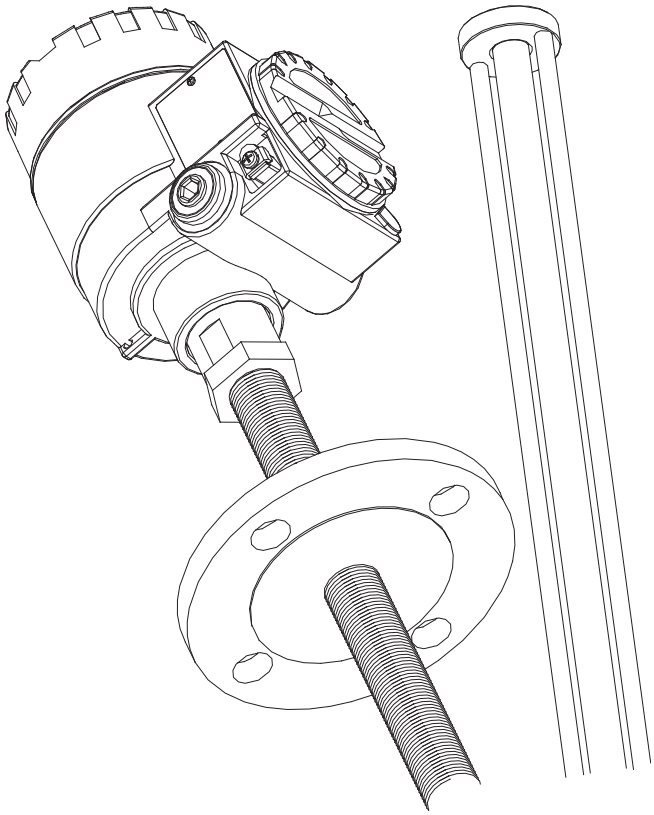
BA01025G/08/EN/22.18
71397855

Operating Instruction
Average Temperature
Prothermo NMT539



Endress+Hauser
People for Process Automation

Table of contents

1 Safety Instructions

1.1 Designated use

Average Temperature Prothermo NMT539 is a multi-spot Pt100 average thermometer combined with a local HART signal converter to meet the demand of temperature measurement for inventory control applications. NMT539 consists of Max. 6 temperature elements which have different length with fixed (2 m or 3 m) interval. It is best suited connected to Proservo NMS5, NMS7, NM8x, Micropilot NMR8x, Tank side monitor NRF81, NRF560 and Digital transmitter TGM5 and TMD1. Mounted on the tank top, NMT539 provides temperature information on the two wire, intrinsically safe (i.s.) powered local HART loop.

1.2 Installation, commissioning, and operation

- Mounting, electrical installation, start-up, and maintenance of the instrument may only be performed by trained personnel authorized by the operator of the facility.
- Personnel must read and understand these installation instructions before performing the procedures.
- The instrument may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual must be observed.
- The installer must make sure that the measuring system is correctly wired according to the wiring diagrams. The measuring system must be grounded.
- Observe all law and regulations applicable and valid for your country and pertaining to the opening and repairing of electrical devices.

1.3 Product requirements

Power source

Check the voltage of the power supply before connecting it to the product. It should be the exact voltage required for proper operation of the product.

Connection to other devices

It is possible to connect to other devices explained in this instruction. Refer to each operation instruction when connecting to devices.

Ground

Do not remove earth terminal or earth wire when the power is on.

Power cable

Use a power cable specified by our company. The product should be protectively grounded before it is connected to a measurement object or an external control circuit.

1.4 Operational safety

Hazardous area

- Use the explosion proof type for measurement in areas where explosion hazards are present.
- Devices installed in areas having explosion hazards must not be opened when the power is on.
- Strict compliance with installation instructions and - ratings, as directed in this supplementary documentation, is mandatory.
- Device maintenance and repair is restricted to meet explosion proof regulations.
- Tighten the cable gland firmly.
- Devices employed in areas having explosion hazards should be installed and wired in keeping with explosion proof regulations.
- Ensure that all personnel are properly qualified.
- Observe the certification requirements as well as national and local regulations.

WARNING Changes or modifications other than those expressly approved by Endress+Hauser are strictly prohibited. Unauthorized modifications can cause malfunction or damage, resulting in serious injury or death.

1.5 Notes on safety conventions and symbols

To highlight safety-relevant or alternative operating procedures in this manual, the following conventions have been used, each indicated by a corresponding symbol on the left.

Symbol	Meaning
DANGER A0011189-EN	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
WARNING A0011190-EN	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
CAUTION A0011191-EN	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE A0011192-EN	**NOTICE!** This symbol contains information on procedures and other facts which do not result in personal injury.

1.6 Symbols for certain types of information

Symbol	Meaning
A0011182	**Allowed** Indicates procedures, processes or actions that are allowed.
A0011183	**Recommendation** Indicates procedures, processes or actions that are recommended.
A0011184	**Forbidden** Indicates procedures, processes or actions that are forbidden.
A0011193	**Tip** Indicates additional information.

2 Identification

2.1 Device designation

2.1.1 Nameplate

The follow technical data are given on the instrument nameplate:

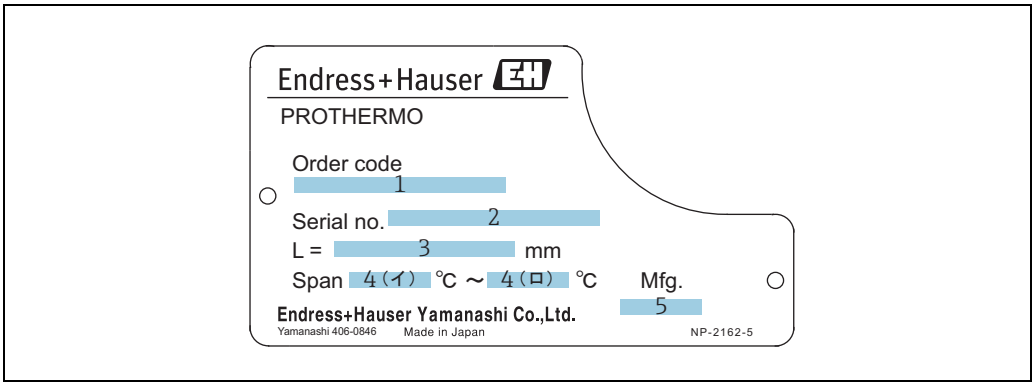


Figure 1: NMT539 module nameplate

1. *Order code*
2. *Serial number*
3. *Flexible tube length*
4. *Measuring temperature range*
5. *Date of manufacture (MM/YY)*

