Read access: Operator
	Write access: Service

7.8 Access to the operating menu via the operating tool

Accessing to the operating menu, there is one possibility:



53 Operation via service interface

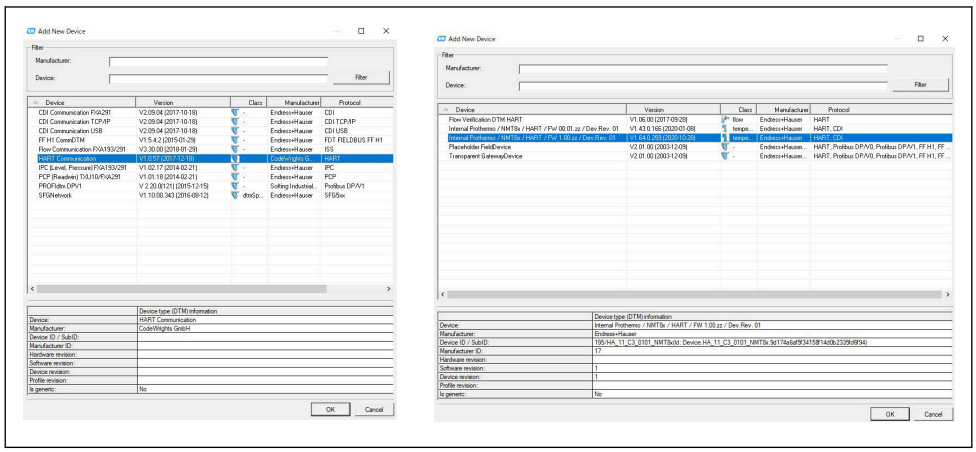
1 Service interface (CDI = Endress+Hauser Common Data Interface)
2 Commubox FXA291, FXA195 (HART model)
3 Computer with "FieldCare" operating tool and "CDI Communication FXA291" or FXA195 (HART model) COM DTM

The "Save/Restore" function
After a device configuration has been saved to a computer, save the data to the computer using the Save/Restore function (Navigate to: Guidance → Import / Export → Save / Restore) of FieldCare → 71, the device must be restarted by the following setting:

System → Device management → Reset device→ Restart device

This ensures correct operation of the device after the restore.

7.8.1 Establishing the connection between FieldCare and the device

1. Make sure that the Prothermo NMT8x DTM is installed and update the DTM catalogue if required.
   ↳ The data name might or will be changed or updated at any time. Find similar name via FieldCare.
2. Create a new project in FieldCare.
3. 

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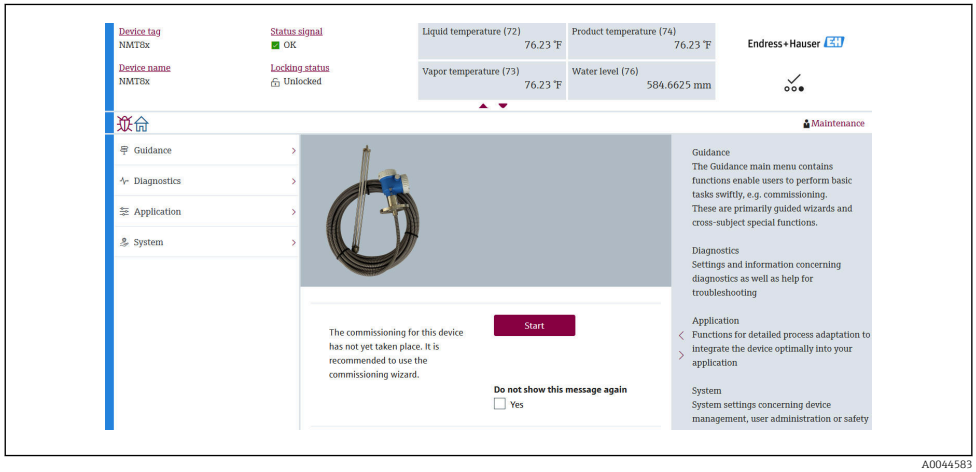
   Add new devices: HART and CDI Communications of the Prothermo NMT8x.
   ↳ If the CDI connection is available, it is recommended to install it because connection speed helps the operation of DTM to be smoother.
4. 

A0044583

   54 *Structure view via FieldCare*

   Select the Prothermo NMT8x to open the DTM data in FieldCare with double-click.
   ↳ The device is configured and it shows the initial screen.

The "Save/Restore" function
After a device configuration has been saved to a computer, save the data to the computer using the Save/Restore function (Navigate to: Guidance → Import / Export → Save / Restore) of FieldCare → 71.

8 System integration

8.1 Overview of the Device Description files (DTM)

To integrate the device via HART into FieldCare, a Device Description file (DTM) according to the following specification is required:

Manufacturer ID	0x11
Device type (NMT81)	0xC3
HART specification	7.0
DD files	For information and files see: www.endress.com

8.2 Measured variables via HART protocol

The following measured values are assigned to the device variables at the factory:

Device variable	Measured value
Primary variable (PV) [1]	Liquid temperature
	Product temperature
	Water temperature
Secondary variable (SV)	Vapor temperature
Tertiary variable (TV)	Water level
Quaternary variable (QV)	Liquid temperature
	Product temperature
	Vapor temperature
	Water temperature
	Water level
	Tank level
	Element temperature
	Element resistance
	Electronics temperature
	Test resistance
	Terminal voltage
	Measured current
	Percent of range
	Loop current

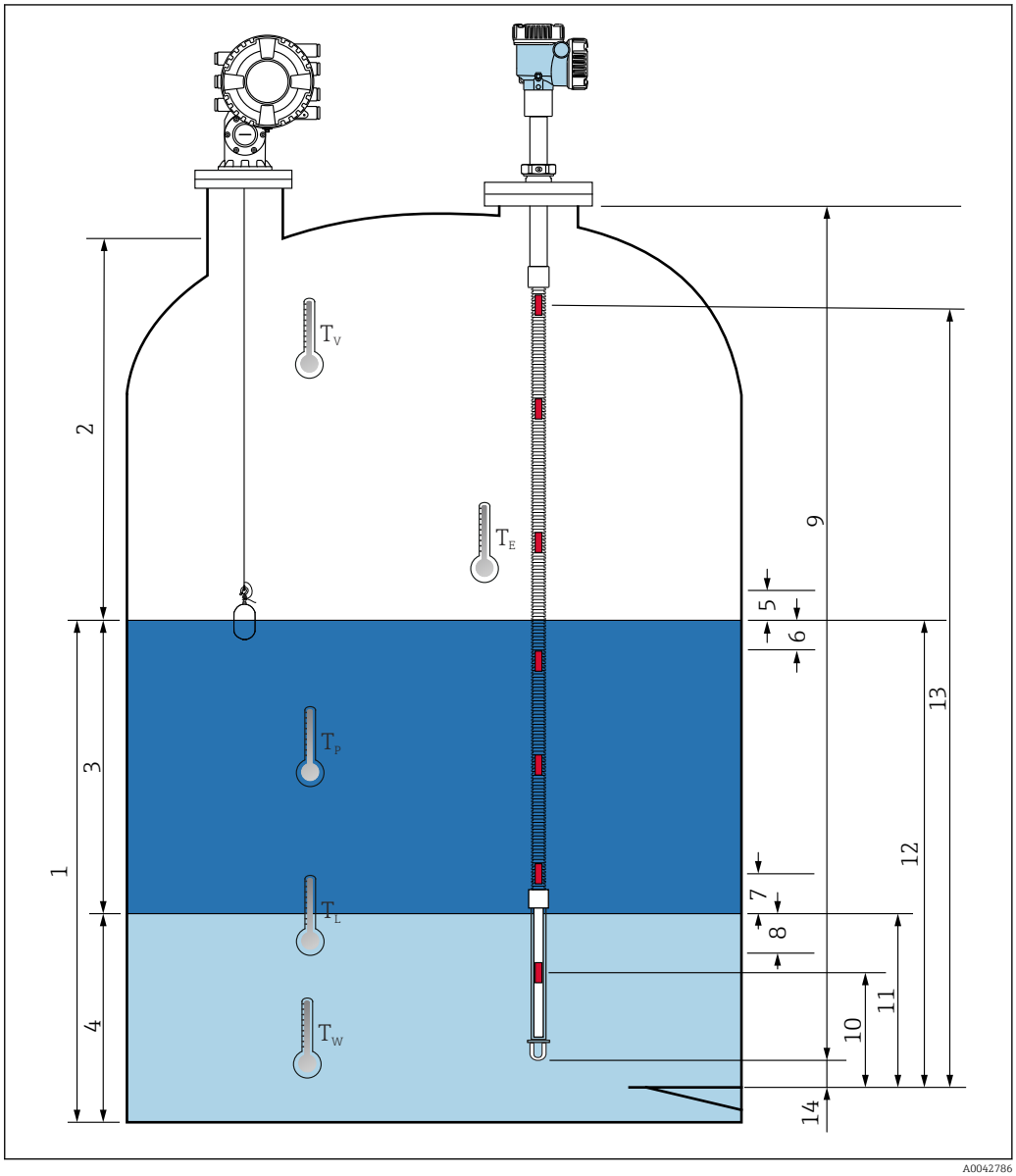
1) The PV is always applied to the current output.

The assignment of the measured values to the device variables can be changed in the following submenu:

Application → HART output → HART output

9 Commissioning

9.1 Terms related to temperature measurement



55 *Terms concerning NMT81 installation*

1 *Liquid temperature*
2 *Vapor temperature*
3 *Product temperature*
4 *Water temperature*
5 *Minimum height above tank level (uncovered)*
6 *Minimum depth below tank level (covered)*
7 *Minimum height above water level (uncovered)*
8 *Minimum depth below water level (covered)*
9 *Probe length*
10 *1st element position*
11 *Water level*
12 *Tank level*
13 *Element "n" position*
14 *End of probe to zero distance*

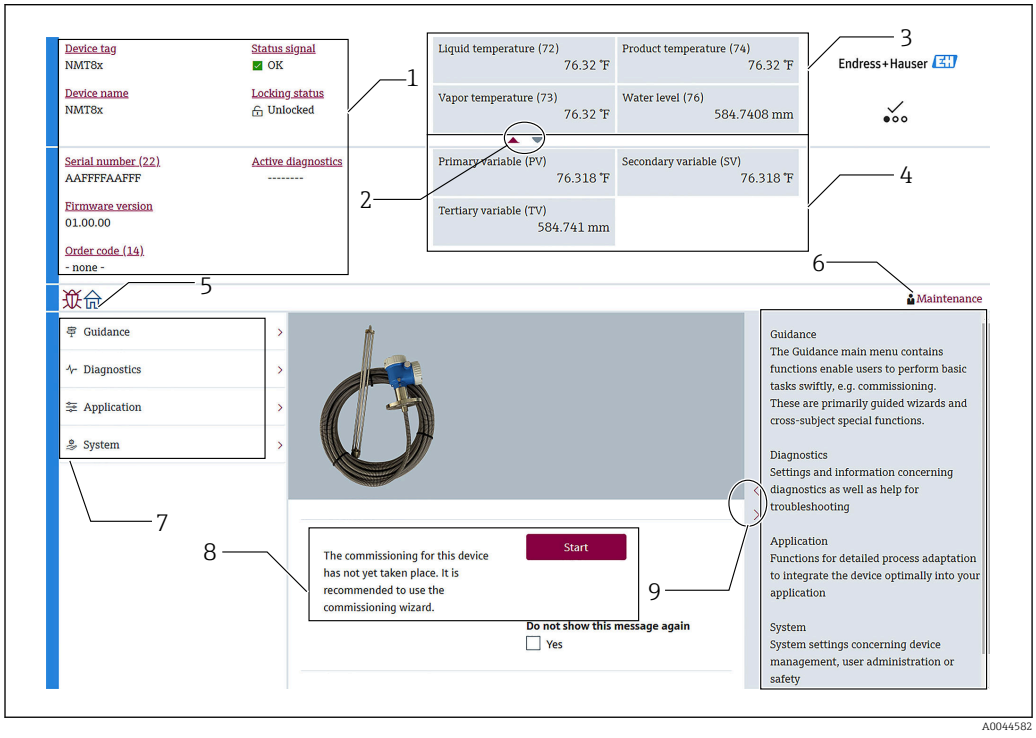
9.2 Initial setting

Depending on NMT81 specification, some of the initial settings described below may not be required.

NMT81 does not have functions for setting display language or setting the real-time clock. The only available display language is English for NMT81.

9.3 Initial screen

This section briefly describes the categories of items and their content, and operations. For further details of each description, refer to the following sections.



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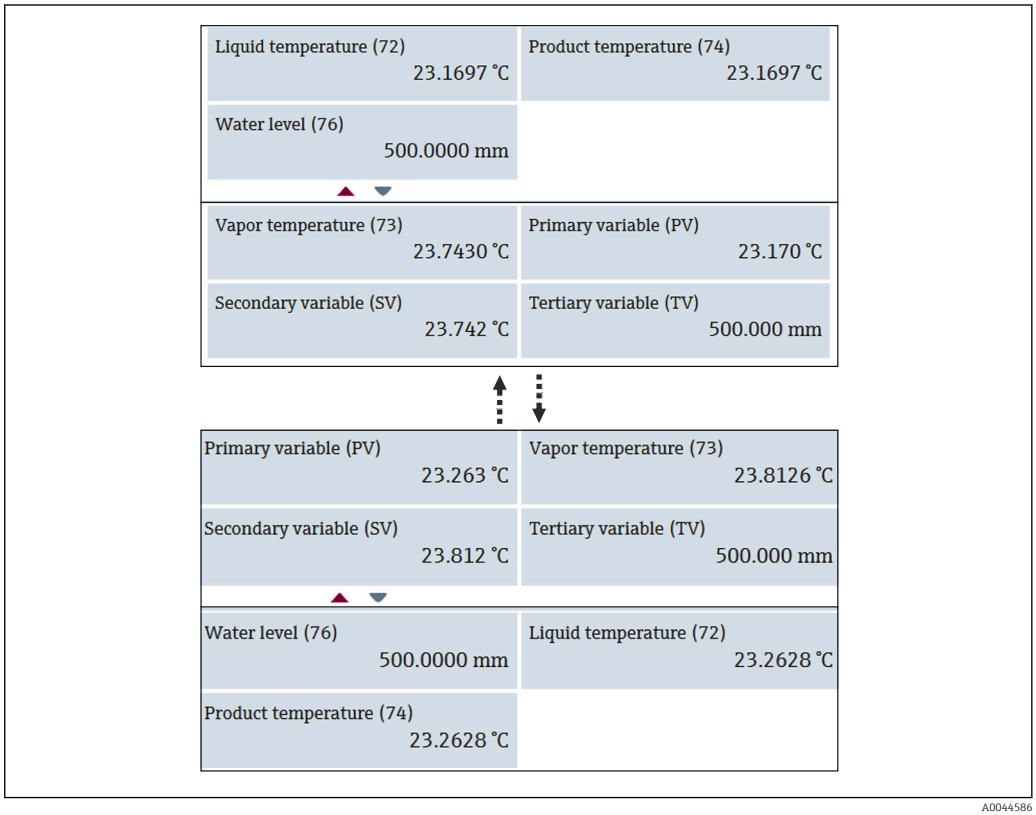
56 *Initial screen via FieldCare*

1 *Device status view area*
2 *Area enlarged view button for upper and lower views*
3 *Upper view area*
4 *Lower view area*
5 *Home button*
6 *Mode view*
7 *Operating menu list*
8 *Setting input area*
9 *Area enlarged view button for descriptions*

9.3.1 Upper and lower view areas

The layout of the items in the upper view area [3] and the lower view area [4] can be changed by dragging and dropping the desired items in the display area above.

For the category of (PV) and (QV), the desired items to be displayed in the upper or lower view area can be selected via the “Output settings” part of the commissioning procedure. For the category of (QV), the items are selectable but not displayed on either of the upper or lower view areas. For more details for setting of the upper and lower views, see next article “Commissioning”.



57 *Upper and lower view areas*

9.4 Guidance

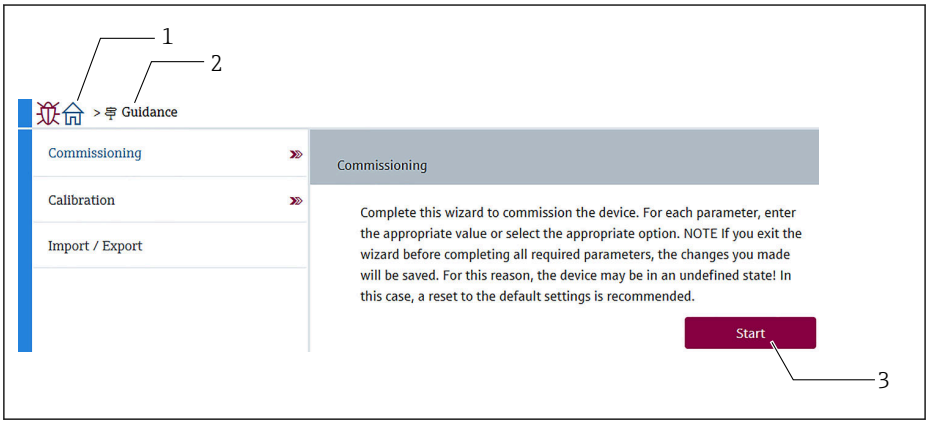
Guidance contains three items: Commissioning, Calibration, and Import / Export; however this section only describes Commissioning and Import / Export. We recommend that calibration be performed by E+H service personnel, and the procedures are therefore not listed in the operating instructions.

9.4.1 Commissioning

Commissioning means to perform the initial settings for measurement. When the DTM is opened for the first time, Commissioning of NMT81 will be required.

Commissioning procedure

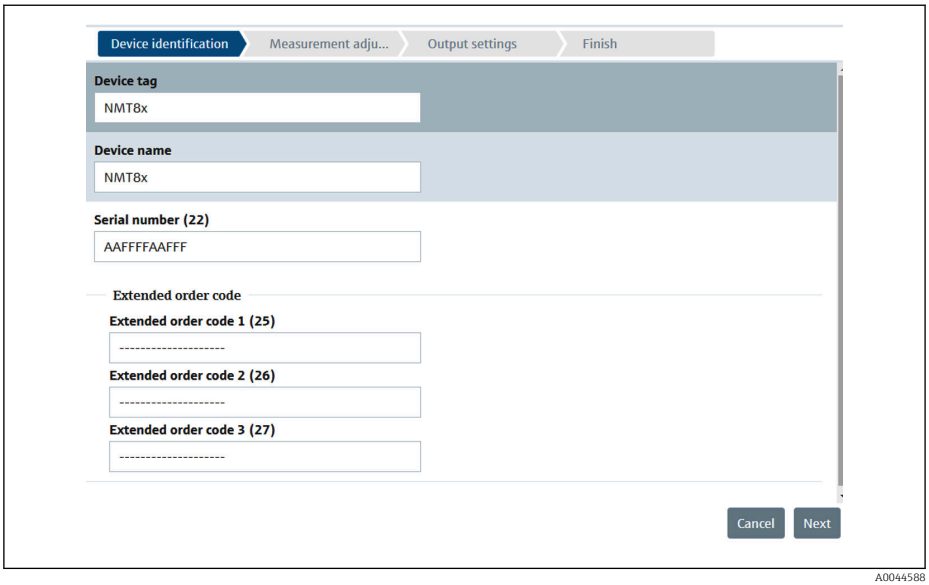
1. Navigate to: Guidance → Commissioning → Start



58 *Initial screen of Commissioning*

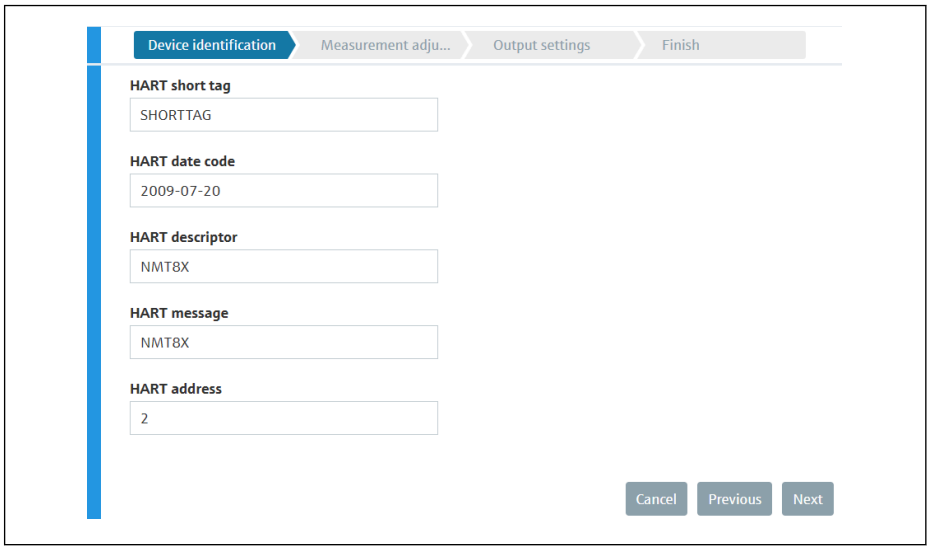
1 *Home button*
2 *Operation menu: Guidance*
3 *Start button*

2. Confirm that the device tag, name and serial number are correct, and select [Next].



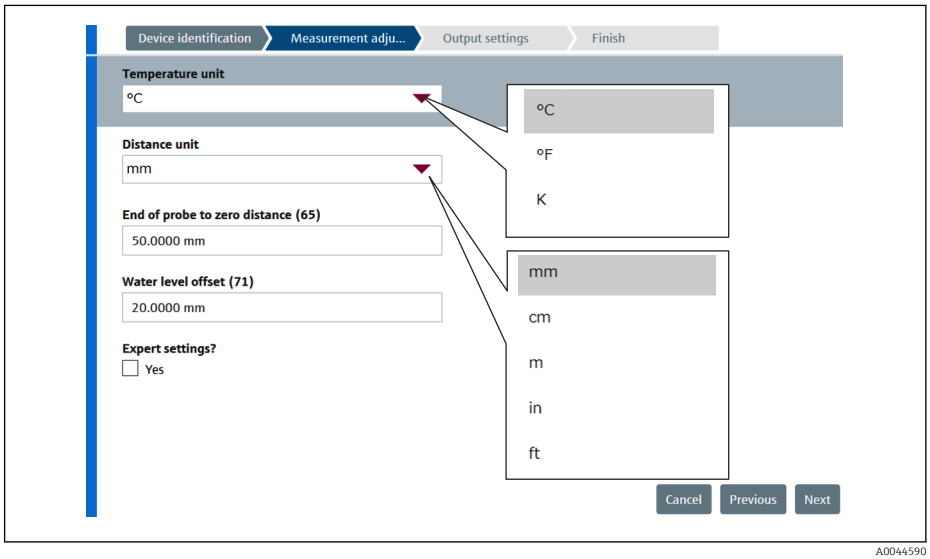
59 *Device identification screen*

3. Confirm that the HART short tag, HART date code, HART descriptor are correct, and select [Next].



60 *Device identification screen 2*

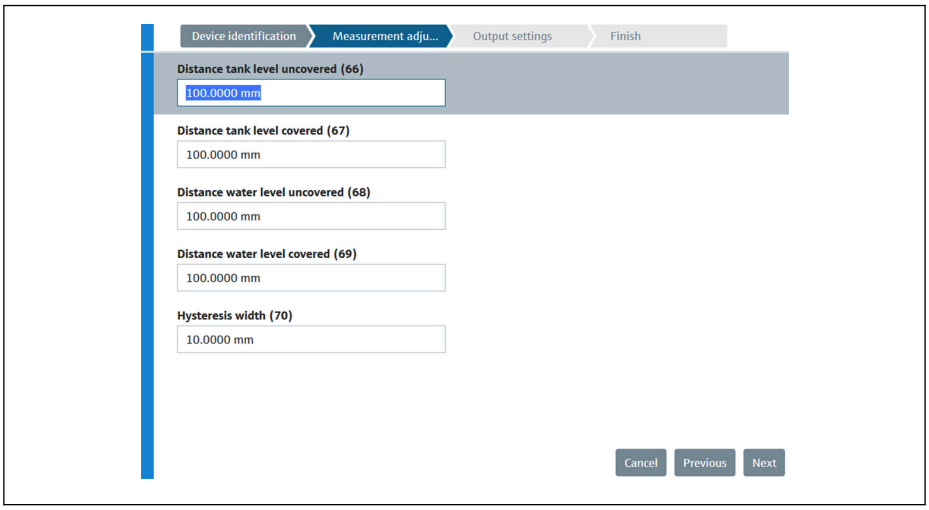
4. Select a unit of the temperature measurement: ℃, ℉, and K and a unit of the distance: mm, cm, m, in, and ft.



61 *Measurement adjustments screen*

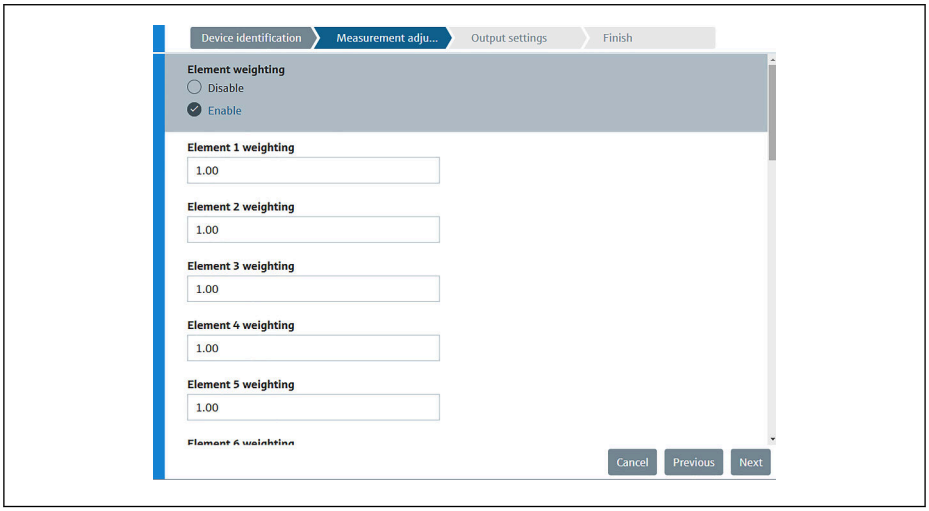
If check [Yes] in Expert setting, go to next step and if not, skip the next step.

5. Set the following five values. For details of each value, → 80



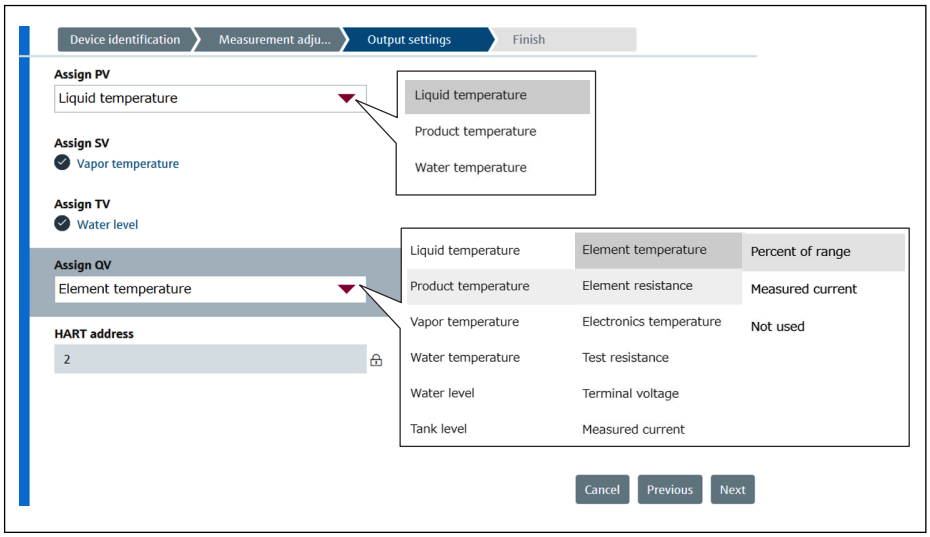
62 *Measurement adjustments screen 2*

6. Select [Next].
7. Set the following values.



8. Select [Next].

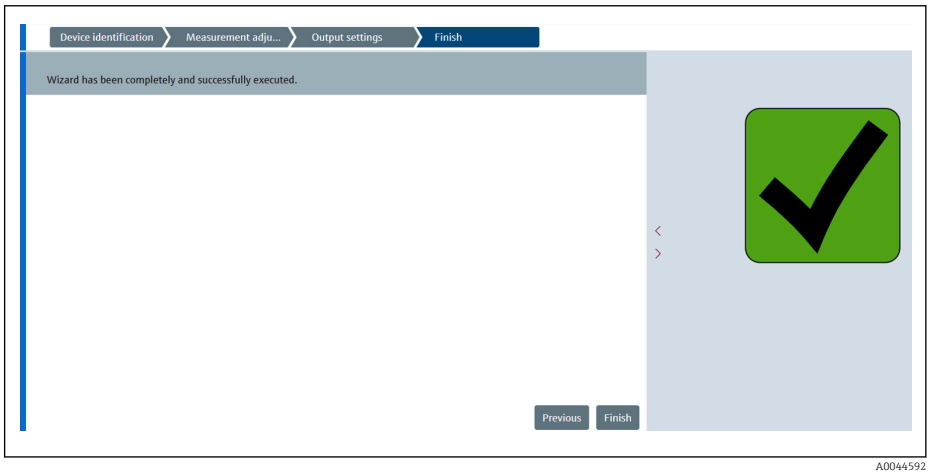
9. Select each item from the Assign PV and the Assign QV, and select [Next].



63 *Output settings screen*

The items selected in this screen will be shown at the upper or lower view area on the initial screen for details→ 67)

10. Select [Finish] to be completed.

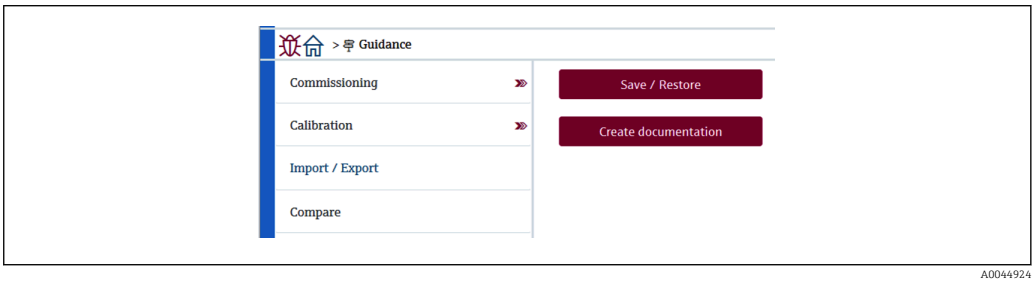


64 *Complete screen*

This completes the commissioning procedure.

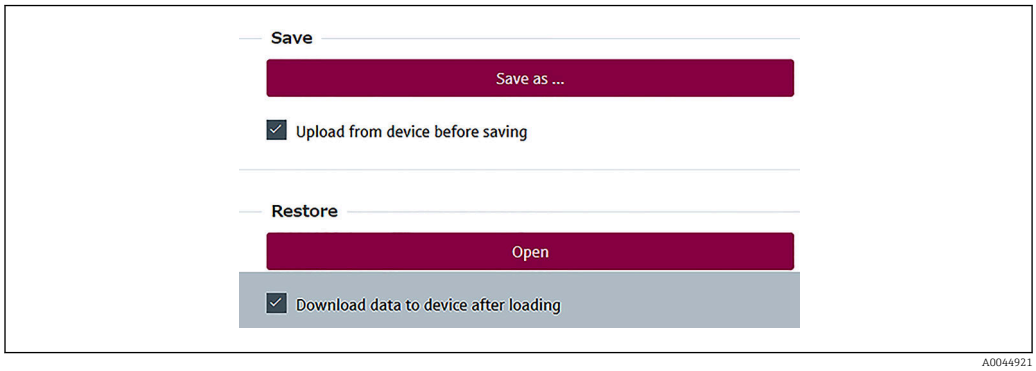
9.4.2 Import / Export

Import / Export has three items to be set or confirmed as follows.



65 *Import / Export screen*

Save / Restore



66 *Save / Restore screen*

Save: The information is sent to a PC from NMT81.

The information of writable parameters regarding device measurements can only be saved on a PC.

Saving procedure

1. Press [Save / Restore].
2. Check upload from the device before saving in order to save the values that are actually saved on the device.
3. Press [Save as].
4. Specify the saving destination.
5. Input a file name.
6. Press [Save].
   ↳ **.deh** file format is created.

This completes the saving procedure.

Restore: Information saved on a PC is sent to NMT81 again.

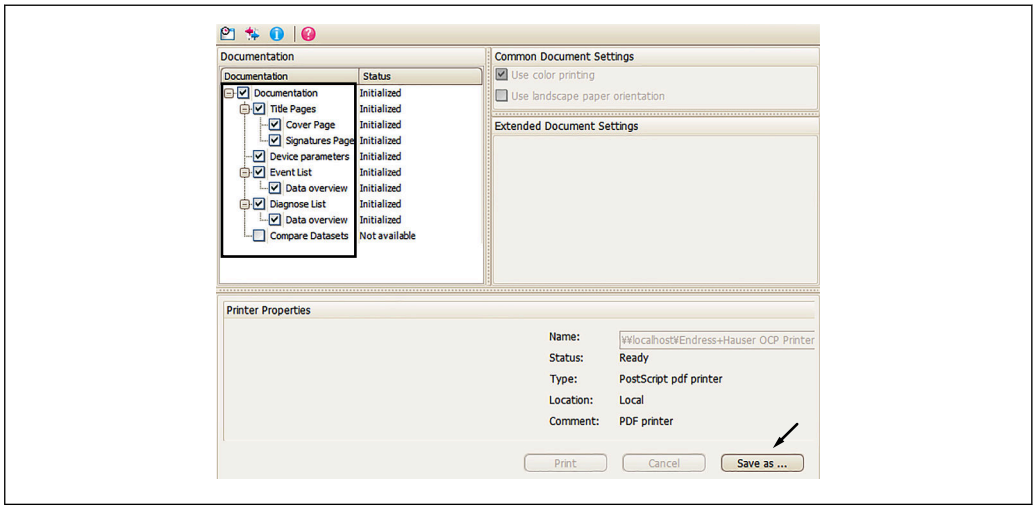
Restore procedure

1. Press [Save / Restore].
2. Check [Download data to device after loading].
   ↳ If data is restored without performing a check, the data is only updated in FieldCare without sending to the master devices.
   The data restore operation without check is used in offline work.
3. Press [Open].
4. Select a desired file.
   ↳ Restoring starts.

This completes the restoring procedure.

Create documentation

This lists the all parameters and displays them in PDF file.



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67 *Create documentation screen*

Creating documentation procedure

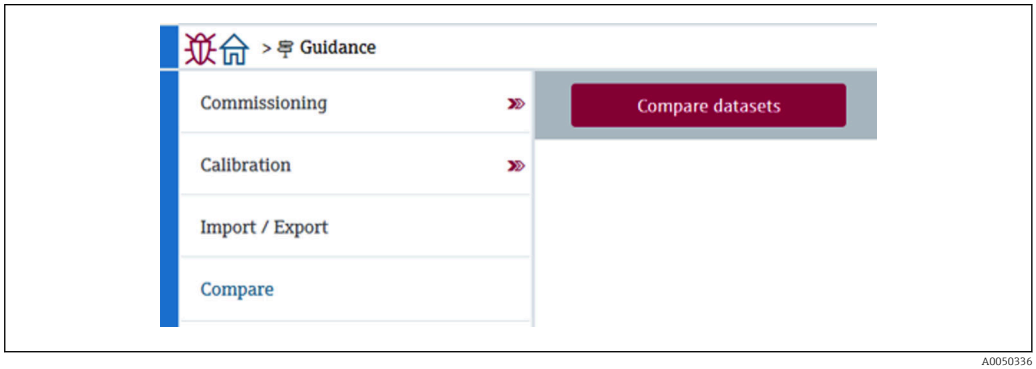
1. Press [Create documentation].
2. Check the required items in the Documentation window.
   ↳ The default setting has every item checked.
3. Press [Save as].
4. Specify the saving destination.
5. Input a file name.
6. Press [Save].
   ↳ The PDF file format is created.

This completes the creating documentation procedure.

9.4.3 Compare

Compare has four items to be set or confirmed as follows.

Compare datasets can simply compare the following items.



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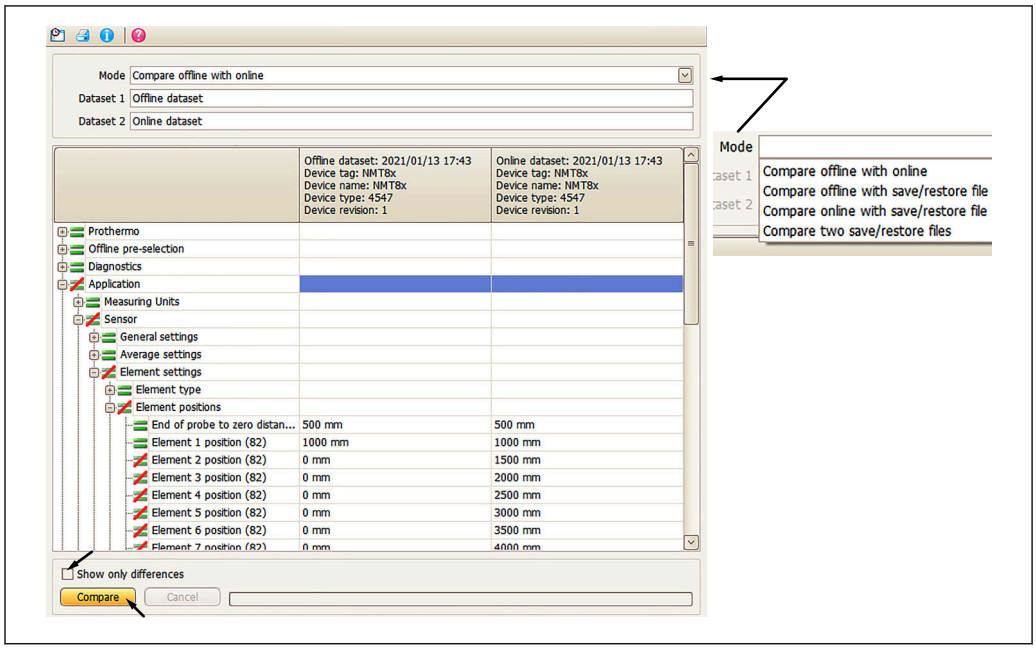
68 *Compare screen*

- Compare offline with online
- Compare offline with save/restore file
- Compare online with save/restore file
- Compare two save/restore files



69 *Compare datasets screen*

Comparing datasets procedure

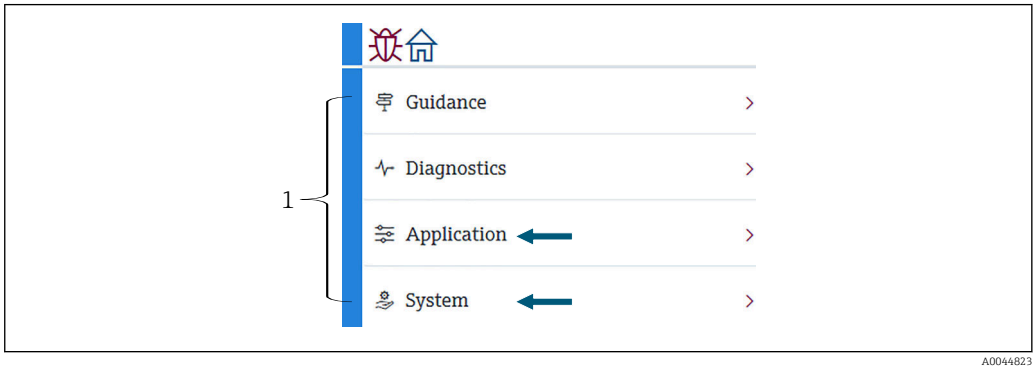
1. Press [Compare datasets].
2. Select a mode as the list above.
3. Check [Show only differences] if necessary.
4. Press [Compare].
   ↳ The comparison analysis starts, and the result is shown on the window with a red diagonal line.

This completes the Comparing datasets procedure.