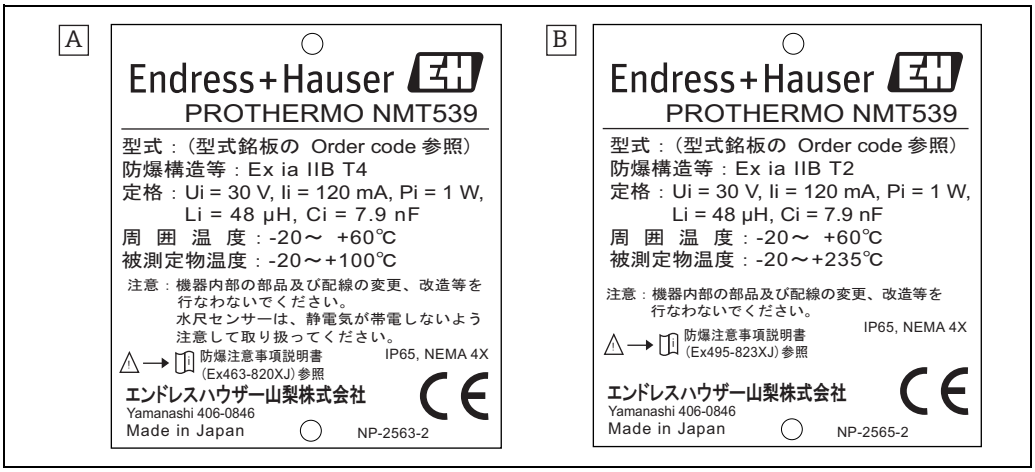


Figure 2: TIIS Ex ia approval nameplate 1

A *Average temperature and water bottom sensor (TIIS number: TC18319)*

B *NMT 539 for Hight temperature (TIIS number: TC18320)*

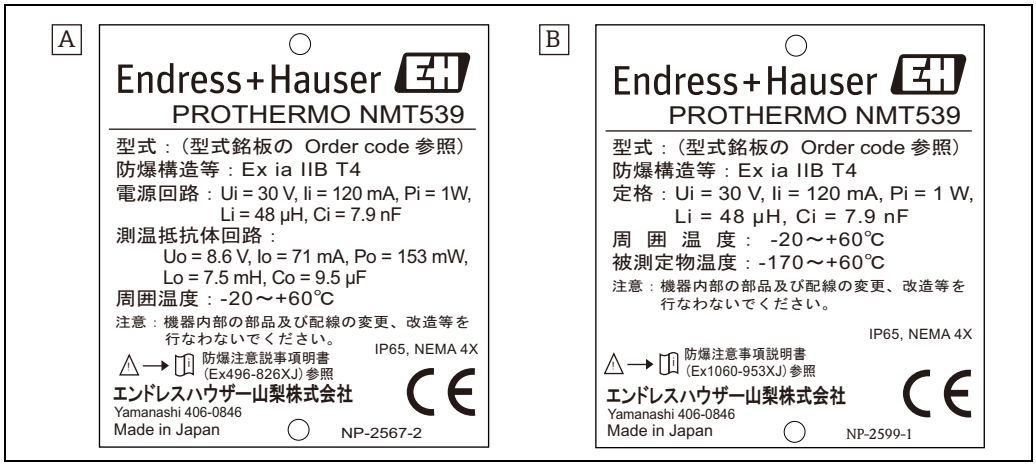


Figure 3: TIIS Ex ia approval nameplate 2

A Only for transmitter (TIIS number: TC18321)

B NMT539 for low temperature (TIIS number: TC18604)1

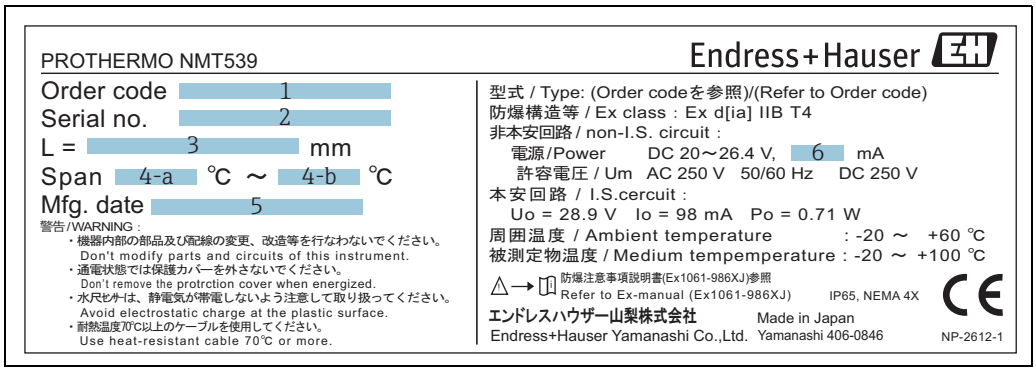


Figure 4: TIIS Ex d [ia] approval nameplate (TIIS number: TC18884)

1. *Order code*
2. *Serial number*
3. *Flexible tube length*
4. *Measuring temperature range*
5. *Date of manufacture (MM/YY)*
6. *Consumption*