10 Operation

This chapter includes only Application and System operation procedures. The explanations of the operations are based on the operational procedures of FieldCare.

- Guidance (Commissioning)
- Diagnostics



70 *Initial screen of FieldCare*

1 *Operating menu list*

10.1 Compatibility mode of NMT53x and NMT81

NMT81 has different HART device codes depending on the measurement conditions. The NMT81 can be switched to a NMT53x compatibility mode in which it operates as an NMT53x but limited to basic functions. When the NMT53x mode is selected, the device can be connected to FieldCare by switching to the NMT81 mode by using the dip switch. → 52

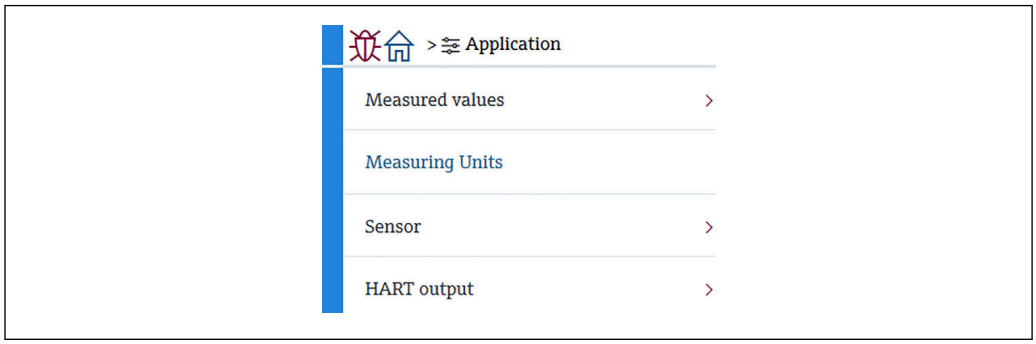
NMT81 will reboot with the modes listed below after being switched to compatibility mode and reset.

Dip switch status	Sensor type	Mode	HART device type
Off	Temperature only Temperature + WB	NMT81	0x11C3
On	Temperature only	NMT53x	0x11B8
	Temperature +WB		0x11BA

- When NMT53x mode is selected, the device cannot be connected to FieldCare of either NMT81 or NMT53x.
- NMT53x compatibility mode supports only limited functions and parameters, for further assistance, contact your Endress +Hauser Sales Center.

10.2 Application

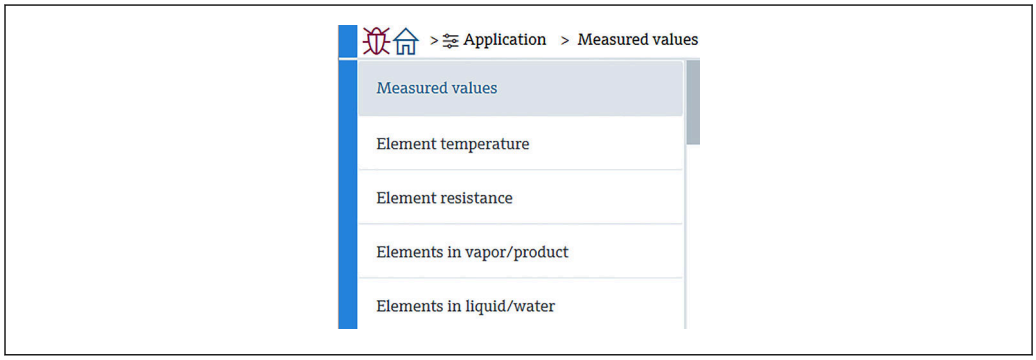
Application is for setting the main parameters. It contains four subordinate items to be set or confirmed. This section describes setting procedure in sequence from the top. For further information of parameters, refer to the "Description of Device Parameters" manual.



71 *Initial screen of Application*

10.2.1 Measured values

Measured values has five items to be confirmed.

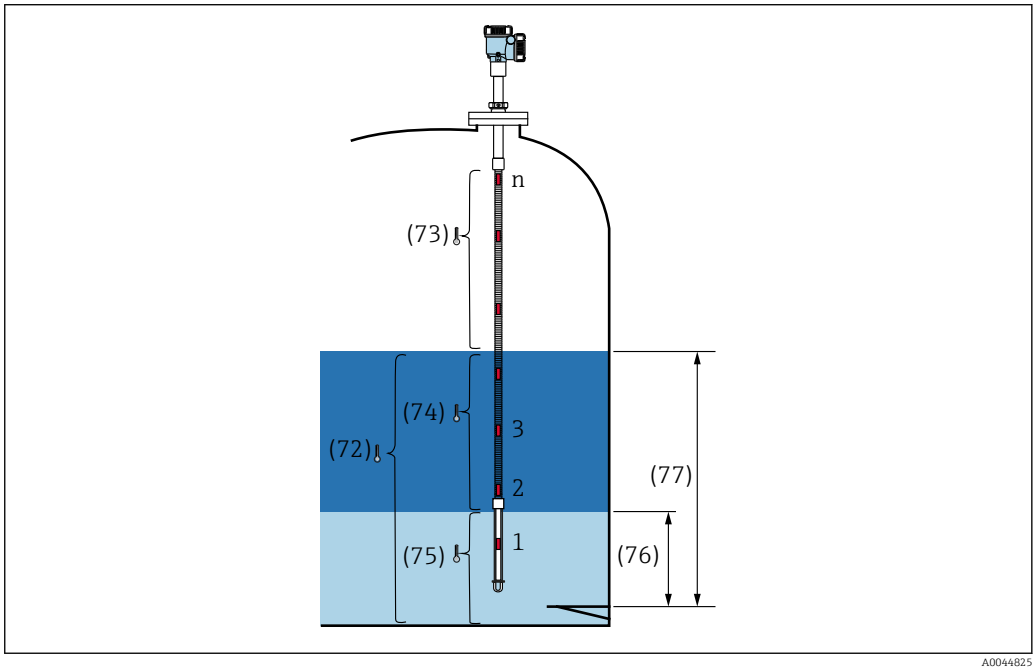


72 *Measured values screen*

The items of Measured values

Check the items below and confirm that temperatures, levels and the other items show appropriate values.

- 72: Liquid temperature
- 73: Vapor temperature
- 74: Product temperature
- 75: Water temperature
- 76: Water level
- 77: Tank level
- Test resistance
- Terminal current
- Terminal voltage 1
- Water bottom frequency ratio

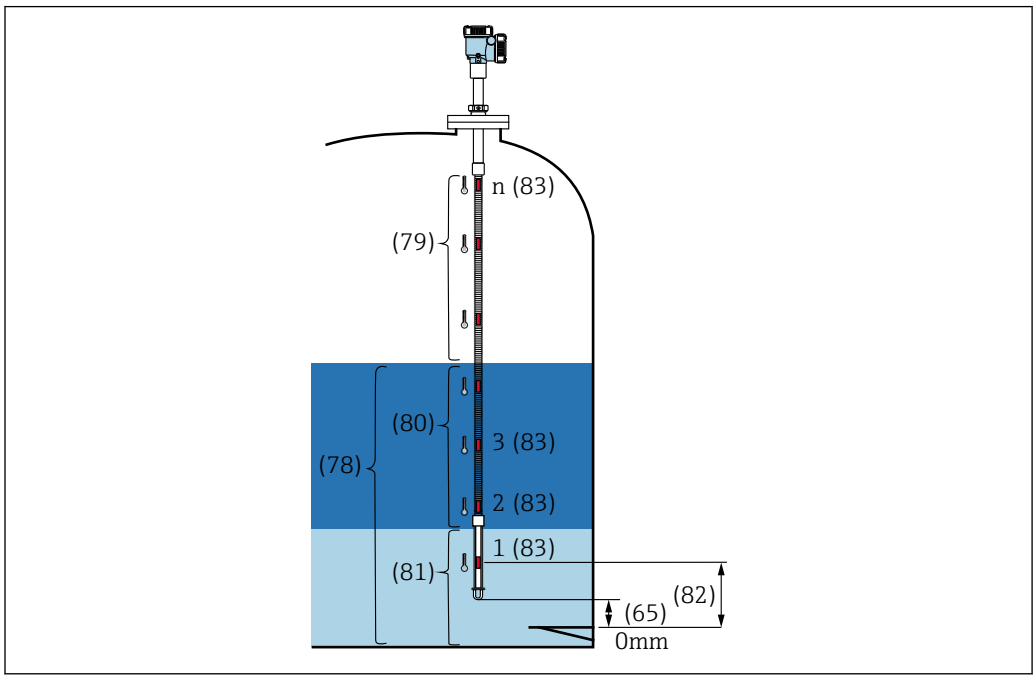


73 *Measured values*

Element temperature

Element temperature screen shows each element temperature and position. Confirm that appropriate values are shown.

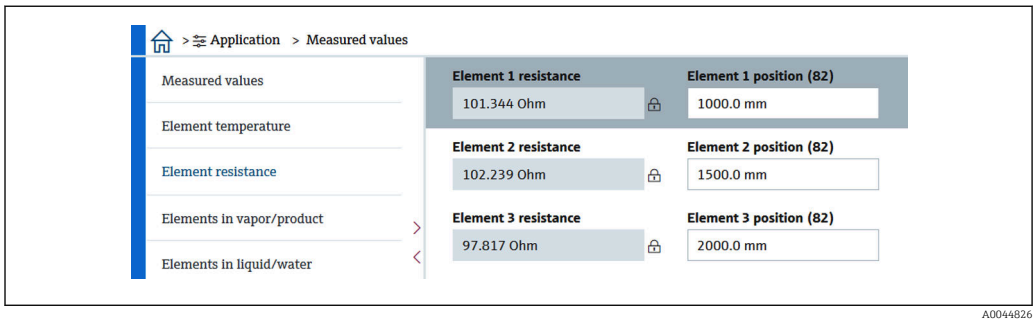
- 82: Element position 1 to 24
- 83: Element temperature 1 to 24



74 *Element temperature*

Element resistance

Element resistance shows each element resistance and position. Confirm each resistance shows appropriate values.



75 *Element resistance screen*

Elements in vapor /Elements in product

Elements in vapor /Elements in product shows the elements used for calculation of average vapor temperature and average product temperature. All elements above the product level are considered to be elements in vapor. Defective elements will be also skipped.

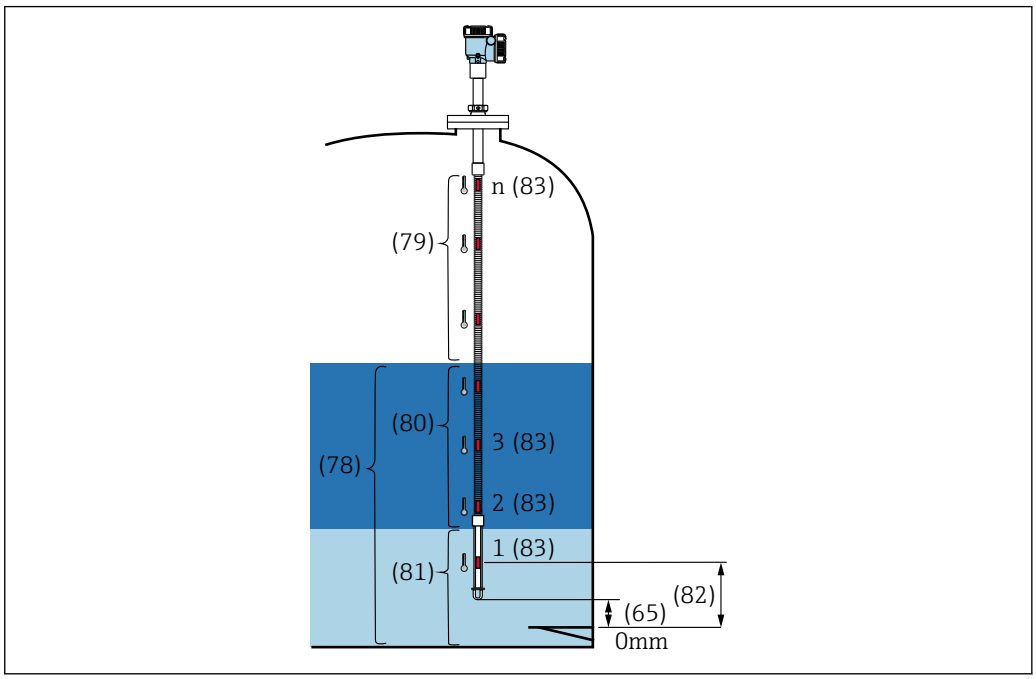
Unused ElementX resistances are displayed as NaN Ohm.

- 79: Elements in vapor
- 80: Elements in product

Elements in liquid / Elements in water

Elements in liquid shows the elements used for calculations of average liquid and water temperature. All elements are in the tank level. Defective elements will be skipped.

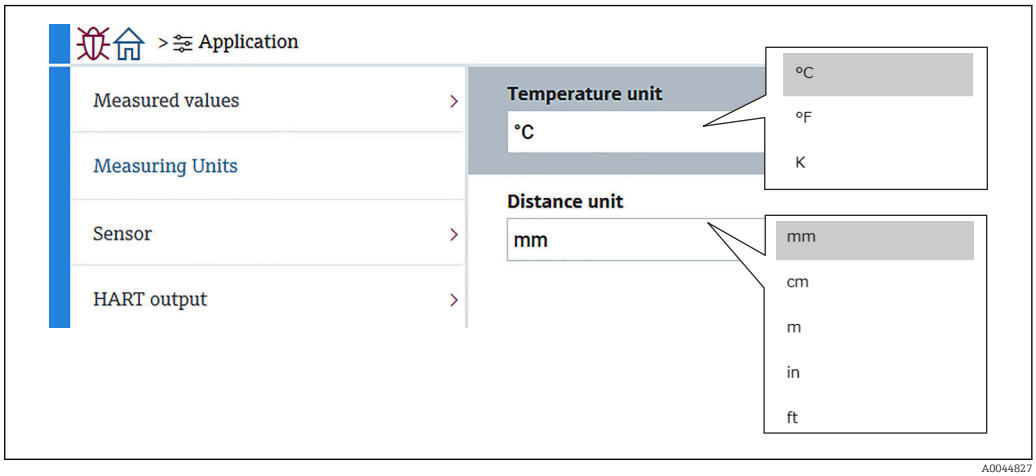
- 78: Elements in liquid
- 81: Elements in water



76 *Element temperature*

10.2.2 Measuring Units

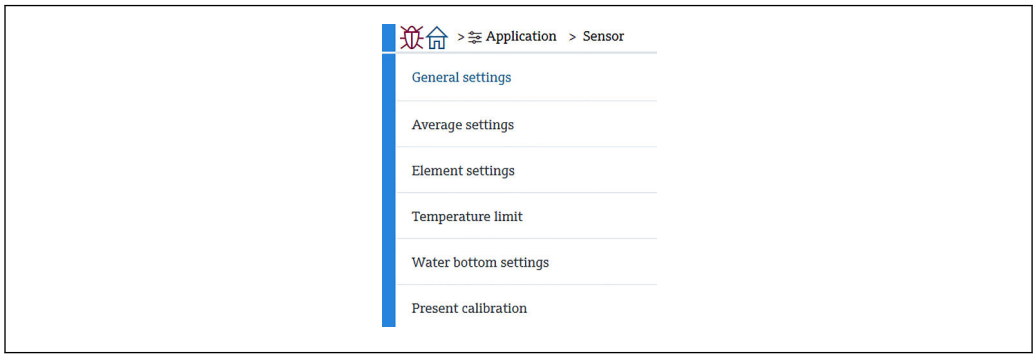
Measuring Units has two items to define the units of temperature and length. Select the desired units respectively.



77 *Measuring Units screen*

10.2.3 Sensor

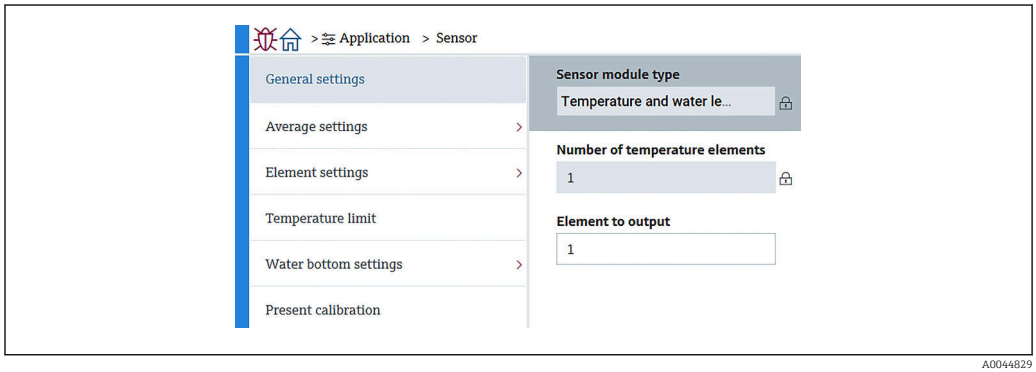
Sensor has six subordinate items to be set or confirmed as follows.



78 *Sensor screen*

General settings

General settings has three items to be set or confirmed as follows.

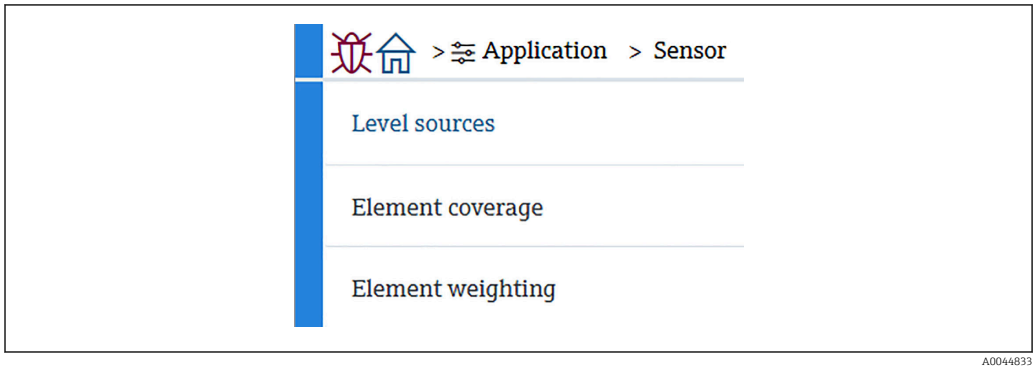


79 *General settings screen*

- Sensor module type: Can be confirmed according to your specifications.
- Number of temperature elements: Can be confirmed according to your specifications.
- Element to output: Defines the element which can be shown on the display and output as QV (Quaternary dynamic Variable).

Average settings

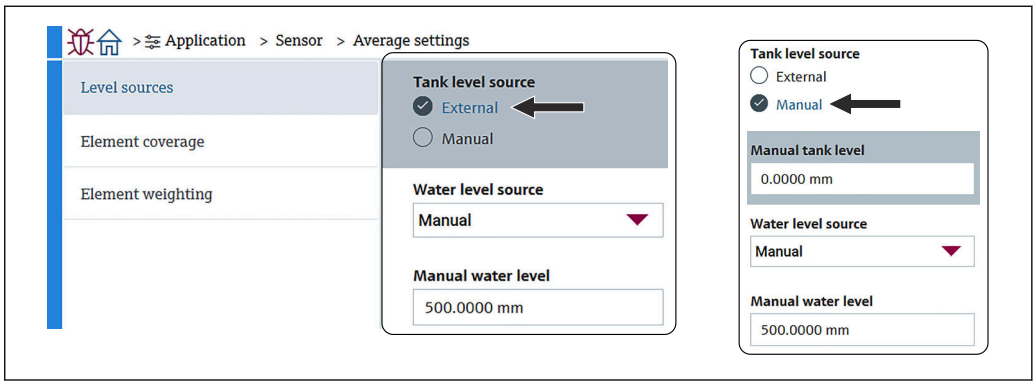
Average settings has three items to be set or confirmed as follows.



80 *Average settings screen*

Tank level source / Water level source

Because both tank (liquid) and water levels play important roles in measuring the average temperature properly, the Level sources parameter has two setting functions for both tank (liquid) and water levels as follows.



81 *Tank level source / Water level source screen*

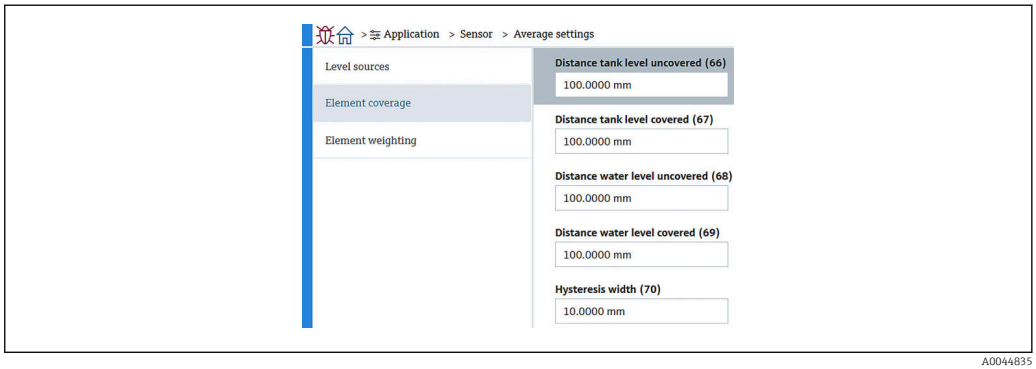
- External: Receives the level data via an external device.
- Manual: Sets an optional value for the level.

When a WB test is required for any reason, the Manual mode is used.

1. Select Manual mode and press [Enter].
2. Select Manual from the pull-down menu of the Water level source.
3. Input the Manual water level.
4. Input a desired value to the Manual water level.

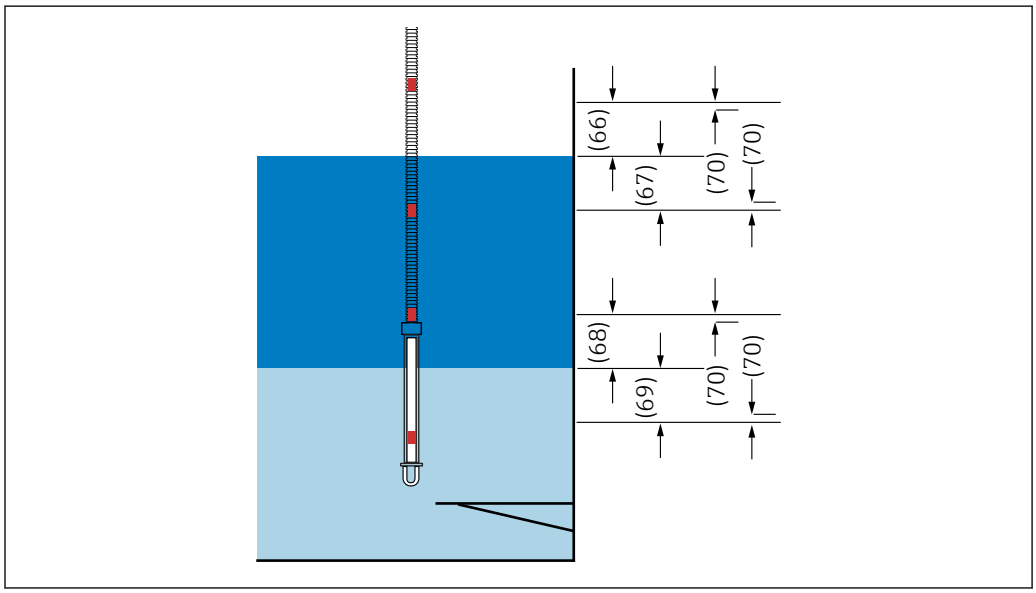
Element coverage

Element coverage has five items to be set or confirmed as follows.



82 *Element coverage screen*

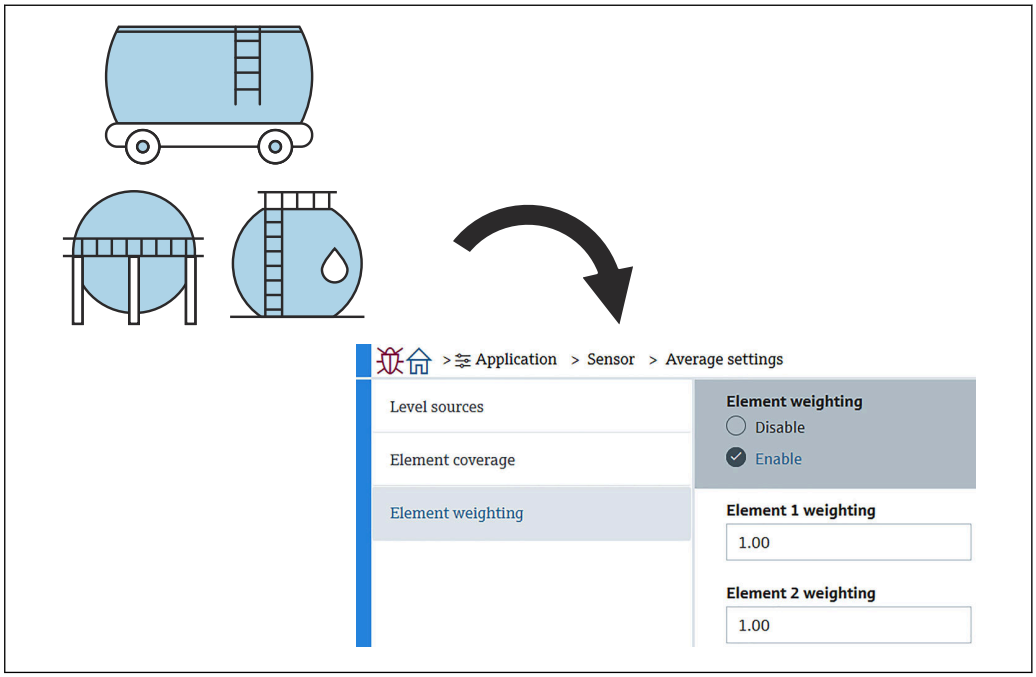
- 66 (Distance tank level uncovered): Sets the distance from the liquid level for determining whether an element above the liquid level is to be included in the average of the vapor temperature.
  Setting range: 0.0000 to 999.9999
- 67 (Distance tank level covered): Sets the distance from the liquid level for determining whether an element under the liquid level is to be included in the average of the product or liquid temperature.
  Setting range: 0.0000 to 999.9999
- 68 (Distance water level uncovered): Sets the distance from the water level for determining whether an element above the water level is to be included in the average of the product temperature.
  Setting range: 0.0000 to 999.9999
- 69 (Distance water level covered): Sets the distance from the water level for determining if an element under the water level is to be included in the average of the water temperature.
  Setting range:0.0000 to 999.9999
- 70 (Hysteresis width): Sets the distance at which elements are excluded from the average of the temperature at each phase. The distance used for determining to exclude at element is obtained by subtracting the hysteresis width from 66, 67, 68, and 69
  Setting range: 0.0000 to 999.9999



83 *The position of the Element coverage*

Element weighting

By enabling the element weighting, the average temperature calculation can be adapted to different tank shapes. If Disable is selected, the element weighting function is turned off.



84 *Element weighting screen*

Average temperature calculation

The following formulas/calculation methods are used to calculate the different average temperatures:

- Average vapor temperature
- Average liquid temperature
- Average product temperature
- Average water temperature

The formula of the element weighting shows as follows.

$$T_{average} = \frac{W_{ElementA} * T_{ElementA} + W_{ElementB} * T_{ElementB} + \cdots + W_{ElementZ} * T_{ElementZ}}{W_{ElementA} + W_{ElementB} + \cdots W_{ElementZ}}$$

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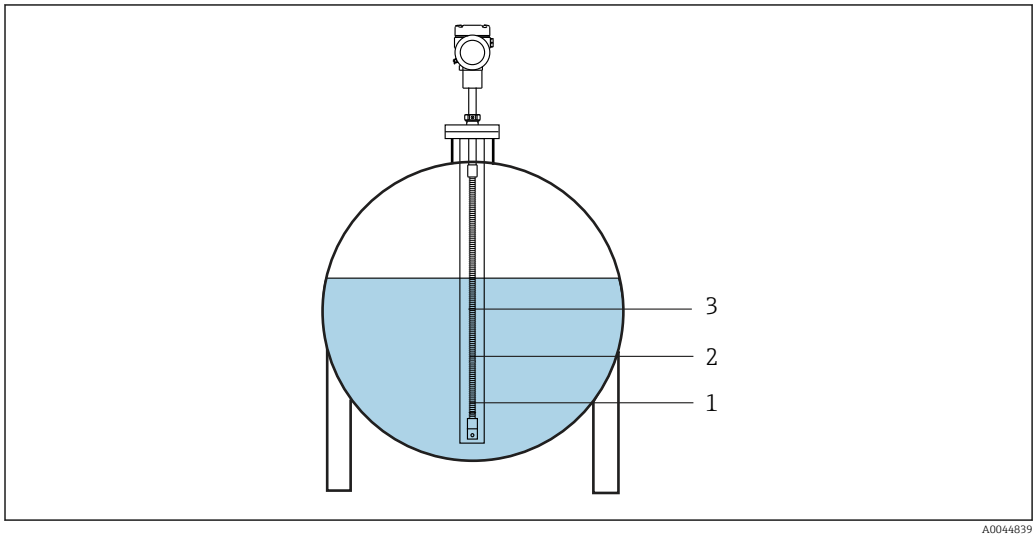
Standard calculation method without weighting

Use the formula above, replacing W to 1 for the standard calculation.

Regardless of the shape of the tank, average temperature is calculated by using the actual formula:

(T1 + T2 + T3) / Number of elements in liquid phase = Average temperature
(3.5 °C (38.3 °F) + 3.0 °C (37.4 °F) + 2.0 °C (35.6 °F)) / 3 = 2.83 °C (37.1 °F)



85 Standard calculation method for liquid temperature

1 T1 (Element No.1): 3.5 °C (38.3 °F)
2 T2 (Element No.2): 3.0 °C (37.4 °F)
3 T3 (Element No.3): 2.0 °C (35.6 °F)

Advanced calculation method with weighting

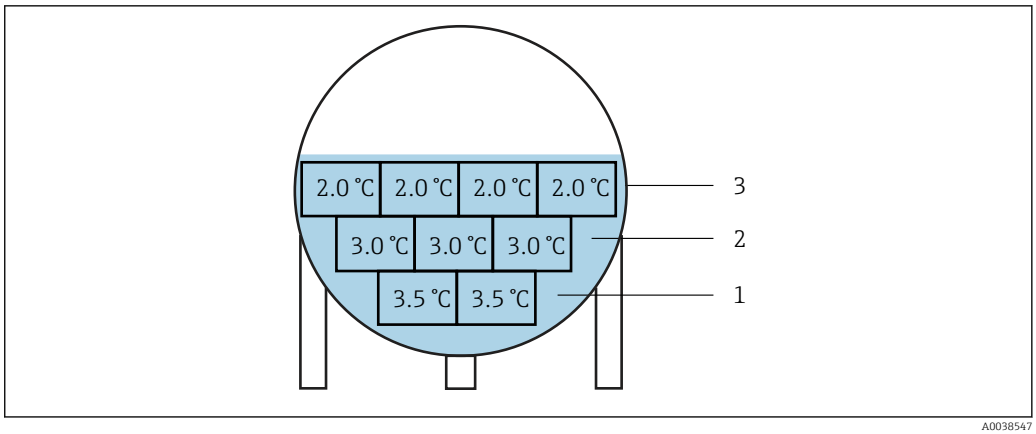
Average temperature is calculated by adding a corrective factor for unequal volume distribution. Use the formula below and input W to volume ratio for the advanced calculation.

Formula: (T1 * W1 + T2 * W2 + T3 * W3) / (W1 + W2 + W3) = Average temperature

Formula: (3.5 °C (38.3 °F) x 2 + 3.0 °C (37.4 °F) x 3 + 2.0 °C (35.6 °F) x 4) / (2 + 3 + 4) = 2.67 °C (36.8 °F)

In the diagram below, □ represents W (volume factor).

(3.5 °C (38.3 °F) x 2 + 3.0 °C (37.4 °F) x 3 + 2.0 °C (35.6 °F) x 4) / (2 + 3 + 4) = 2.67 °C (36.8 °F)

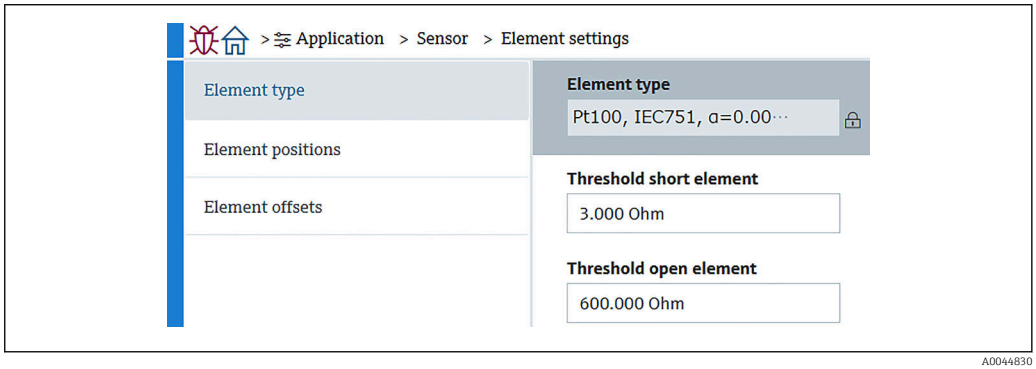


86 *Advanced calculation method*

1 *T1 (Element No.1): 3.5 °C (38.3 °F)*
2 *T2 (Element No.2): 3.0 °C (37.4 °F)*
3 *T3 (Element No.3): 2.0 °C (35.6 °F)*

Element settings

Element settings has three items as follows.



87 *Element settings screen*

Element type

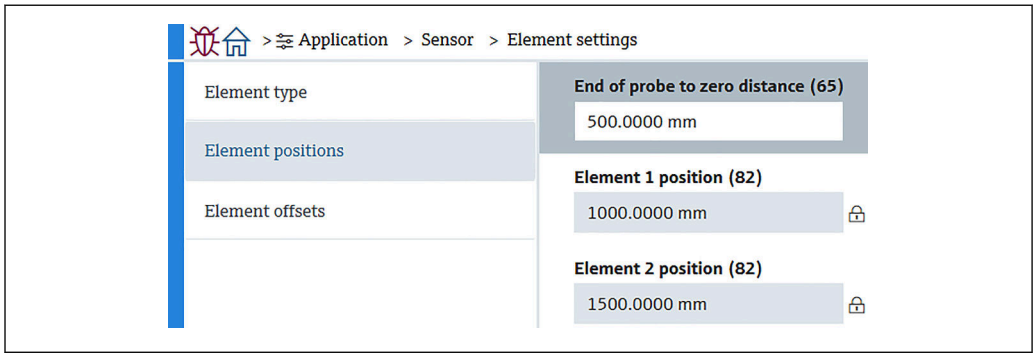
The element type has three items to be set or confirmed as follows.

- Element type: Can be confirmed according to your specifications.
- Threshold short element: Defines the threshold value at which the main unit will consider the element to be short.
- Threshold open element: Defines the threshold value at which the main unit will consider the element to be open.

When elements have shorted and/or are open, the temperature of those elements is not used for average temperature calculation.

Element position

Element position has two items as follows.

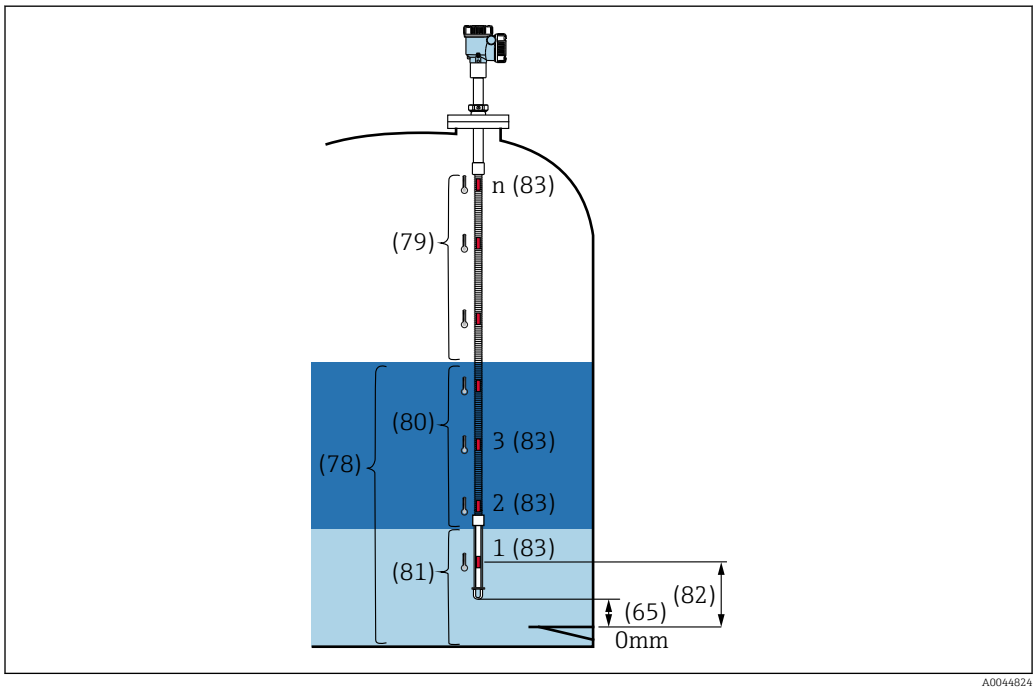


88 *Element positions screen*

When selecting Redundancy specification, same position value is set to the pair elements.

- 65 (End of probe to zero distance): Defines the distance between the physical end of the probe and the zero level value in the tank (datum plate/tank bottom). Adjust this value so that the absolute element positions fit to the level in the tank.
  Setting range: −99 999.9900 to 99 999.9900
- 82 (Element position): Can be confirmed according to your specifications.
  Setting range: −99 999.9900 to 99 999.9900

The absolute position will be changed depending on the setting of the End of probe to zero distance. The position 1 to 24 will be automatically set based on the information of the zero distance. However for the converter-only specification, each Element position must be manually set.



89 *Element position*

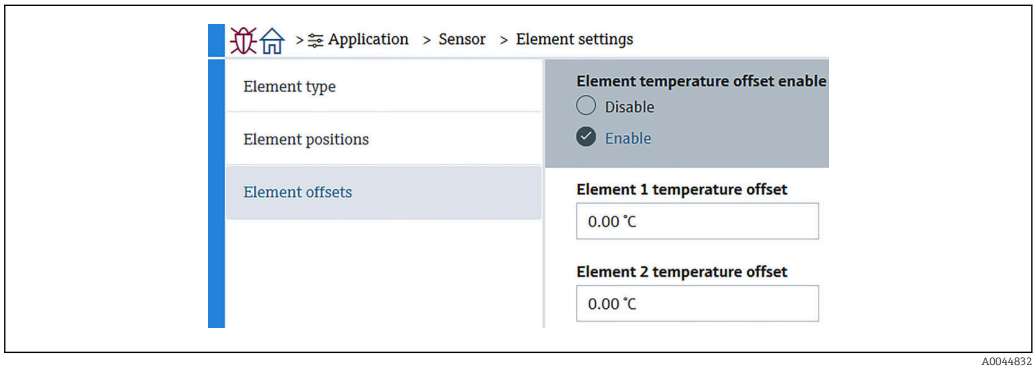
Element offsets

The setting of the element offsets enables individual element 1 to 24 temperature offsets to be activated.

Input the offset values if needed.

Setting range: −100 to 100 °C or -180 °F to 180 °F

When changing the unit of temperature (°C ↔ °F), the display and the temperature range automatically show proper unit.