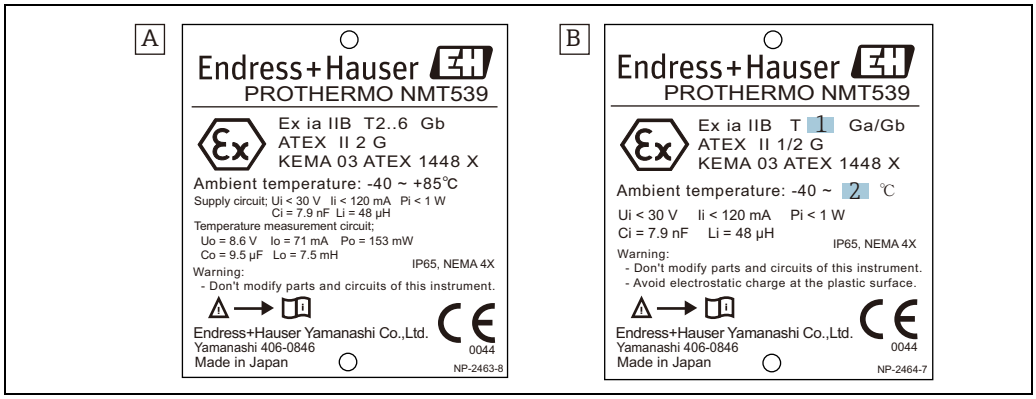


Figure 5: ATEX Ex ia approval

A Converter

B Average temperature and water bottom sensor

1. *Temperature class*
2. *Maximum ambient temperature*

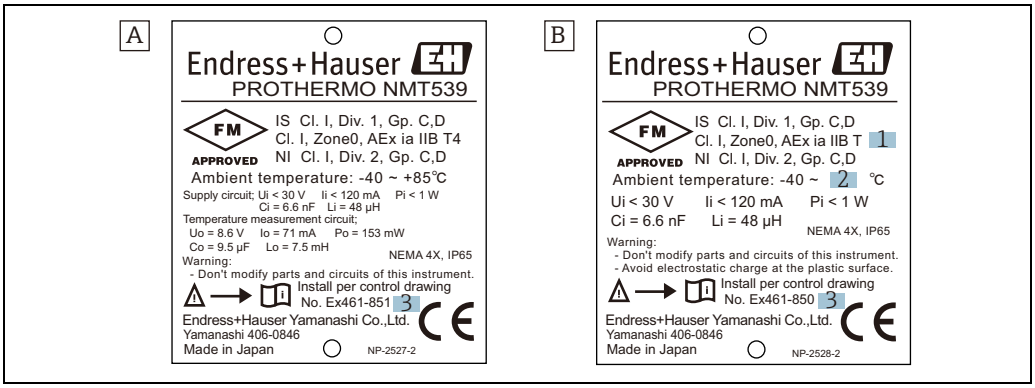


Figure 6: FM C/US approval nameplate

A Converter

B Average temperature and water bottom sensor

1. Temperature class

2. Maximum ambient temperature

3. XA revision number

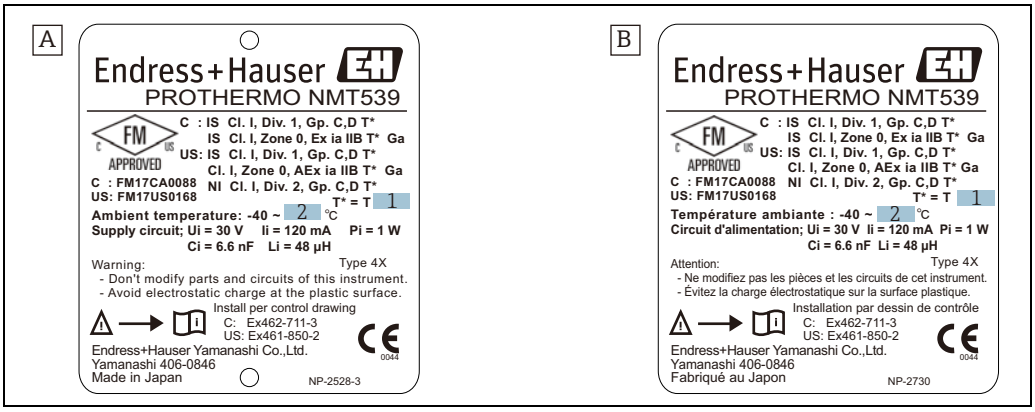


Figure 7: cFMus approval nameplate (Converter + Temperature + WB)

A cFMus approval nameplate (English)

B cFMus approval nameplate (France)

1. Range of measured temperature

2. Maximum ambient temperature

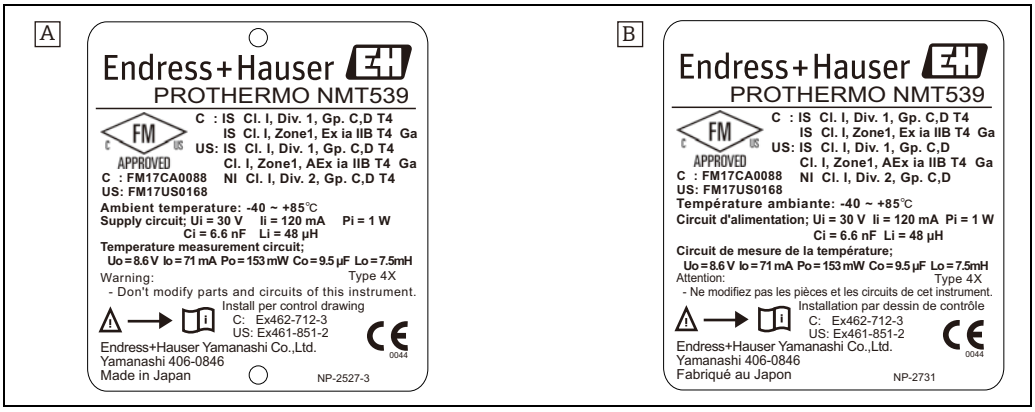


Figure 8: cFMus approval nameplate (Converter only)