90 Element offsets screen

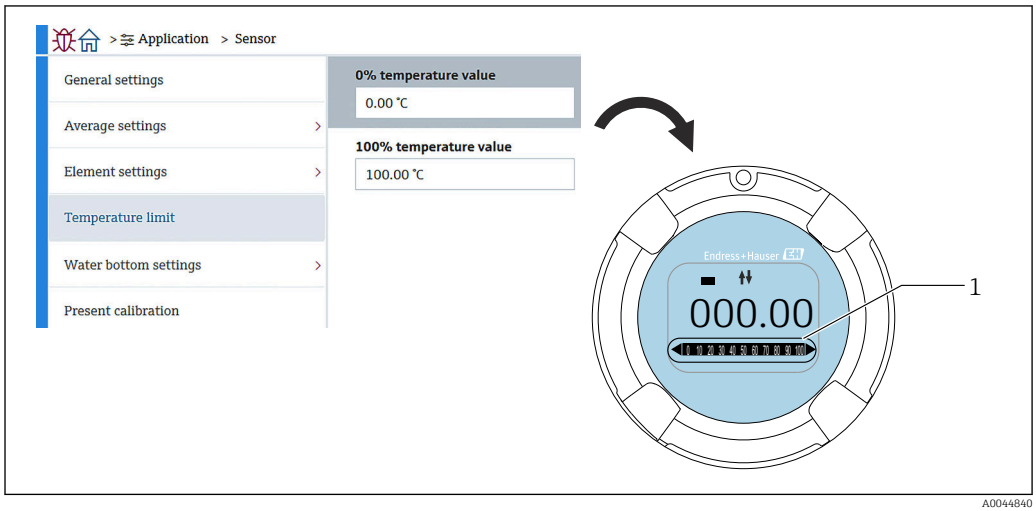
- Disable: Inactivates the offset values.
- Enable: Activates the offset values.

Temperature limit

The range of the Temperature limit corresponds to the application temperature of the order code. The range is set according to your order code when shipped.

The set values are used to calculate the bar graph on the display (option).

Setting range varies depending on the specifications.



91 *Temperature limit*

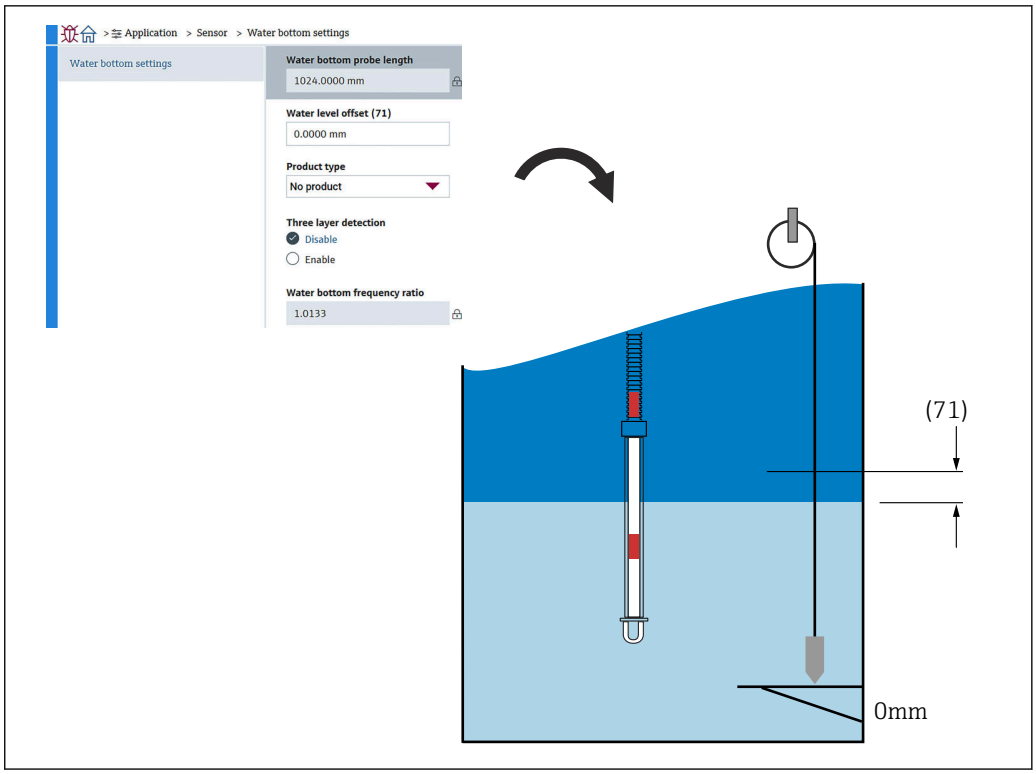
1 Bar graph

- 0% temperature value: Defines the available temperature of the lower range.
- 100% temperature value: Defines the available temperature of the upper range.

- Values can be set within a range that is pre-set when shipped.
- The values set for this parameter are used for the other parameters as effective upper/lower temperature values. If the actual values exceed the range of setting, an S844 error event occurs.

Water bottom settings

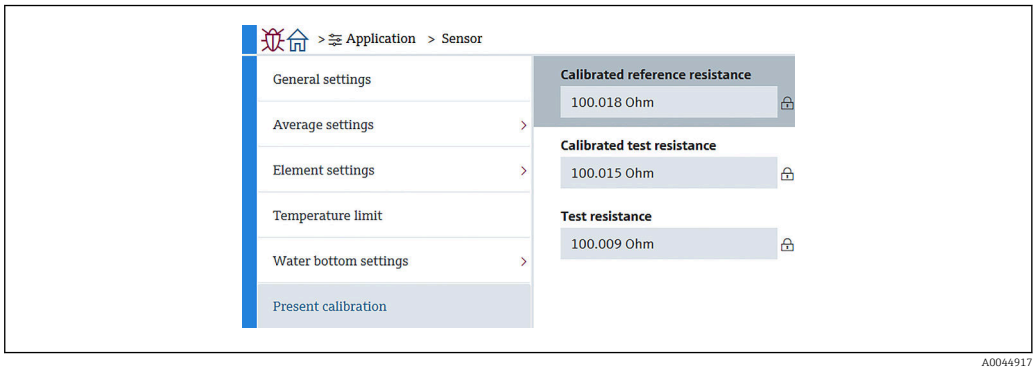
- Water bottom probe length: Shows the actual length of the probe.
- 71 (Water level offset): Defines the offset value of the water level.
  Setting range: −100 to 100 m (−328.08 to 328.08 ft)
- Product type: Selects the product from the pull-down menu for the product type used with your application, or select something similar.
- Three layer detection: Detects the layers if there are water, product, and vapor in the white part of the WB in the figure below.
  - Disable: Off
  - Enable: On
- Water bottom frequency ratio: Shows the values which the board of the sensor outputs.



92 *Water bottom settings*

Present calibration

Present calibration shows the result of the current performed calibration as follows. Confirm that the all values are shown appropriately.

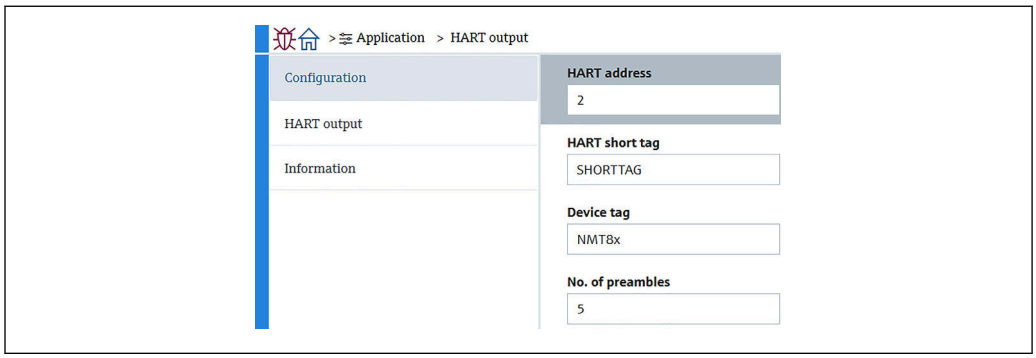


93 *Present calibration screen*

10.2.4 HART output

Configuration

Configuration has four items to be set or confirmed as follows.



94 *Configuration screen*

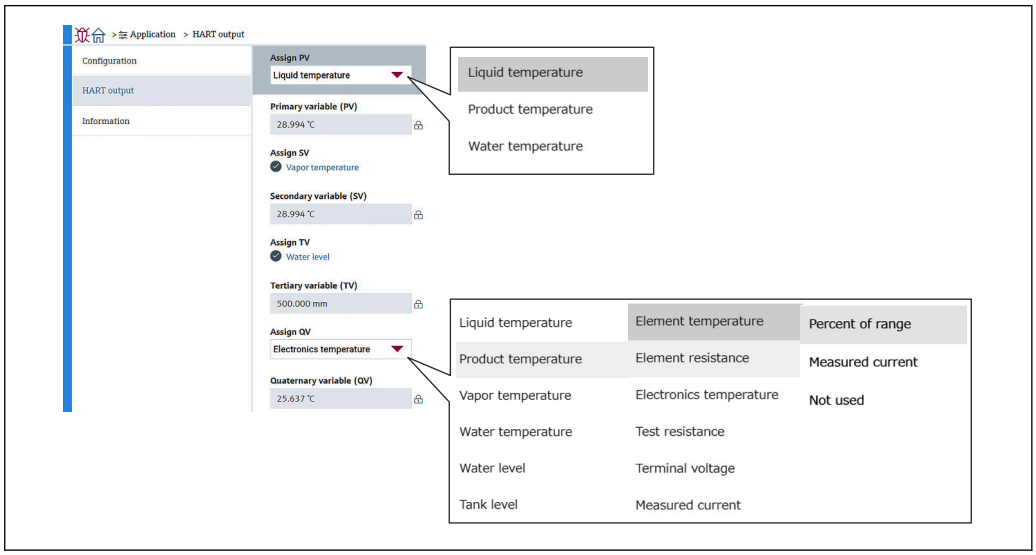
- System polling address: Shows the communication address of the device and NMT81 is usually set to 2.
  Setting range: 0 to 63
- HART short tag: Defines the name of the device to identify the device easily in the master device.
  Allowed characters type: 8 characters with A to Z, 0 to 9, and certain special characters (+-*/!?).
- Device tag (long tag): Defines the name of the device to identify the device easily.
  Allowed characters type: 0 to 32 characters with A to Z, 0 to 9, and certain special characters (+-*/!?).
- No. of preambles: Defines the number of the bit when communicating with HART.
  NMT81 is usually set to 5.
  Setting range: 5 to 20

- If you select "with tag" when ordering the device, you can apply names to both short or long tags.
- When changing the No. of preambles, the HART master must be set to the same number as the NMT81.

HART output

HART output has four items to be set or confirmed as follows.

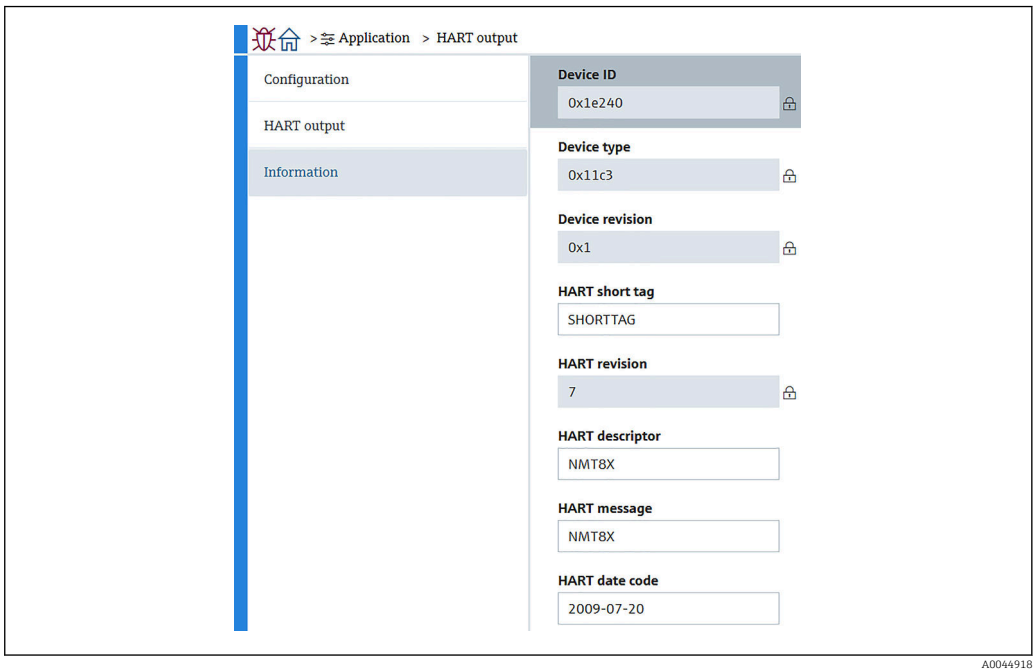
- PV stands for Primary dynamic Variable.
  Assign PV from the pull-down menu as shown on the following figure.
- SV stands for Second dynamic Variable.
- TV stands for Tertiary dynamic Variable.
- QV stands for Quaternary Variable.
  Assign QV from the pull-down menu as shown in the following figure.



95 *HART output screen*

Information

Information has eight items to be set or confirmed as follows.



96 *Information screen*

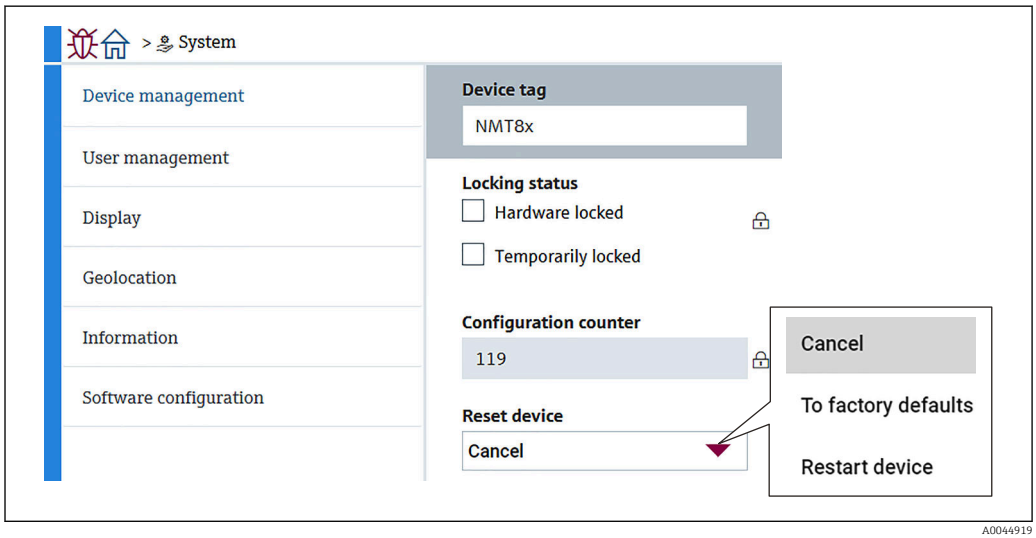
The Information of the Device ID, Device type, Device revision, and HART revision show the status of your order.

- HART short tag: Defines the name for the measuring point.
  Allowed characters type: 8 characters with A to Z, 0 to 9, and certain special characters (+-*/!?).
- HART descriptor: Defines descriptions for the measuring point.
  Allowed characters type: 16 characters with A to Z, 0 to 9, and certain special characters (+-*/!?).
- HART message: Defines a HART message sent via HART protocol when requested by the master device.
  Allowed characters type: 32 characters with A to Z, 0 to 9, and certain special characters (+-*/!?).
- HART date code: Defines the last date of the configuration change.
  Allowed characters type: 10 characters with 0 to 9, yyyy-mm-dd.

If you select "with tag" when ordering the device, you can apply names to both short or long tags.

10.3 System

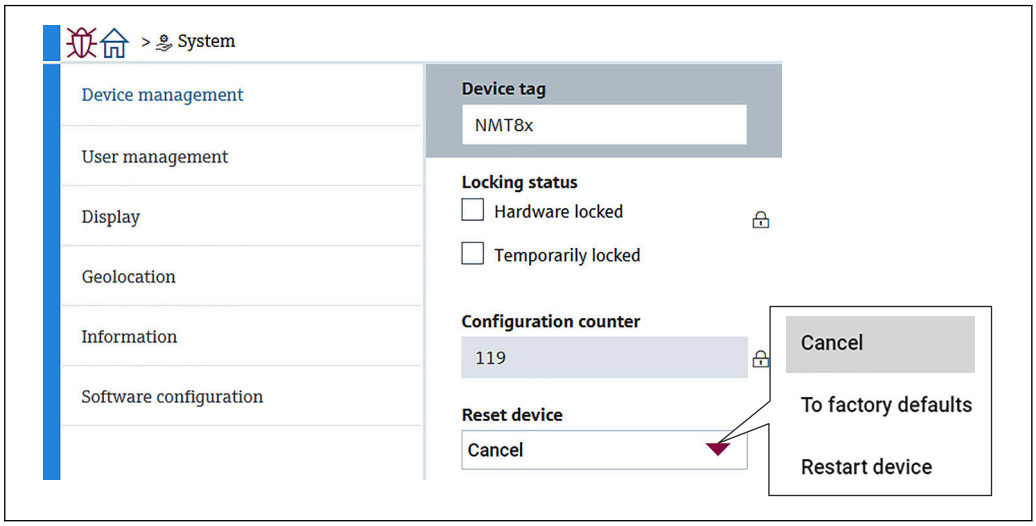
System has six subordinate items to be set or confirmed and mostly shows the descriptions of the device. This section sequentially describes the instructions of the settings from the top. For further information of parameters, refer to the separate "Description of Device Parameters" manual.



97 *Initial screen of System*

10.3.1 Device management

Device management has four items to be set or confirmed as follows.

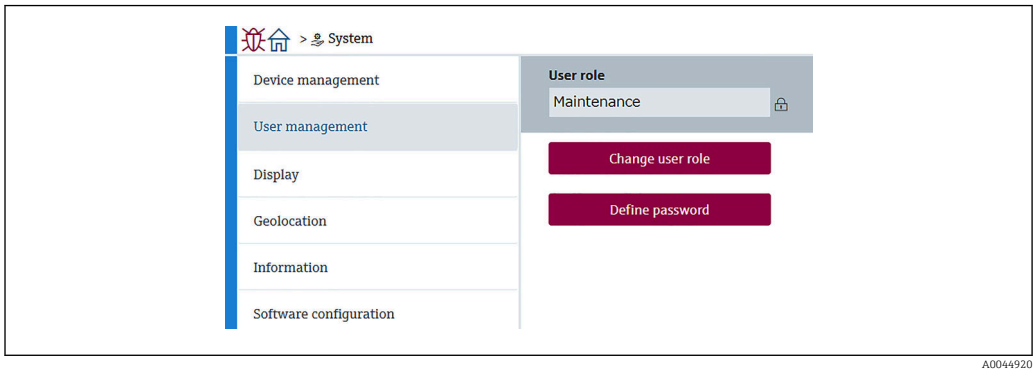


98 *Device management screen*

- Device tag: Defines the name for the measuring point in order to identify the device easily in the master device.
  Allowed characters type: 32 characters with A to Z, 0 to 9, and certain special characters (+-*/!?).
- Locking status: Shows if any of those two items are locked with a check mark.
  - Hardware locked: The device is locked by using the DIP switch. For details, → 52
  - Temporarily locked: The device is temporarily locked by some process (e.g. reset factory default or restart device). The device will be unlocked after completion of the process.
- Configuration counter: Shows the counter for changes to the device parameters.
  - If the value of the static parameter is changed at the time of optimizing or configuring the parameter, the counter is incremented by 1.
    This is to enable tracking different parameter versions.
  - If multiple parameters are changed simultaneously (e.g. when loading parameters into the device from an external source such as FieldCare), the counter displays a higher value.
    The counter cannot be reset, nor return to a default value when performing a device reset.
- Device reset: Enables reset to factory defaults or restart device.

10.3.2 User management

User management defines the user role and changes the authority.



99 *User management screen*

Software locking or unlocking

If operation is locked by means of the DIP switch, the operation is only unlocked again by means of DIP switch. For details of Hardware locking or unlocking → 52

Access to the configuration of the measuring device can be locked by assigning a password. When the device is delivered from the factory, the user role is set to the Maintenance. The measuring device can be fully configured with the Maintenance user role. Afterwards, access to the configuration can be locked by assigning a password. The Maintenance switches to the Operator as a result of the locking. The configuration can be accessed by entering the password.

The password is defined under:

System User management

The user role is changed from the Maintenance to the Operator under:

System → User management → Logout

Deactivating the lock via FieldCare

After entering the password, you can enable the configuration of the measuring device as an Operator with the password. The user role then changes to Maintenance.

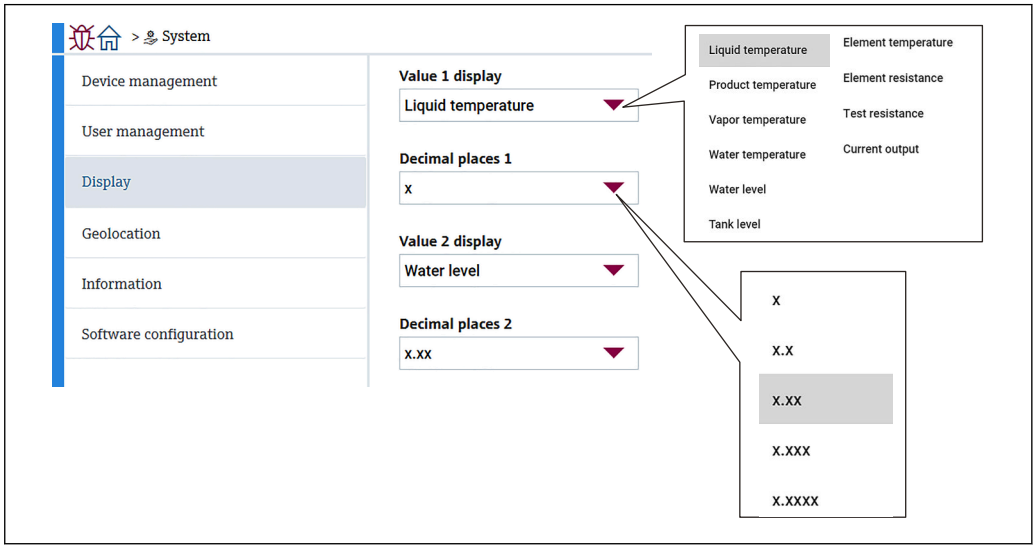
If necessary, the password can be deleted in the User management: System → User management

Navigate to:

System → User management Define password

10.3.3 Display

Display has eight parameters to be set. This function is to set the items to be shown in the Display (option) of the device with the certain cycle. When the combination of the temperature (℃/℉) and length (mm/in) is selected for Value 1 or Value 2, each parameter is identified and displayed in the appropriate units.

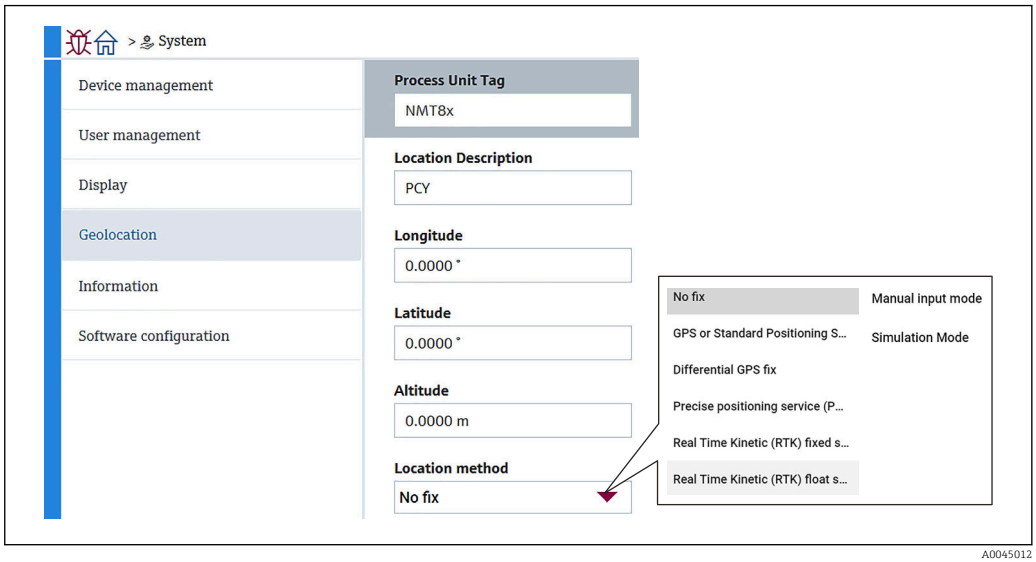


100 *Display screen*

The pull-down menus are the same for Values 2, 3, and 4, and Decimal places 2.

10.3.4 Geolocation

When the usage location of the device is set, this can be used to confirm the maintenance operation details, status, and unexpected events, which can help to keep the device operating smoothly and to analyze and resolve any issues.

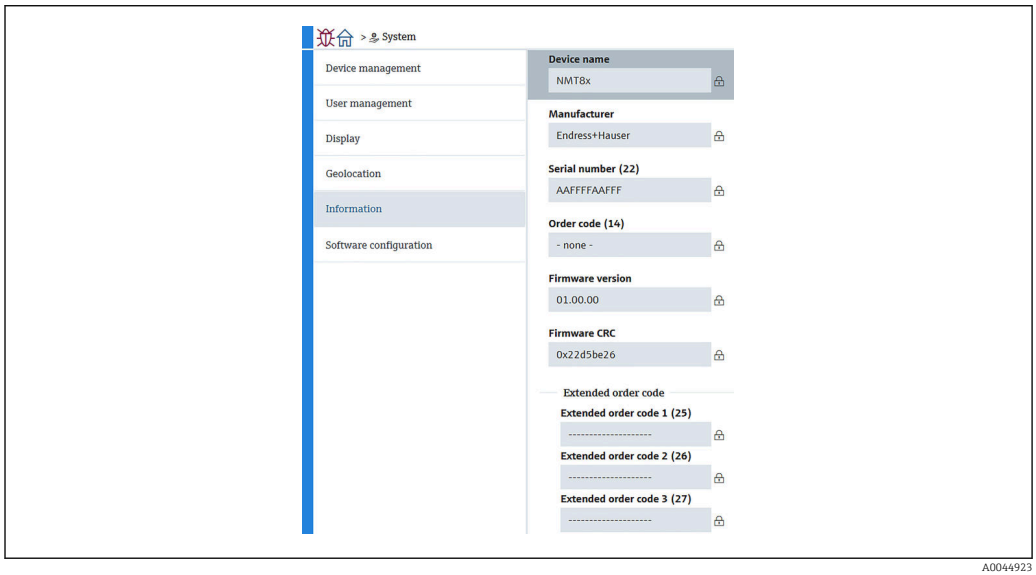


101 *Geolocation screen*

- Process Unit Tag: Name for master devices to identify easily the device.
  Allowed characters type: 32 characters with A to Z, 0 to 9, and certain special characters (+-*/!?).
- Location Description: Defines location (address) where the device is.
  Allowed characters type: 32 characters with A to Z, 0 to 9, and certain special characters (+-*/!?).
- Longitude, Latitude, and Altitude: Defines the detailed locations where the device is.
  - Longitude setting range: −180.0000 to 180.0000
  - Latitude setting range: −90.0000 to 90.0000
  - Altitude setting range: -3E+38 to 3E+38
- Location method: Selects how to get the location information of the device.

10.3.5 Information

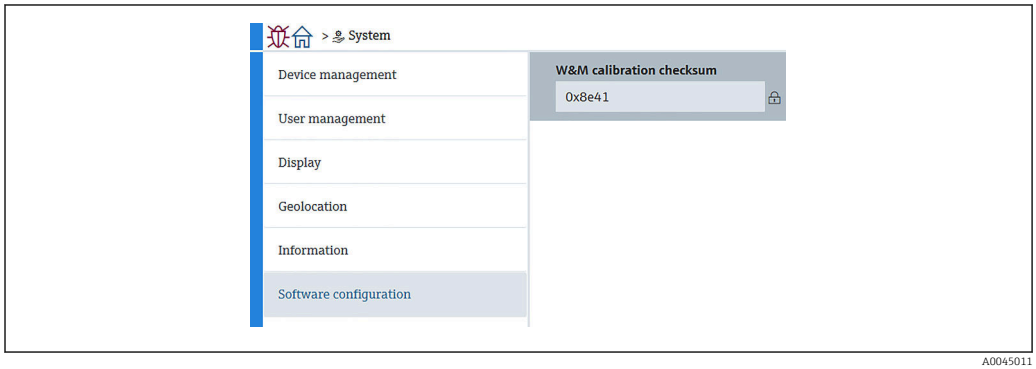
Information shows all descriptions of the device.



102 *Information screen*

10.3.6 Software configuration

W&M calibration checksum: Shows the calculated checksum over all temperature calibration relevant parameters.



103 *Software configuration screen*

11 Diagnostics and troubleshooting

11.1 System error messages

11.1.1 Error signal

Errors occurring during commissioning or operation are signaled in the following way:

Error symbol, display color, error code and error description on the display and operating module.

11.1.2 Types of error

- Error-free operation: display is lit green
- Alarm or warning: display is lit red
- Warning: the device continues to measure. An error message is displayed (alternating with the measured value)

Error indication via a display color change only works if the operating voltage is not below 16 V

11.2 Diagnostic event

11.2.1 Diagnostic event in the operating tool

If a diagnostic event is present in the device, the status signal appears in the top left status area of the operating tool along with the corresponding symbol for the event level in accordance with NAMUR NE 107:

- Failure (F)
- Function check (C)
- Out of specification (S)
- Maintenance required (M)

- Error-free operation: display is lit green
- Alarm: display is lit red

Calling up remedial measures

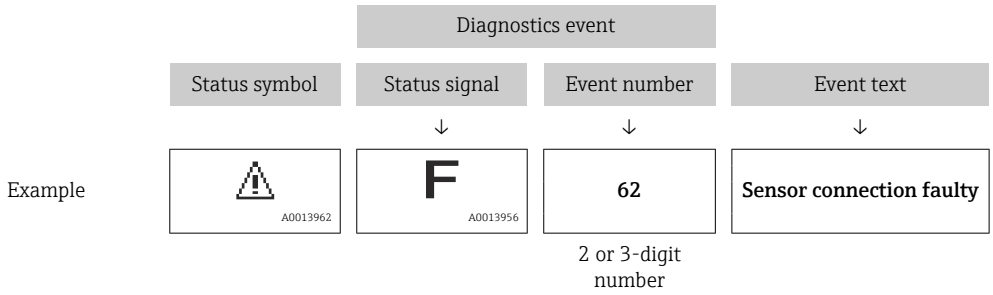
▶ Navigate to the Diagnostics
↳ In the Actual diagnostics the diagnostic event is shown with event text

Status symbol (symbol for event level)

 A0013961	**"Alarm" status** The measurement is interrupted. The signal outputs take on the defined alarm condition. A diagnostic message is generated.
 A0013962	**"Warning" status** The device continues to measure. A diagnostic message is generated.

Diagnostics event and event text

The fault can be identified using the diagnostics event. The event text helps you by providing information about the fault. In addition, the corresponding symbol is displayed before the diagnostics event.



If two or more diagnostic messages are pending simultaneously, only the message with the highest priority is shown. Additional pending diagnostic messages can be shown in **Diagnostic list**.

11.2.2 General errors

Error	Possible cause	Remedial action
Device does not respond.	Supply voltage not connected.	Connect the correct voltage.
	The cables do not contact the terminals properly.	Ensure electrical contact between the cable and the terminal.
Values on the display invisible	The plug of the display cable is not connected correctly.	Connect the plug correctly.
	Display is defective.	Replace display.
"Communication error" is indicated on the display when starting the device or connecting the display	Electromagnetic interference	Check grounding of the device.
	Broken display cable or display plug.	Exchange display.
CDI communication does not work.	Wrong setting of the COM port on the computer.	Check the setting of the COM port on the computer (e.g. FieldCare) and change it if necessary.
Device measures incorrectly.	Parametrization error	Check and adjust parameterization.

11.2.3 List of diagnostic events in the operating tool

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
Diagnostic of sensor				
061	Sensor electronics faulty	Replace sensor electronics	F	Alarm
062	Sensor connection faulty	Check sensor connection	F	Alarm
101	Sensor temperature	1. Check process temperature 2. Check ambient temperature	S	Warning
107	Temperature element open	1. Check probe connection 2. Check elements	M	Warning [1)]
108	Temperature element short	1. Check probe connection 2. Check elements	M	Warning [1)]

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
109	Test resistance out of range	Carry out sensor calibration	S	Warning
116	Temperature pair open short	1. Check probe connection 2. Check elements	M	Warning [1)]
117	Temperature pair difference out of spec.	1. Check sensor 2. Check process conditions	M	Warning [1)]
148	Waterbottom connection faulty	Check sensor connection	F	Alarm
149	Waterbottom electronics faulty	Deactivate water bottom sensor or replace device.	F	Alarm
Diagnostic of electronic				
242	Firmware incompatible	1. Check software 2. Flash or change main electronic module	F	Alarm
252	Module incompatible	1. Check if correct electronic module is plugged 2. Replace electronic module	F	Alarm
270	Main electronics defective	Replace main electronics	F	Alarm
272	Main electronics faulty	1. Restart device 2. Contact service	F	Alarm
273	Main electronics defective	Replace main electronics	F	Alarm
281	Electronic initialization active	Firmware update active, please wait!	F	Alarm
282	Data storage inconsistent	Restart device	F	Alarm
283	Memory content inconsistent	1. Restart device 2. Contact service	F	Alarm
287	Memory content inconsistent	1. Restart device 2. Contact service	M	Warning
331	Firmware update failed	1. Update firmware of device 2. Restart device	F	Alarm
388	Electronics and HistoROM defective	1. Restart device 2. Replace electronics and HistoROM 3. Contact service	F	Alarm
Diagnostic of configuration				
410	Data transfer failed	1. Retry data transfer 2. Check connection	F	Alarm
412	Processing download	Download active, please wait	C	Warning
431	Trim required	Carry out trim	C	Warning
437	Configuration incompatible	1. Update firmware 2. Execute factory reset	F	Alarm
438	Dataset different	1. Check data set file 2. Check device parameterization 3. Download new device parameterization	M	Warning
441	Current output out of range	1. Check process 2. Check current output settings	S	Warning

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
484	Failure mode simulation active	Deactivate simulation	C	Alarm
485	Process variable simulation active	Deactivate simulation	C	Warning
491	Current output simulation active	Deactivate simulation	C	Warning
495	Diagnostic event simulation active	Deactivate simulation	S	Warning
538	Configuration Sensor Unit invalid	1. Check sensor configuration 2. Check device configuration	M	Warning
560	Sensor calibration incomplete	Carry out sensor calibration	C	Warning
586	Calibration active	Calibration in progress, please wait	C	Warning
Diagnostic of process				
801	Supply voltage too low	Increase supply voltage	F	Alarm
802	Supply voltage too high	Decrease supply voltage	S	Warning
805	Loop current faulty	1. Check wiring 2. Replace electronics	F	Alarm
825	Electronics temperature	1. Check ambient temperature 2. Check process temperature	S	Warning
844	Process value out of specification	1. Check process value 2. Check application 3. Check sensor	S	Warning [1]
969	No element in phase	1. Check device configuration 2. Check water and tank level	M	Warning [1]
973	Level invalid	1. Check level source setting 2. Check connected level device	C	Warning

1) Diagnostic behavior can be changed.

- For redundancy specification, the diagnostic behaviors of the diagnostic numbers 107 and 108 are for "Logbook entry only" and the numbers of 116 and 117 are shown only on redundancy specification.
- If the element temperature exceeds the set temperature range, diagnostic of process "844" is generated. A temperature exceeding the range is also included in the calculation of the average temperature even if 844 occurs.

11.2.4 List of diagnostic events for NMT53x

When using NMT81 in NMT539x compatibility mode, the following error codes respond to the NMT53x's.

NMT53x error codes to be supported

NMT81 Error code	Short text	NMT539 Error code	Short text	Diagnostic behavior [from the factory]
148	⊗F148 Waterbottom connection faulty	43	WB line open	F
149	⊗F149 Waterbottom electronics faulty	44	WB line short	F
107	⚠M107 Temperature element open	3	Element No.1 open	M
108	⚠M108 Temperature element short	4	Element No.1 short	M

NMT81 Error code	Short text	NMT539 Error code	Short text	Diagnostic behavior [from the factory]
560	⚠C560 Sensor calibration incomplete	24	Memory defect (ROM)	C
109	⚠S109 Test resistance out of range	24	Memory defect (ROM)	S
973	⚠C973 Level invalid	24	Memory defect (ROM)	C
969	⚠M969 No element in phase	24	Memory defect (ROM)	M
485	⚠C485 Process variable simulation active	24	Memory defect (ROM)	C
331	⊗F331 Firmware update failed	24	Memory defect (ROM)	F
282	⊗F282 Data storage inconsistent	42	Memory defect (EEROM)	F
273	⊗F273 Main electronics defective	42	Memory defect (EEROM)	F
801	⊗F801 Supply voltage too low	42	Memory defect (EEROM)	F
272	⊗F272 Main electronics faulty	42	Memory defect (EEROM)	F
283	⊗F283 Memory content inconsistent	42	Memory defect (EEROM)	F
252	⊗F252 Module incompatible	42	Memory defect (EEROM)	F
242	⊗F242 Firmware incompatible	42	Memory defect (EEROM)	F
437	⊗F437 Configuration incompatible	42	Memory defect (EEROM)	F
270	⊗F270 Main electronics defective	42	Memory defect (EEROM)	F
62	⊗F062 Sensor connection faulty	42	Memory defect (EEROM)	F
101	⚠S101 Sensor temperature	42	Memory defect (EEROM)	S
61	⊗F061 Sensor electronics faulty	42	Memory defect (EEROM)	F
281	⊗F281 Electronic initialization active	42	Memory defect (EEROM)	F
805	⊗F805 Loop current faulty	42	Memory defect (EEROM)	F
410	⊗F410 Data transfer failed	42	Memory defect (EEROM)	F
484	⊗C484 Failure mode simulation active	42	Memory defect (EEROM)	C
538	⚠M538 Configuration Sensor Unit invalid	41	Memory defect (RAM)	M
586	⚠C586 Calibration active	41	Memory defect (RAM)	C
491	⚠C491 Current output simulation active	41	Memory defect (RAM)	C
412	⚠C412 Processing download	41	Memory defect (RAM)	C
844	⚠S844 Process value out of specification	41	Memory defect (RAM)	S
431	⚠C431 Trim required	41	Memory defect (RAM)	C
802	⚠S802 Supply voltage too high	41	Memory defect (RAM)	S
441	⚠S441 Current output out of range	41	Memory defect (RAM)	S
825	⚠S825 Operating temperature	41	Memory defect (RAM)	S
287	⚠M287 Memory content inconsistent	41	Memory defect (RAM)	M
311	⚠M311 Electronic failure	41	Memory defect (RAM)	M
438	⚠M438 Dataset different	41	Memory defect (RAM)	M
495	⚠C495 Diagnostic event simulation active	41	Memory defect (RAM)	C

11.2.5 Displaying the diagnostic events

Actual diagnostics

The menu contains the "Actual diagnostics" parameter with a time stamp.

Previous diagnostics

The menu contains the "Previous diagnostics" parameter with a time stamp.

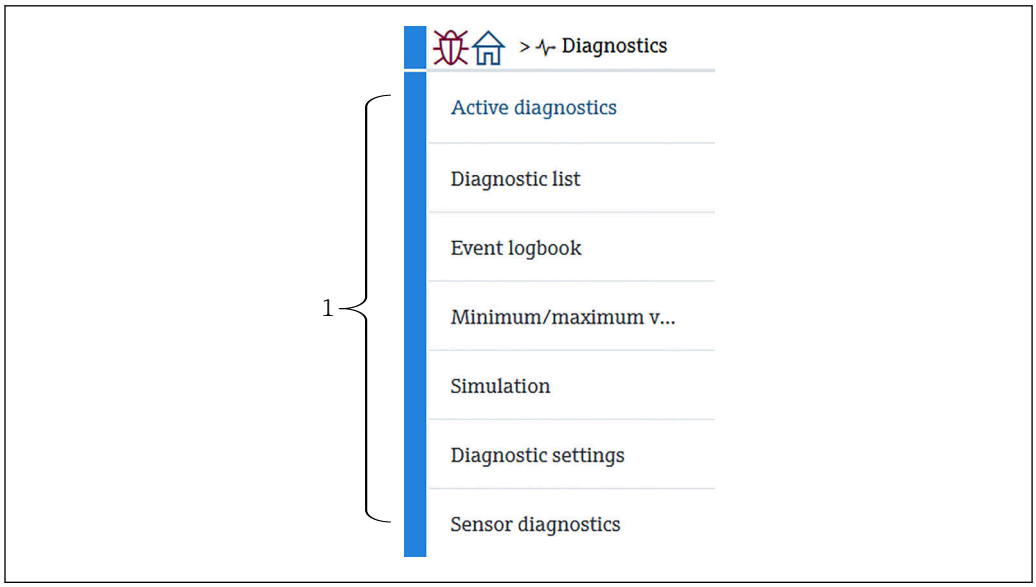
Event logbook

The events are saved in the event logbook.