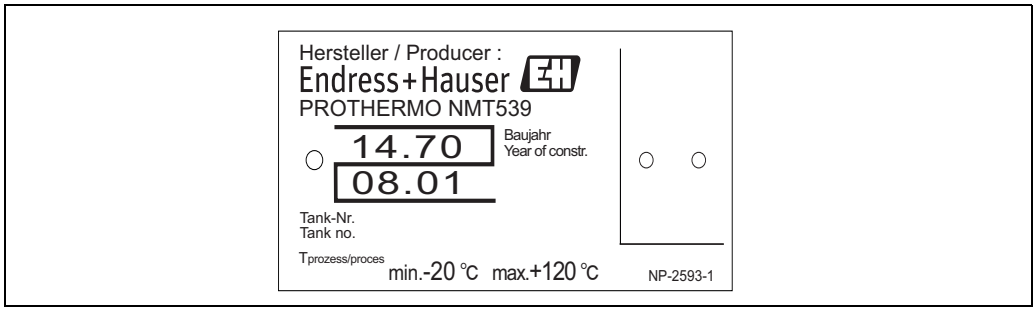


Figure 9: PTB W&M approval nameplate

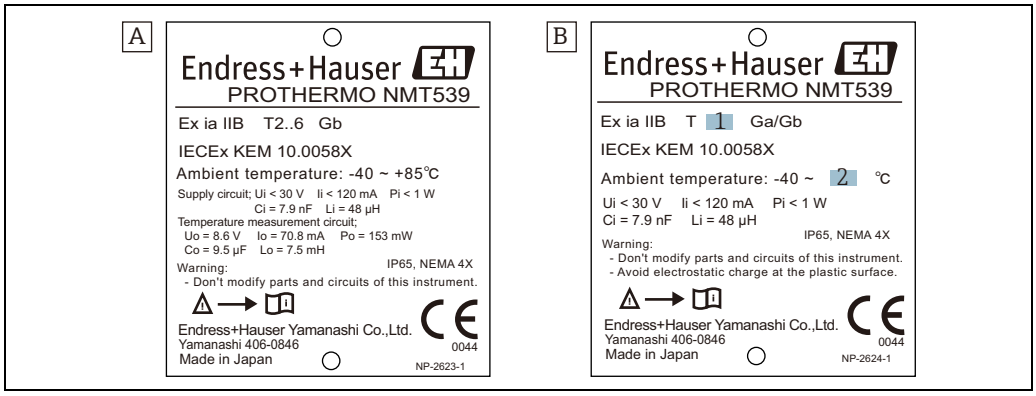


Figure 10: IEC approval nameplate

A Converter

B Average temperature and water bottom sensor

1. Temperature class

2. Maximum ambient temperature

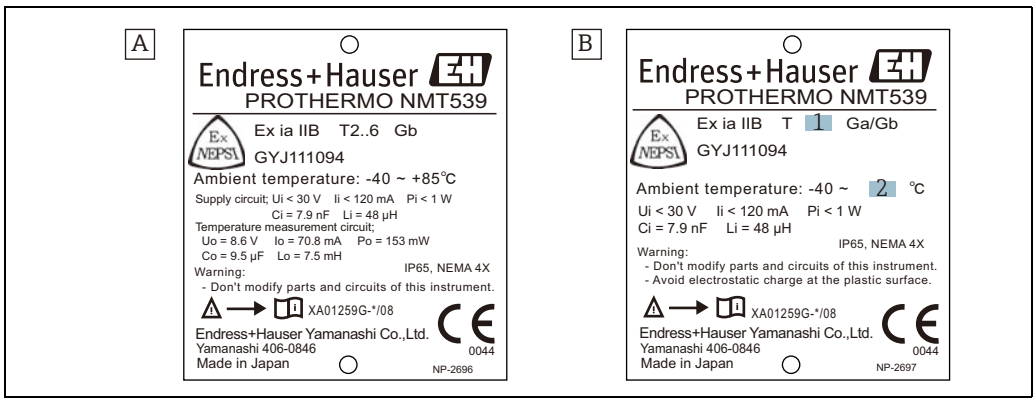


Figure 11: NEPSI approval nameplate

A Converter

B Average temperature and water bottom sensor

1. Temperature class

2. Maximum ambient temperature

Figure 12: EAC approval nameplate

2.2 Order information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product configurator.
- From your Endress+Hauser Sales Center: www.addresses.endress.com Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

2.3 Scope of delivery

It is essential to follow the instructions concerning the unpacking, transport and storage of measuring instruments given in the chapter "Incoming acceptance, transport, storage" on.

The scope of delivery consists of:

- Assembled instrument
- Accessories (Mounting Bracket)

Accompanying documentation:

- Operating Manual (this manual)
- Operating Instructions and Description of Instrument Function
- Safety Instruction (XA)

2.4 Certificates and approvals

CE Mark, Declaration of Conformity

The device is designed 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. The device complies with the applicable standards and regulations as listed in the EC declaration of conformity and thus complies with the statutory requirements of the EC directives. Endress+Hauser confirms the successful testing of the device by affixing to it the CE mark.

2.5 Registered trademarks

HART®

Registered trademark of HART Communication Foundation, Austin, USA

FieldCare®

Registered trademark of the company Endress+Hauser Flowstone AG, Heinrich, CH

3 Installation

3.1 Incoming acceptance, transportation, and storage

3.1.1 Incoming acceptance

Check the packing and contents for any signs of damage.
Check the shipment, and make sure that nothing is missing and that the items match your order.

3.1.2 Transportation

- Follow the safety instructions and conditions of transportation for instruments in excess of 18kg (40 lbs.).
- Do not lift the measuring instrument by its housing during unpacking.

3.1.3 Storage

Pack the measuring instrument so that it is protected against impacts during storage and transportation.
The original packing material provides the optimum protection for this.
The allowed storage temperature is -40 to +85 °C (-40 to +185 °F)

3.2 Installation conditions

3.2.1 Dimensions

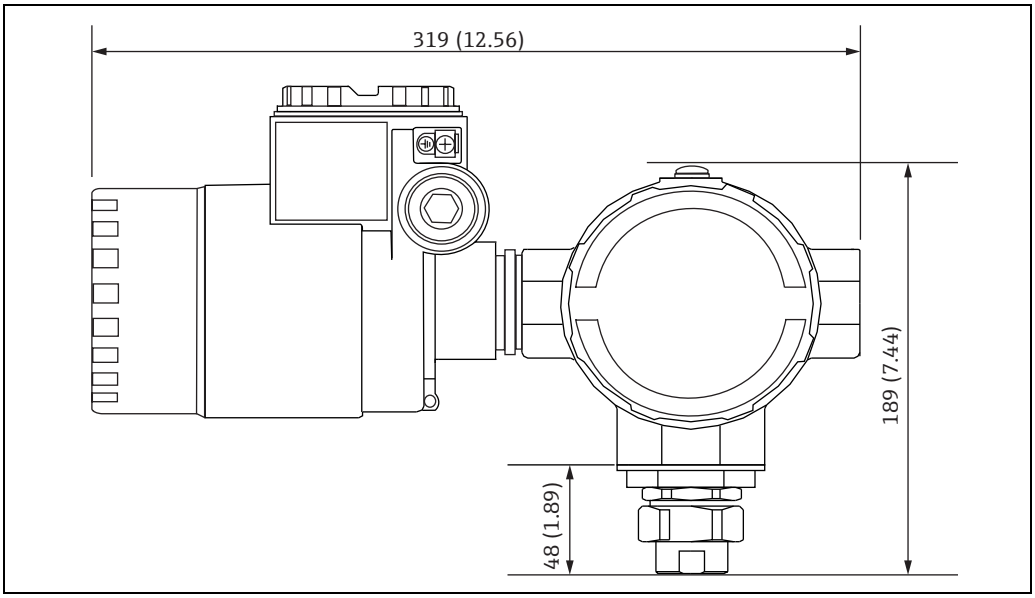


Figure 13: Converter only (standard PF (NPS) 3/4 universal coupling connection), Unit of measurement: mm (in)