Navigation
"Diagnostics" menu → Event logbook

11.3 Diagnostics

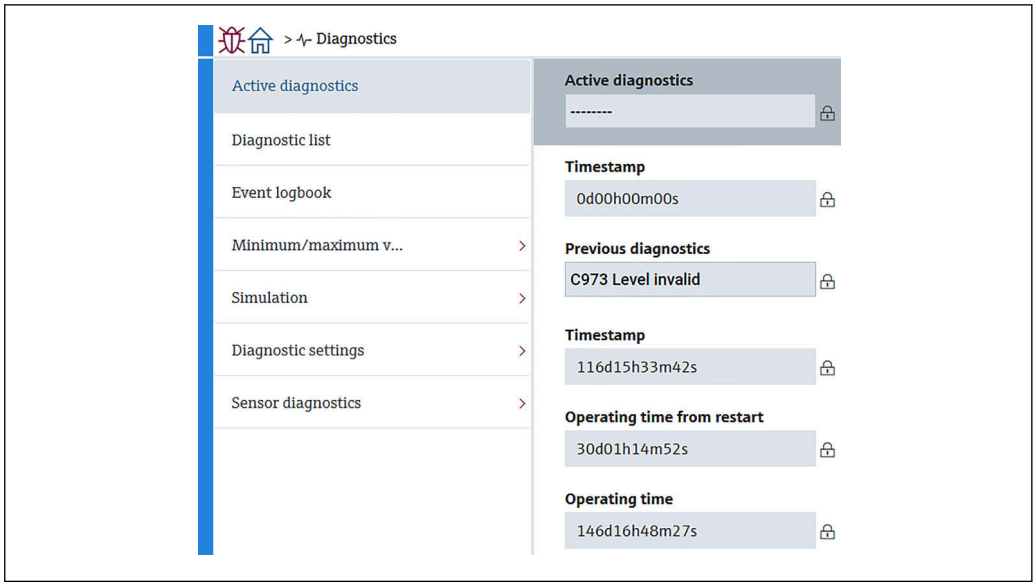
Diagnostics has seven items to be set or confirmed as follows. This section sequentially describes the instructions of the settings from the top. For further information of parameters, refer to the separate "Description of Device Parameters" manual.



104 Diagnostics screen

1 Operating menu list

11.3.1 Active diagnostics



105 *Active diagnostics screen*

- Active diagnostics: Displays the current diagnostic message. If two or more messages occur simultaneously, the message with the highest priority is shown on the display.
- Timestamp: Displays the cumulative operating time at which the active diagnostic message occurred.
- Previous diagnostics: Displays error message that occurred before the active message occurred (or is still occurring).
- Timestamp: Displays the cumulative operating time when the previous diagnostic message occurred.
- Operating time from restart: Shows the time elapsed since the last time the power of the master device turned on.
- Operating time from restart: Shows cumulative operating time (current values) when the NMT81 is turned on.

11.3.2 Diagnostic list and Event logbook

- Diagnostic list: Displays the currently active diagnostic message.
- Event logbook: Saves events and displays data overview of the date, time, operating hours, diagnostic information, remedy instructions, changed parameters, previous values, and new values.

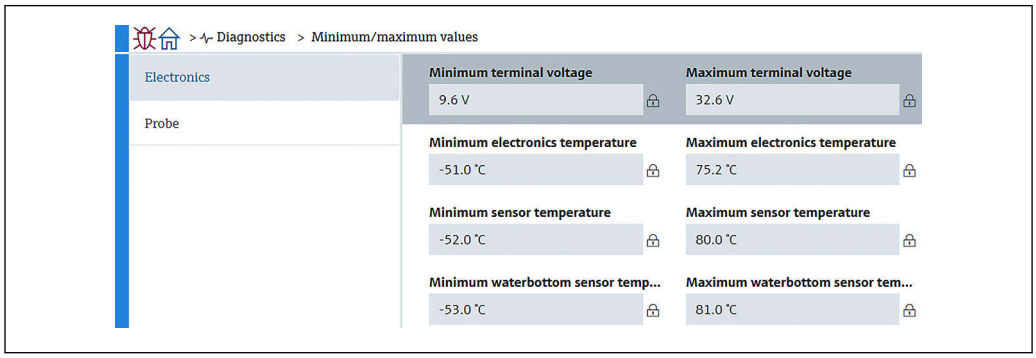
Press the [Diagnostic list] or [Event logbook] to show the data in the new window.

11.3.3 Minimum/maximum values

Minimum/maximum values has two items to be confirmed. The Minimum/maximum values displayed here are the observed values from the start of operation to the present.

Electronics

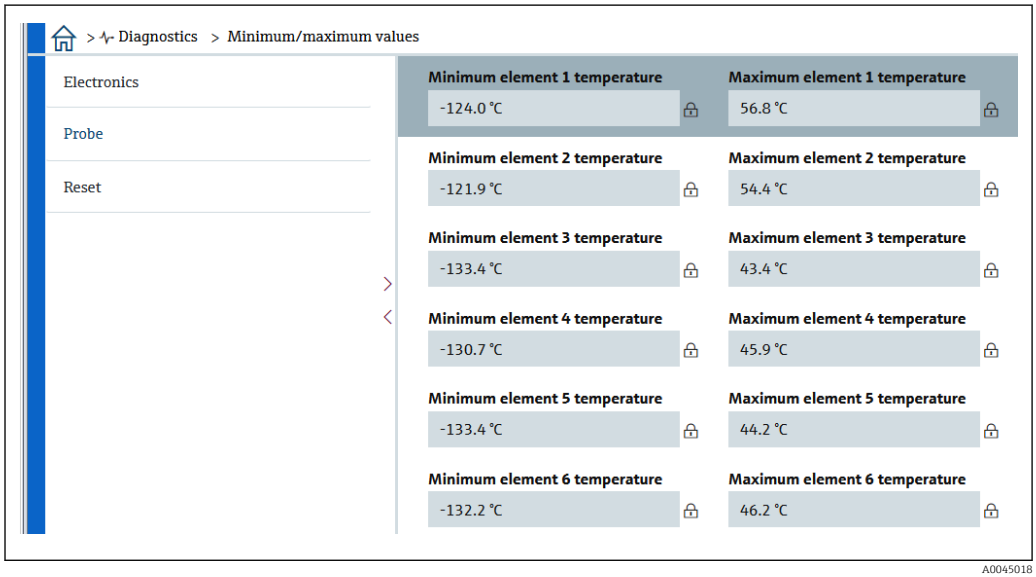
The following minimum and maximum terminal voltages can be confirmed from the Electronics.



106 *Electronics screen*

Probe

The following minimum and maximum element temperatures can be confirmed from the Probe.

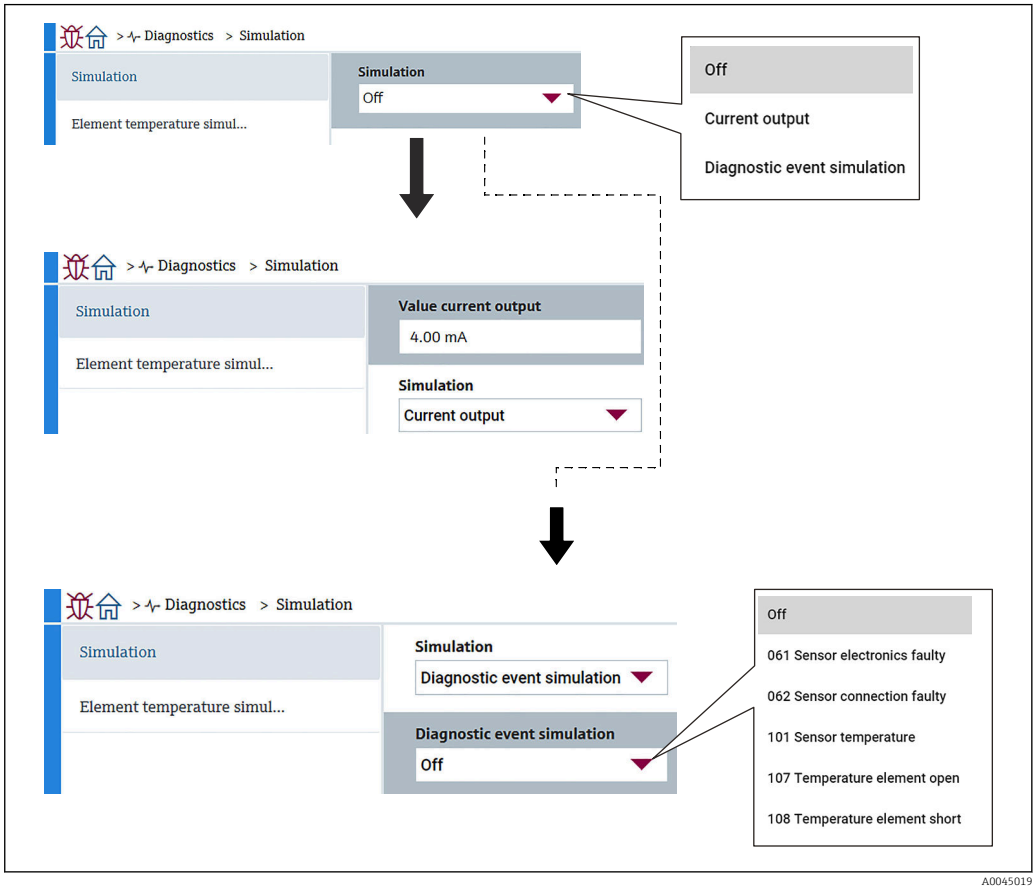


107 *Probe screen*

Unused Minimum and Maximum element X are displayed as NaN °C.

11.3.4 Simulation

This is to generate an error deliberately and verify how the output appears in a simulation. Simulation has two parameters to be set in the Simulation pull-down menu. Normally set to Off.



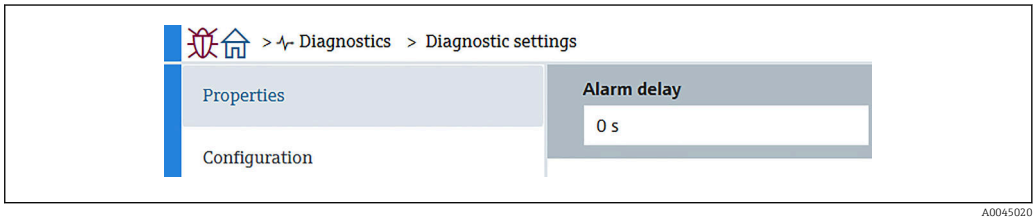
108 *Simulation screen*

- Current output : Sets current output to other than 4 mA.
- Diagnostic event simulation: Selects the error code to verify how the output appears. For details of error codes, → 97

11.3.5 Diagnostic settings

Diagnostic settings has two items to be confirmed and set.

Properties

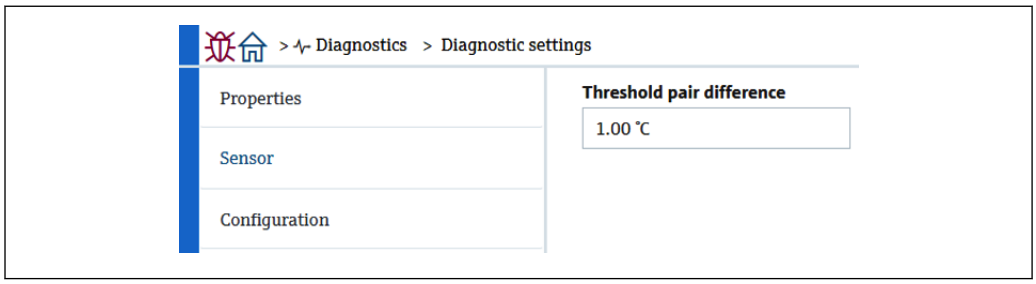


109 *Properties screen*

The following can set the delay time of the alarm between 0 to 60 sec..

Sensor

The Threshold pair difference is displayed only for redundancy specifications. In redundancy, there is a pair of elements and if their temperature difference is greater than this parameter's for one hour, an event (diagnostic message) will be generated.



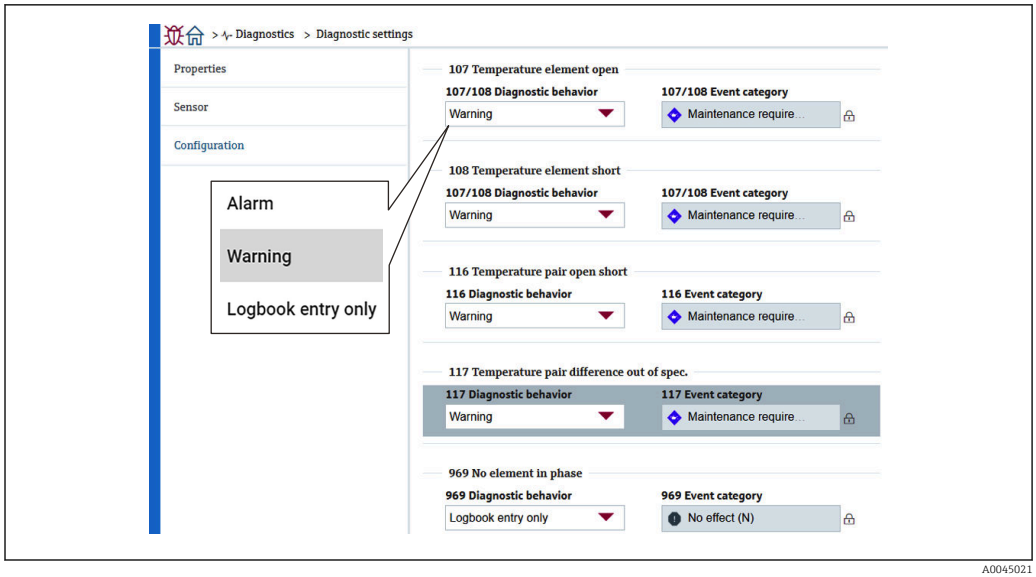
110 *Threshold pair difference screen*

Configuration

Configuration for setting the behaviors of open, short, and no element in phase corresponding to the temperature elements.

- Logbook entry only: Writes the error into the logbook and ignores the error.
- No element in phase: Sets whether or not recognize an error when no elements are in any of the phases.
- 117Temperature pair difference out of spec.: Changes the type (Alarm, Warning, LogbookOnly).

116 Diagnostic behavior/116 Event category functions are displayed only for redundancy specifications. When the status of both elements that can be a pair is Open or Short, an event (diagnostic message) will be generated. The type of diagnostic message (Alarm, Warning, LogbookOnly) should be set at this time.



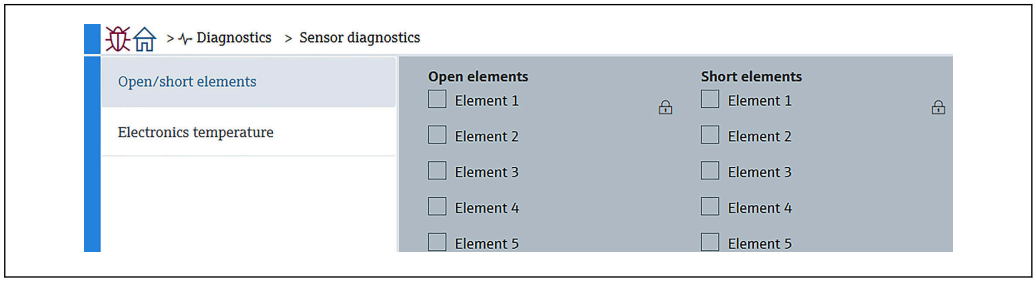
111 *Configuration screen*

11.3.6 Sensor diagnostics

Sensor diagnostics has two items to be confirmed as follows.

Open elements/Short elements

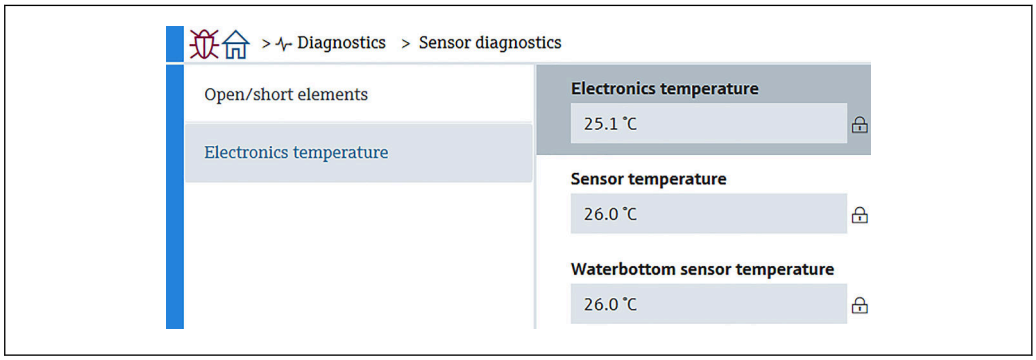
Checks are entered to indicate elements that have opened or shorted, or are in an open or short state.



112 *Open elements/Short elements screen*

Electronics temperature

Electronics, sensor, and water bottom sensor show current temperatures.



113 *Electronics temperature screen*

12 Maintenance

12.1 Maintenance tasks

No special maintenance work is required.

12.1.1 Exterior cleaning

When cleaning the exterior of measuring devices, always use cleaning agents that do not attack the surface of the housing or the seals.

12.2 Endress+Hauser services

Endress+Hauser offers a wide variety of services for maintenance such as recalibration, maintenance service or device tests.

Your Endress+Hauser Sales Center can provide detailed information on the services.

13 Repair

13.1 General information on repairs

13.1.1 Repair concept

The Endress+Hauser repair concept assumes that the devices have a modular design and that repairs can be done by the Endress+Hauser service or specially trained customers.

Spare parts are contained in suitable kits. They contain the related replacement instructions.

For more information on service and spare parts, contact the Service Department at Endress+Hauser.

13.1.2 Repairs to Ex-approved devices

⚠ WARNING

Incorrect repair can compromise electrical safety!
Explosion hazard!

- Only specialist personnel or the manufacturer's service team may carry out repairs on Ex-certified devices in accordance with national regulations.
- Relevant standards and national regulations on hazardous areas, safety instructions and certificates must be observed.
- Only use original spare parts from the manufacturer.
- Please note the device designation on the nameplate. Only identical parts may be used as replacements.
- Carry out repairs according to the instructions.
- Only the manufacturer's service team is permitted to modify a certified device and convert it to another certified version.

13.1.3 Replacement of a device or electronic module

After a complete device or the electronic main unit has been replaced, the parameters can be downloaded into the instrument again via FieldCare.

Condition: The configuration of the old device has been saved to the computer via FieldCare.

If an electronic module of the sensor or other parts of the sensor have been replaced, the initial setting must be performed. Refer to Commissioning → 68.

The "Save/Restore" function

After a device configuration has been saved to a computer and restored to the device using the **Save/Restore** function of FieldCare, the device must be restarted by the following setting:

System → Device management → Reset device→ Restart device

13.2 Spare parts

Some interchangeable measuring device components are listed on an overview sign in the connection compartment cover.

The spare part overview sign contains the following information:
- A list of the most important spare parts for the measuring device, including their ordering information.
- The URL for the *W@M Device Viewer* (www.endress.com/deviceviewer):
  All the spare parts for the measuring device, along with the order code, are listed here and can be ordered. If available, users can also download the associated Installation Instructions.

13.3 Endress+Hauser services

Endress+Hauser offers a wide range of services.

Your Endress+Hauser Sales Center can provide detailed information on the services.