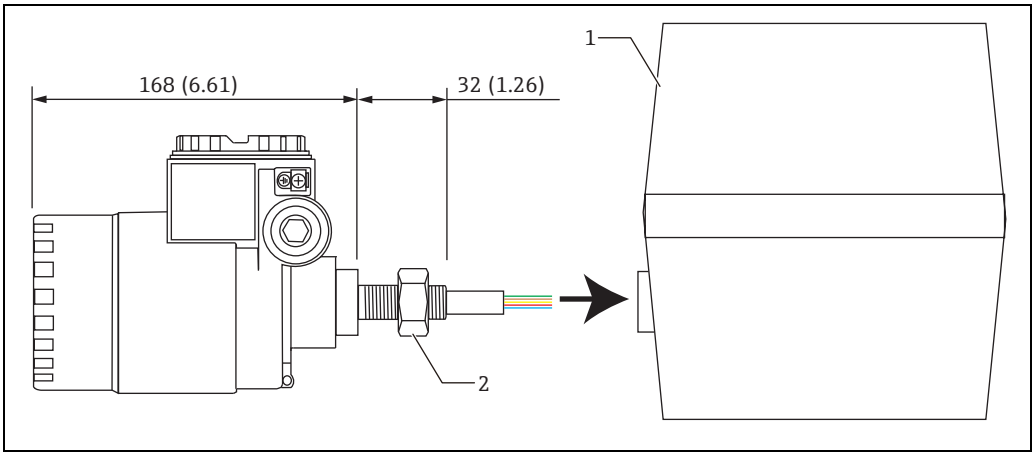


Figure 14: Converter only (for Varec 1700 with M20 threaded connection), Unit of measurement: mm (in)

1. *Secure nut*
2. *Terminal box for Varec 1700 RT probe*

⚠ CAUTION UK Special is designed specifically to connect with the average temperature probe of Whessoe Varec 1700 series. UK Special is not equipped with the water bottom data accessibility function.

Mounting procedure of UK special M20 connection to Varec 1700 terminal box

1. Use sealing tape on the threaded gauge to terminal box connection. Connect a bunch of cable (RTD signal inlet cable) into the female thread connection of the terminal box.
2. Turn the entire NMT539 gauge head clockwise 10 times or more and secure it to the terminal box with a lock nut.
   - Make sure that terminal housing connection for NMT539 and Varec1700 is secured.

This completes the mounting procedure.

Converter + average temperature probe

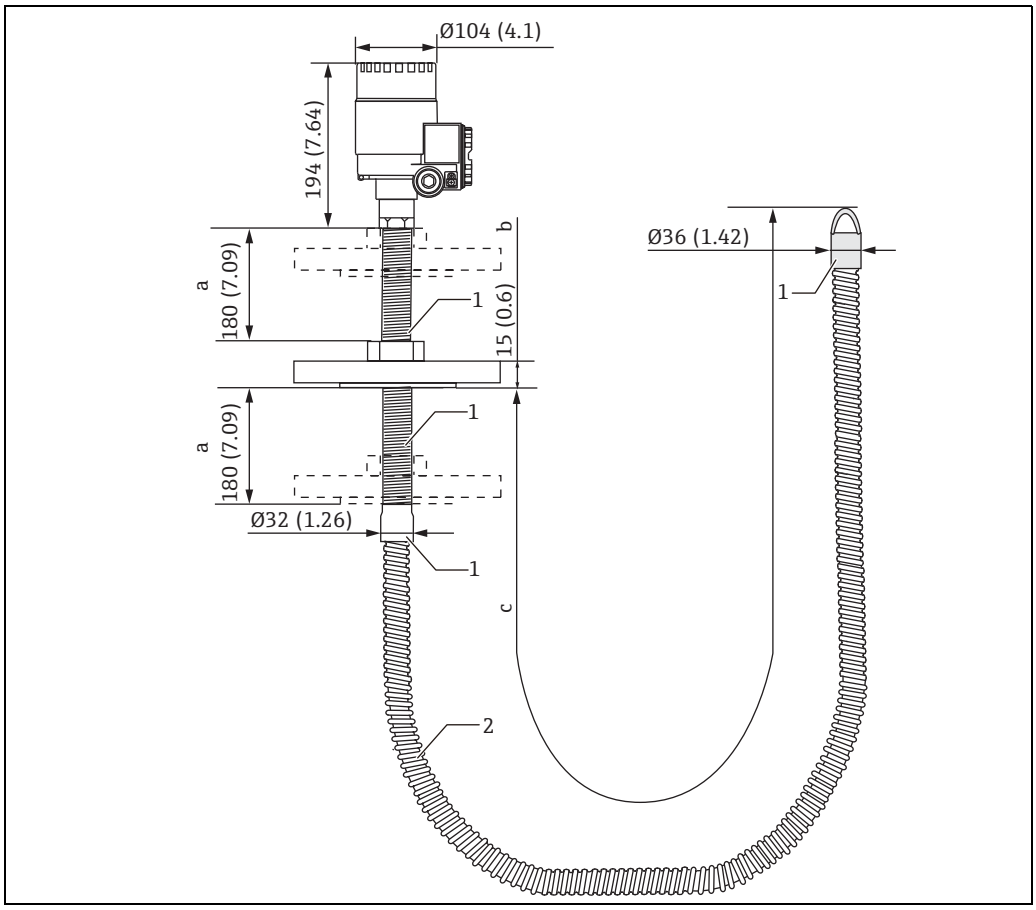


Figure 15: Dimensions for converter + average + temperature prob, Unit of measurement: mm (in)

a *Adjustable installation height*

b *Height of the flange (depending on spec.)*

c *Length of the flexible tube (depending on tank height) (Margin of error for temp. probe length:* ±50 mm)

1. *SUS316*

2. *SUS316L*

The position of the welded flange can not be adjusted.

Converter + temperature + water bottom probe

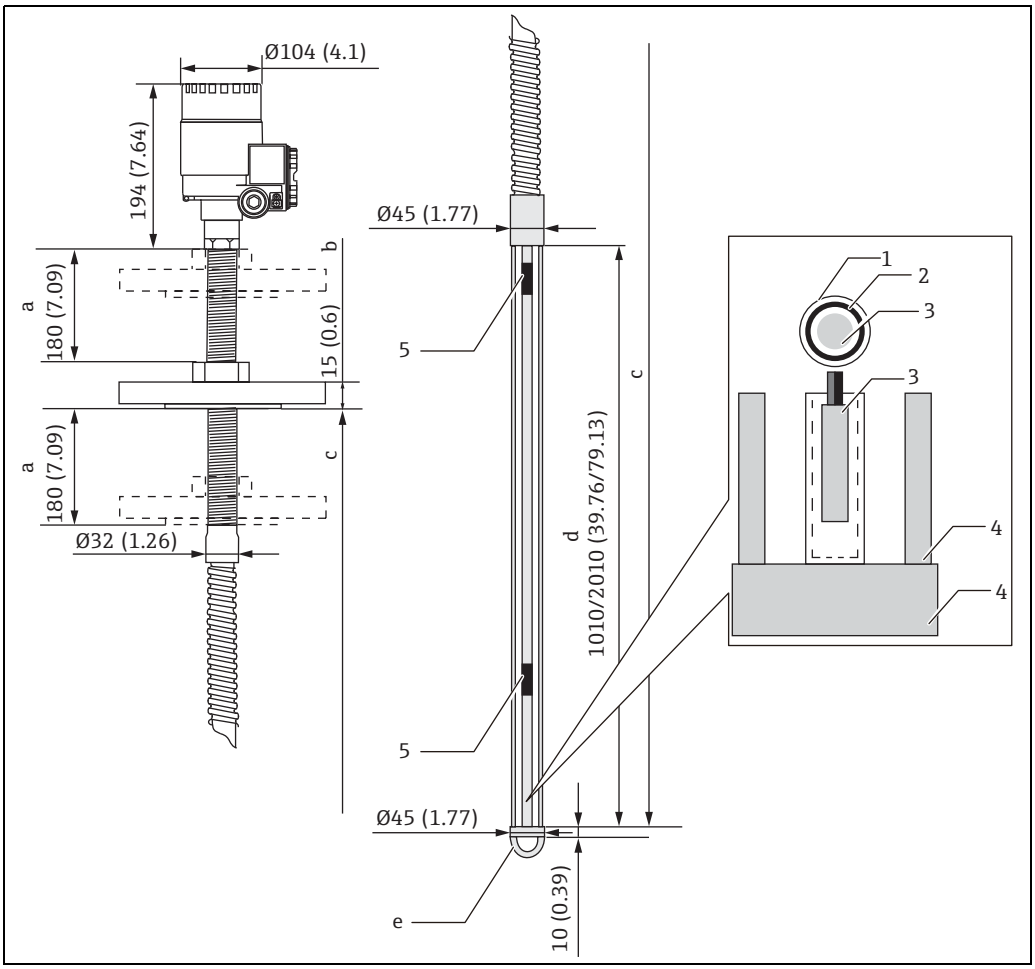


Figure 16: Dimension of Converter + average temperature probe + WB probe, Unit of measurement: mm (in)

a *Adjustable installation height*
b *Height of the flange (depending on spec.)*
c *Length of the flexible tube (depending on tank height) (Margin of error for temp. probe length:* ±50 mm)
d *Capacitance water bottom probe*
e *Hook for anchor weight (in case that the option is selected)*
1. *PFA protection tube (thickness: 1 mm)*
2. *Center rod (SUS304)*
3. *Pt100 element*
4. *Base plate/datum plate and side rod (316)*
5. *Element (Pt100 element can be installed up to 2 points.)*

The position of the welded flange can not be adjusted.