13.4 Return

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the website for more information:
   http://www.endress.com/support/return-material
2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

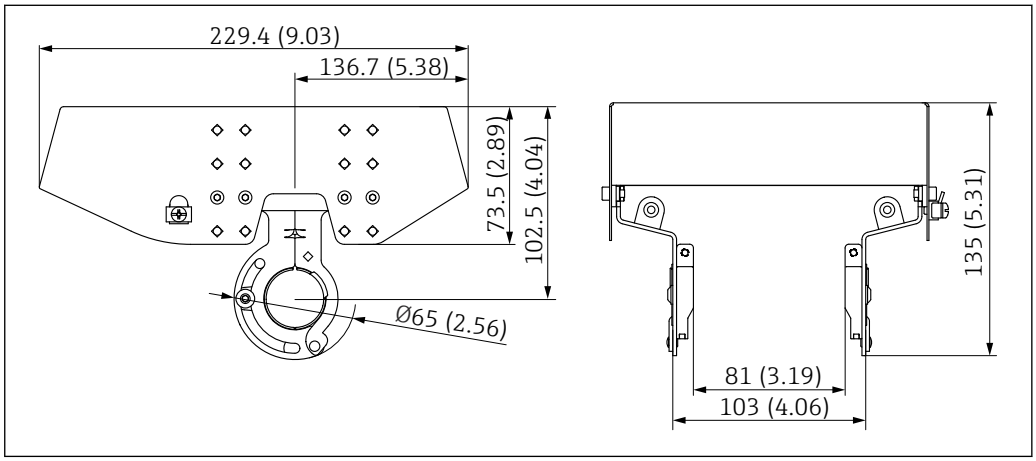
13.5 Disposal

Observe the following notes during disposal:
- Observe valid federal/national regulations.
- Ensure proper separation and reuse of the device components.

14 Accessories

14.1 Device-specific accessories

14.1.1 Weather protection cover



114 Weather protection cover. Unit of measurement mm (in)

Materials

Part	Material
Protection cover and mounting brackets	stainless steel 316L

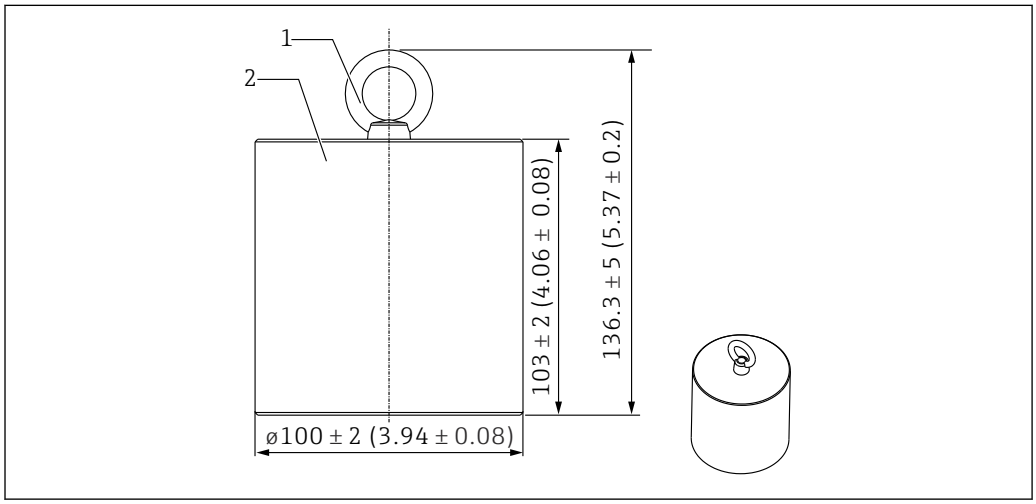
- The weather protection cover can be ordered together with the device:
  Ordering feature 620 "Accessory Enclosed", option PA "Weather Protection Cover")
- It can also be ordered as an accessory:
  Order code: 71438303
- For cover installation instructions, refer to the separate SD02424F

14.1.2 Anchor weight (High profile)

This anchor weight was mainly designed for the converter + temperature probe version. Even when an anchor weight is used for the installation, the bottom element (bottom point temperature measurement position) will be set at approx. 500 mm (19.69 in) above the tank bottom. When installing a high profile anchor weight from a nozzle at the top of the tank, ensure that the nozzle opening is at least 150A (6").

The following items are supplied when shipped.

- Stranded wire (1 000 mm (39.37 in)/φ3 mm (0.12 in)) which connects between the anchor weight and the probe
- Wire (1 300 mm (51.12 in)/φ0.5 mm (0.02 in)) for binding



115 Installation attachment. Unit of measurement mm (in)

1 Eyebolt
2 Weight

Because an anchor weight is made of mild carbon steel, exposure it to the air for over a long period may get rust during storage.

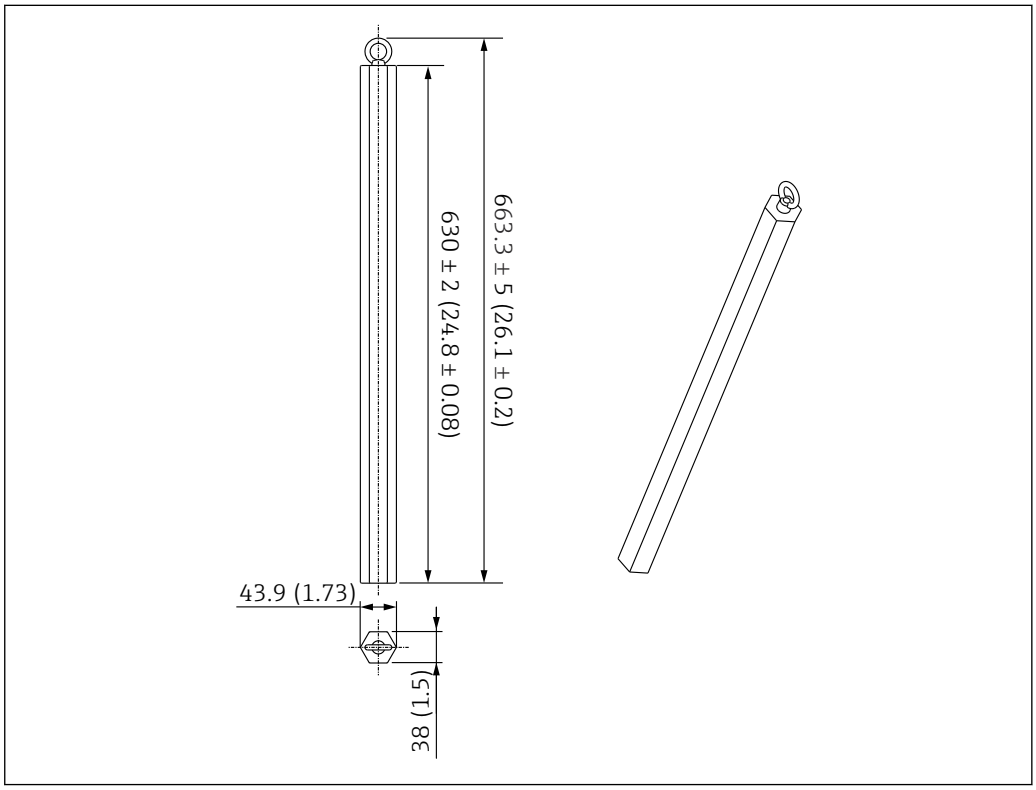
Description	Details
Anchor weight	JIS SS400 mild carbon steel
Eyebolt	JIS SS400 mild carbon steel
Weight	6 kg (13.23 lb)

14.1.3 Anchor weight (Low profile)

The low profile anchor weight is mainly designed to secure a WB probe for measuring the WB measurement range accurately. It can be also used as an installation attachment for the converter + temperature probe version when trying to install it in a small tank nozzle (e.g., 50A (2")).

The following items are supplied when shipped.

- Stranded wire (1 000 mm (39.37 in)/φ3 mm (0.12 in)) which connects between the anchor weight and the probe
- Wire (1 300 mm (51.12 in)/φ0.5 mm (0.02 in)) for binding



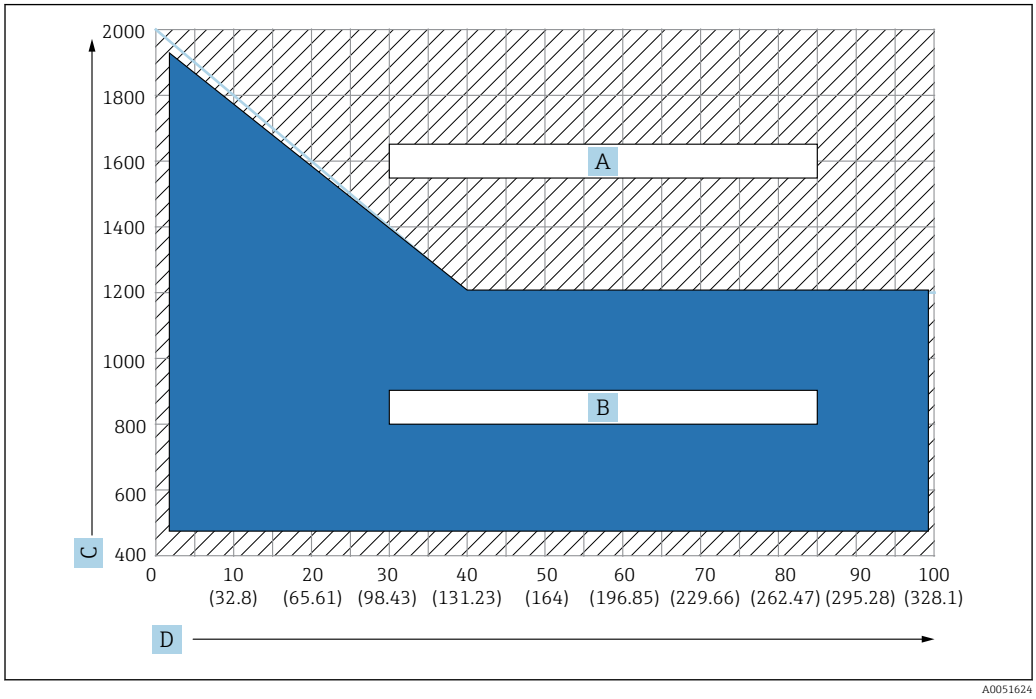
116 *Installation attachment. Unit of measurement mm (in)*

Because an anchor weight is made of mild carbon steel, exposure it to the air for over a long period may get rust during storage.

Description	Details
Anchor weight	JIS SS400 mild carbon steel
Eyebolt	JIS SS400 mild carbon steel
Weight	6 kg (13.23 lb)

14.1.4 Specification of anchor weight

The use of the available range for the anchor weight varies depending on the specification or application of the tank. See the following chart for selection of the appropriate anchor weight.



117 *Anchor weight selection chart, C: Unit of density [kg/m3], D: Unit of length m/(ft)*

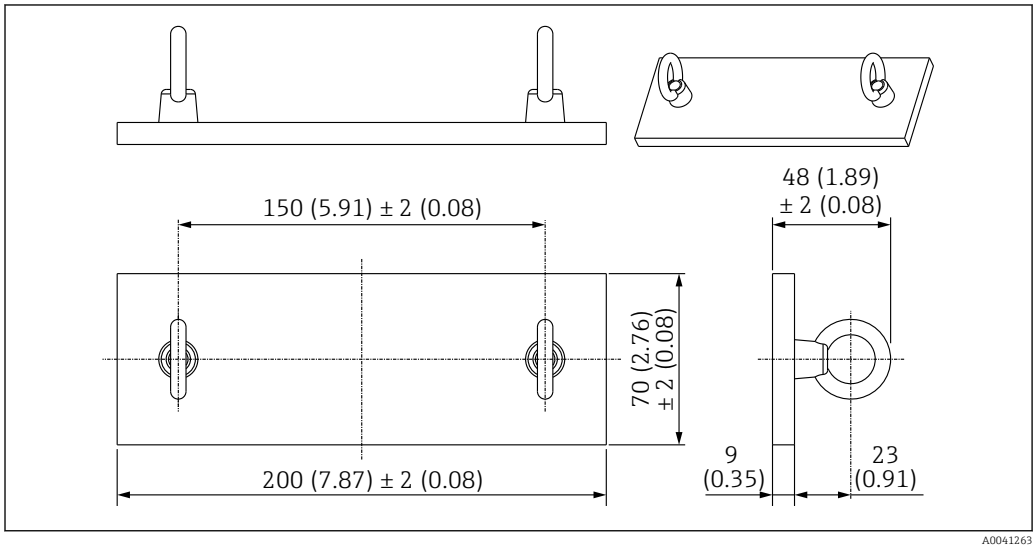
A Range for requirement of advance inquiry
B Range for standard use

14.1.5 Wire hook

The actual tension is created by the securing wire between the wire hook and the top anchor (316).

The following items are supplied when shipped.

- Stranded wire (Specified length of the probe + 2 000 mm (78.74 in)/φ3 mm (0.12 in))
- Wire (2 000 mm (78.74 in)/φ0.5 mm (0.02 in)) for binding



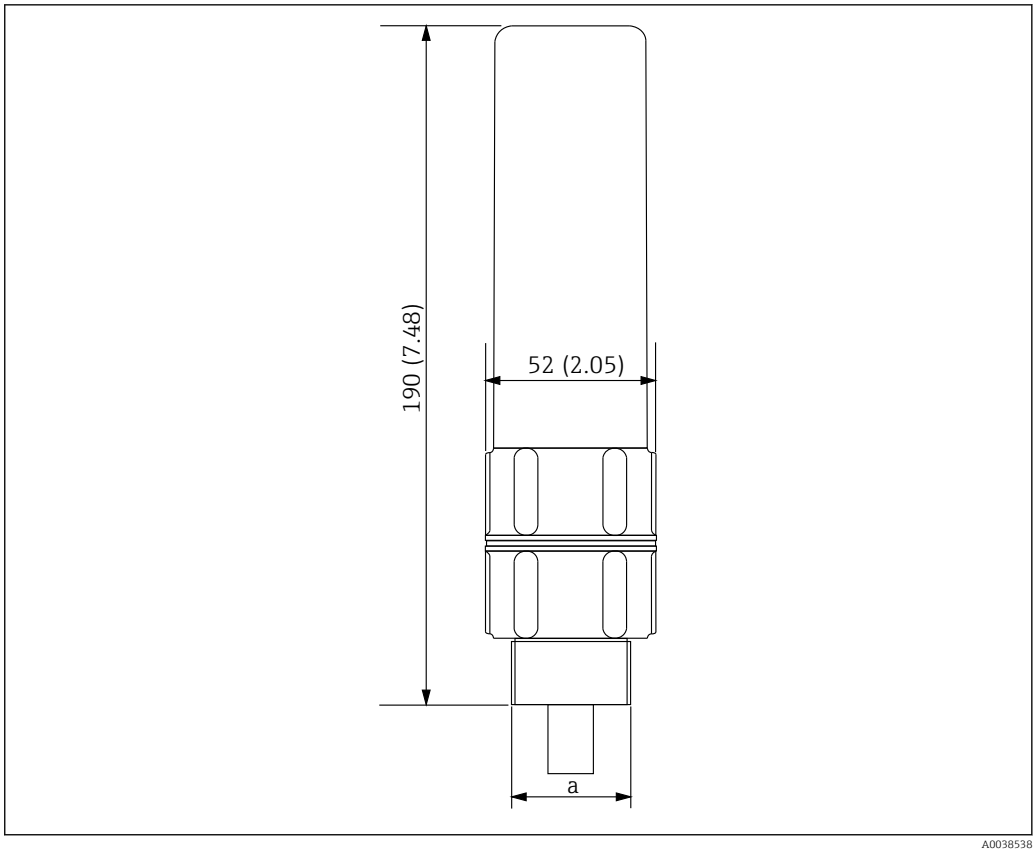
118 *Wire hook. Unit of measurement mm (in)*

Description	Details
Plate	JIS SS400 mild carbon steel
Eye nut	JIS SS400 mild carbon steel
Weight	1.5 kg (3.31 lb)

Because a wire hook is made of mild carbon steel, exposure it to the air for over a long period may get rust during storage.

14.1.6 Top anchor

The standard threaded connection for a top anchor is an R1 threaded connection.



119 Top anchor dimensions. Unit of measurement mm (in)

a R1 thread

Description	Details
Exterior	ADC (aluminum)
Interior	316
Weight	1.2 kg (2.65 lb)

Index

A

Access to the operating menu
  Operating tool 62
Accessories 111
Active diagnostics 103
Advanced calculation method with weighting 84
Anchor weight 114
  High profile 112
  Low profile 113
Anchor weight method 35, 39
Application 9, 76
Average settings 80

C

Cleaning
  Exterior cleaning 108
Commissioning 65, 68
Compare 73
Compare datasets 73
Compatibility mode
  NMT53x and NMT8 75
Configuration 106
Configuring NMT81
  NMS5/NMS7/NRF590 56
  NMS8x/NMR8x/NRF81 56
Converter 14
  M20 mounting thread 15
  Measurement functions 16
  Universal coupling 14
Converter + average temperature probe + water bottom probe 18
Converter + average temperature probe version 16
Create documentation 73

D

DD 64
Deactivating the lock via FieldCare 94
Device Descriptions 64
Device management 93
Device replacement 109
Device-specific accessories 111
Diagnostic event 97
Diagnostic event in the operating tool 97
Diagnostic list 103
Diagnostic settings 105
Diagnostics 97, 102
Diagnostics event and event text 98
DIP switches 52
Display 51, 95
Displaying
  Diagnostic events 102
Disposal 110
Document
  Function 5
Document function 5

E

Electrical connection 41
Electronics temperature 107
Element coverage 81
Element offsets 87
Element position 21, 86
Element resistance 78
Element settings 85
Element temperature 78
Element type 85
Element weighting 83
Elements in liquid / Elements in water 79
Elements in vapor /Elements in product 78
Endress+Hauser services
  Maintenance 108
  Repair 110
Error signal 97
Errors 97
  General 98
Establishing the connection
  Between FieldCare and the device 63
Event logbook 103
Exterior cleaning 108

F

Factory reset 54
Flange 20
Flange types 28
Function
  Operating menu 49

G

General settings 80
Geolocation 95
Guidance 68
Guide ring 39
Guide ring and anchor weight method 39

H

Hardware locking or unlocking 53
HART output 90, 91
HART scanner of NRF590 56

I

Import / Export 71
Information 91, 96
Initial screen 66
Initial setting 66
Installation 14, 28
Installation height adjustment 27
Installation procedure 27
Intended use 9
Intrinsically safe connection
  Ex ia 41
  NMS5 (Ex d [ia]) 43
  NMS8x/NMR8x/NRF81 (Ex d [ia]) 42

L
Level sources 81
List
Diagnostic events 98
List of diagnostic events 100
Locking 53
Locking state 53

M
Maintenance 108
Measured materials 9
Measured values 76, 77
Measured variables via HART protocol 64
Measurement functions
Converter 15
Measuring Units 79
Mechanical connection
Converter-only version 45
Minimum/maximum values 104
Mounting NMT81
on a cone roof tank 31
on a floating roof tank 36
on a pressurized tank 40

N
NMT53x diagnostic events 100
No. 1 position 21
NRF590 terminals 44

O
Open elements 107
Operability 49
Operating keys 52
Operating keys and DIP switches 52
Operation 51, 75
HART master connecting with devices 51
Operational safety 9
Overview
Operation options 49

P
Parameters
NMS5/NMS7/NRF590 56
Pre-installation 25
Preparation for configuring NMS8x/NMR8x/NRF81 . 56
Present calibration 89
Product description 11
Product design 11
Product safety 10
Properties 105

R
Recalibration 108
Repair concept 109
Replacing a device 109
Requirements for personnel 9
Return 110

S
Safety instructions
Basic 9
Safety Instructions (XA) 7
Sensor 80
Sensor diagnostics 107
Short elements 107
Simulation 105
Software configuration 96
Software locking or unlocking 94
Status symbol (symbol for event level) 97
Stilling well method 34, 38
Structure
Operating menu 49
Structure and function of the operating menu 49
Submenu
Event logbook 102
System 92
System error message 97
System integration 64

T
Tank level source / Water level source 81
Temperature limit 88
Terms
Temperature measurement 65
Threshold pair difference 106
Top anchor 115
Top anchor method 32, 37
Transmitter and element connection 42
Troubleshooting 97
Types of error 97

U
Unit setting
inch (in) and Fahrenheit (°F) 55
metric (mm) and Celsius (°C) 54
Unlocking 53
Upper and lower view areas 67
User management 94

W
Water bottom settings 88
Water level measurement 24
WB probe design 23
Weather protection cover 111
Wire hook 114
Wiring connection 47
Workplace safety 9

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