NMT539 No.1 element position

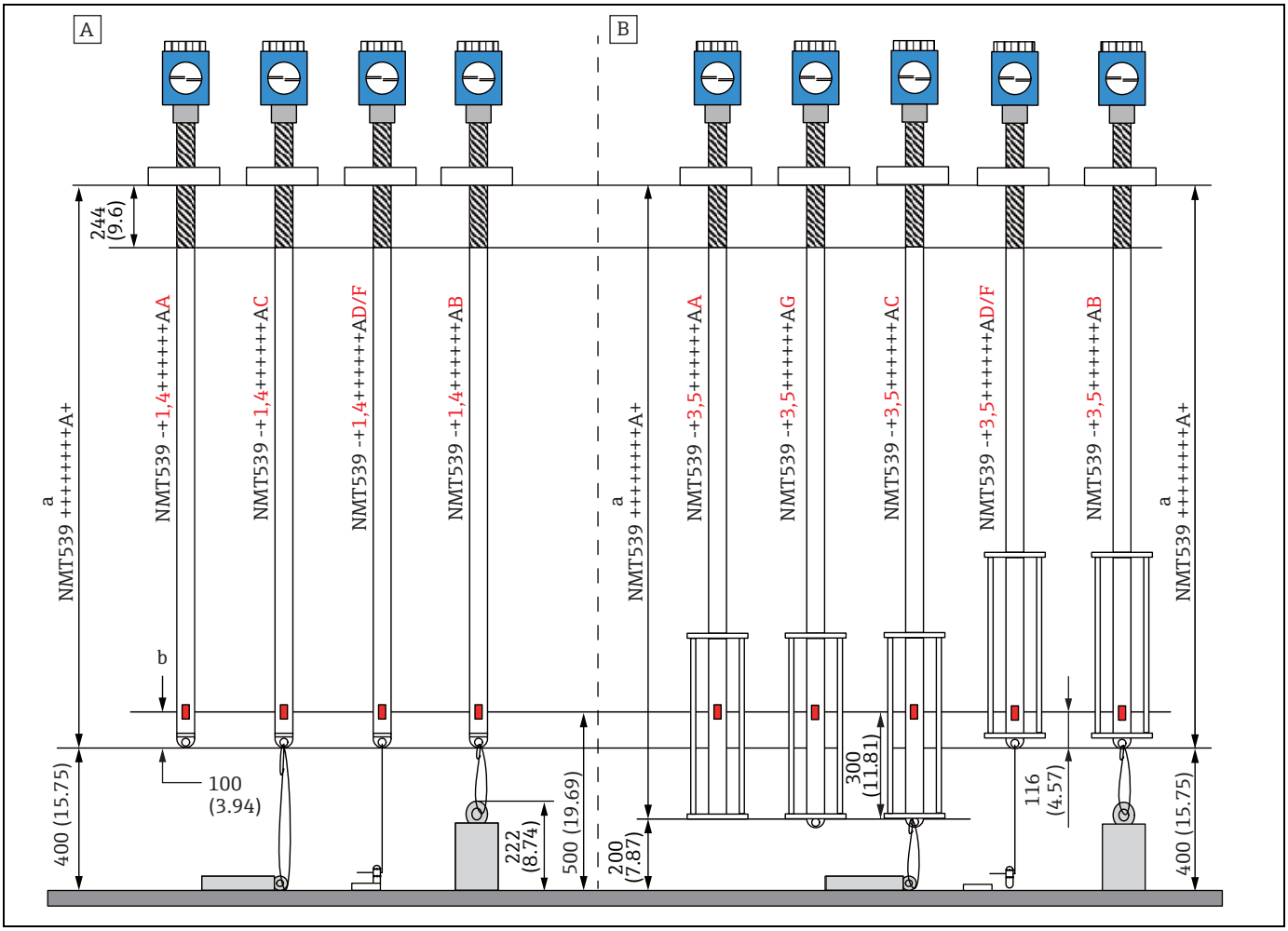


Figure 17:#1 Element Position, Unit of measurement: mm (in)

A *Transmitter + Temperature probe*
B *Transmitter + Temperature probe + Water probe*
a *Distance from the bottom of the flange*
b *Position of No.1 element*

3.2.2 Unpacking procedure

When unpacking NMT539 by only one worker, it may bend or twist the flexible tube. This work must be handled by three or more workers.

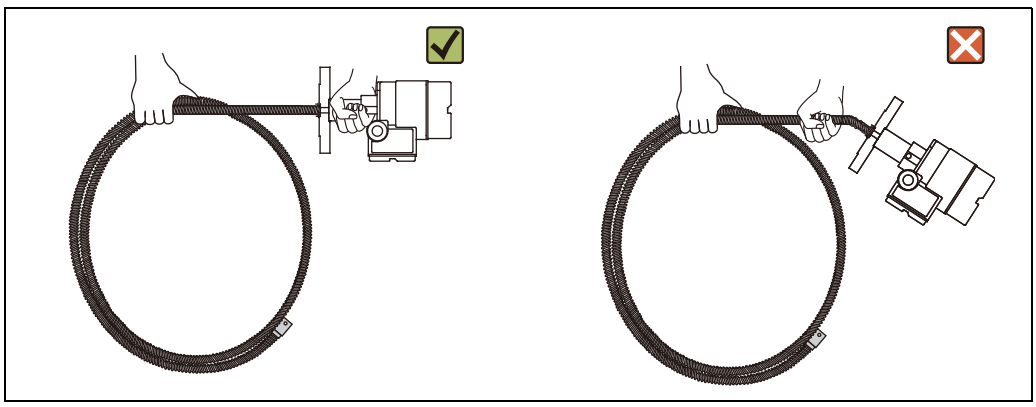


Figure 18: Unpacking procedure for NMT539

3.2.3 Handling of flexible tube

Do not hold the flexible tube at a single point and lift the sensor. This may cause damage to the tube.

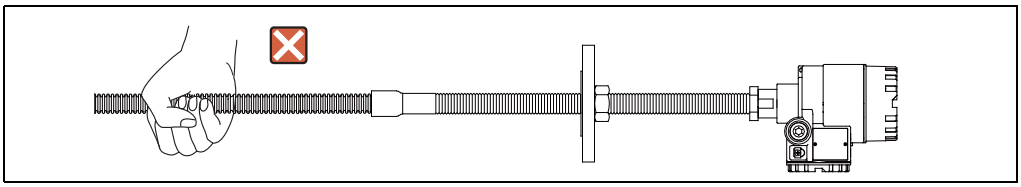


Figure 19: Handling of flexible tube

When winding the flexible tube, keep the diameter of the tube at a minimum of 1000 mm (39.37 in) or more. When bending the flexible tube to attach to a tank, the radius of curved area must be 500mm (19.69 in) or more.

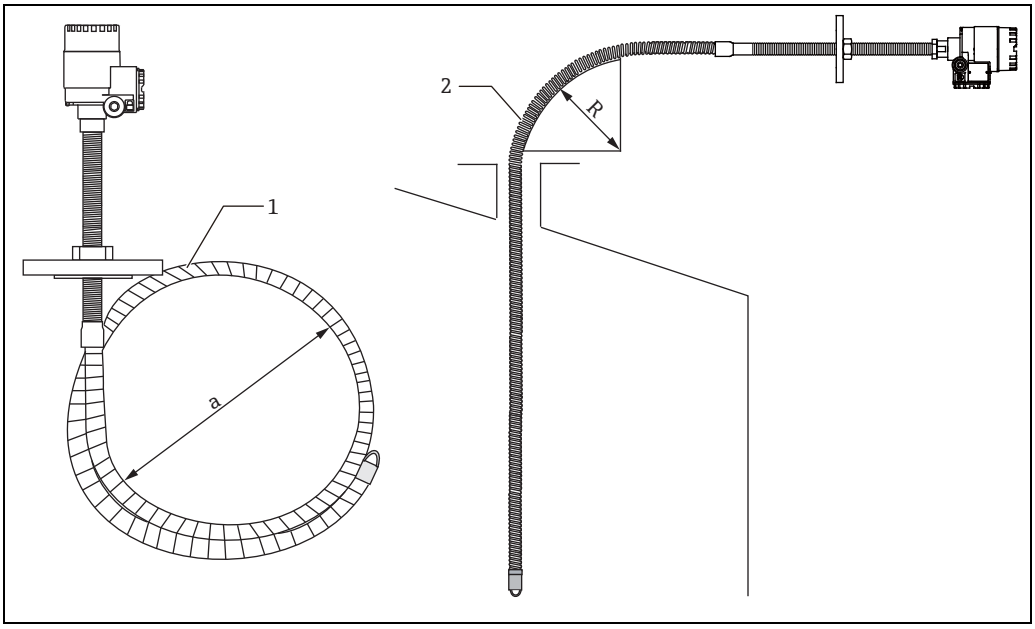


Figure 20: Handling of flexible tube 2, Unit of measurement: mm (in)

a *1000 mm (39.37 in) or more*

R *500 mm (19.69 in) or more*

1. *Temperature probe*

2. *Element protection pipe*

⚠ CAUTION If the radius of the curved area must be shown above becomes smaller than 500 mm (19.69 in), the flexible tube or the measuring element may be seriously damaged or broken.

3.2.4 Mounting of NMT539

- The flexible tube length of NMT539 is defined for the customer's specifications. Before mounting, check as follows:
  1. Tag Number (if any) on the body of NMT539
  2. Length of Flexible Tube
  3. Number of Measuring Points
  4. Intervals between Measuring Points
- Mount NMT539 at a minimum of 500 mm(19.67 in) away from the tank shell. This will ensure that the measurement is not influenced by changes in ambient temperature.
- The procedure for mounting of NMT539 on a tank varies depending on the type of tank. Procedures for a fixed roof tank and a floating roof tank are shown in this section as examples. However, procedures for mounting of the flexible tube head are the same (mounted on the top of the tank) in any types of tanks.
- The recommended standard diameter of nozzle is 50 mm (2 in).

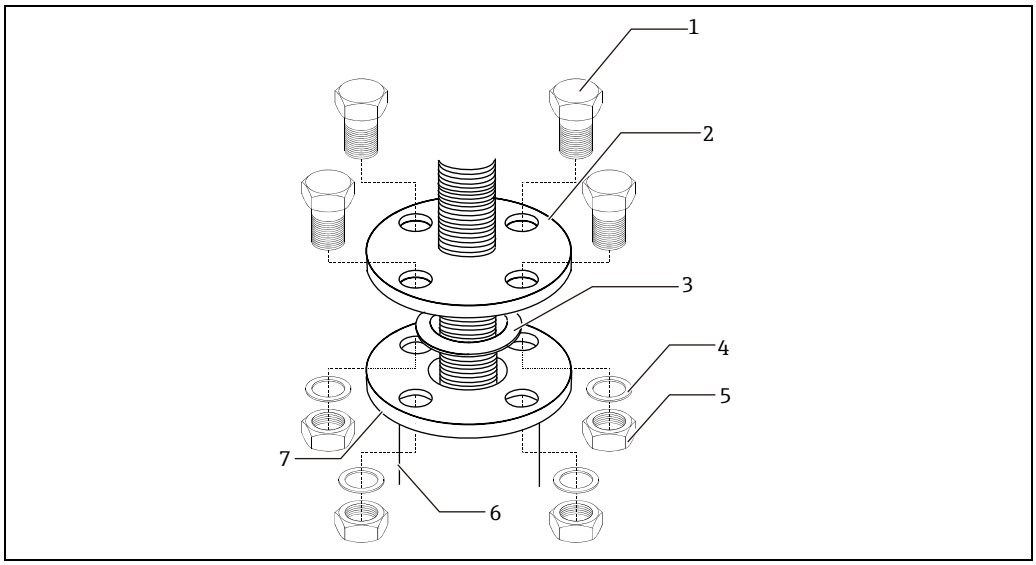


Figure 21: Mounting NMT539

1. *Hexagonal bolt*
2. *End of the temperature probe*
3. *Gasket*
4. *Washer*
5. *Bolt*
6. *Nozzle*
7. *End of the flange*

Wrapping sealing tape procedure

NOTICE Wrap the sealing tape around the screwed part shown below at a width of 30 mm (1.18 in) or more to maintain high level of air sealing between flanges.

1. When the installation height of the probe is set, lift the probe and mark the position of the bottom of the flange.
2. Turn the flange and moves it up toward the converter unit approximately 30 mm (1.18 in).
3. Wrap sealing tape (e.g. material: PTFE or other appropriate materials) around the adjusting pipe below the bottom of the flange.
4. Turn the flange back to the marked installation (original) height.
5. Wrap sealing tape around the adjusting pipe above the flange.
6. Turn the lock nut downwards to the flange until it is properly secured.

This completes the wrapping sealing tape procedure.

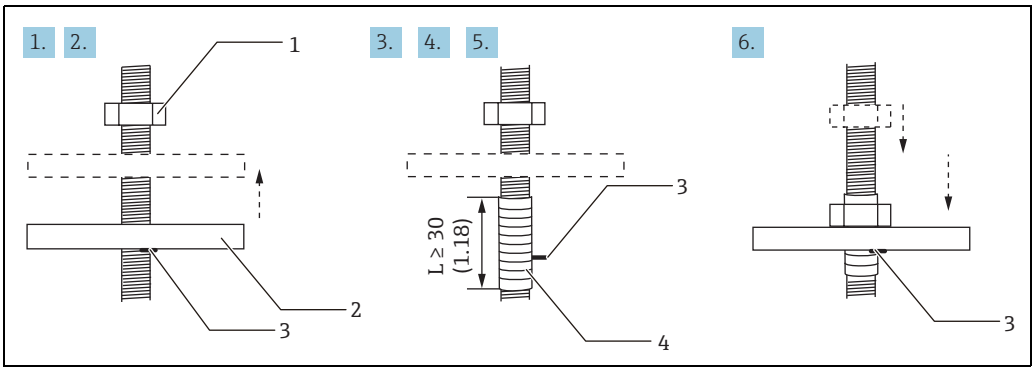


Figure 22: Wrapping Sealing Tape, Unit of measurement: mm (in)

1. *Nut*
2. *Flange*
3. *Mark*
4. *Seal tape*

⚠ WARNING Ensure to keep the tension at of 16kg or less during setting and after setting. Exceeding the limit may cause breakage in the flexible tube.

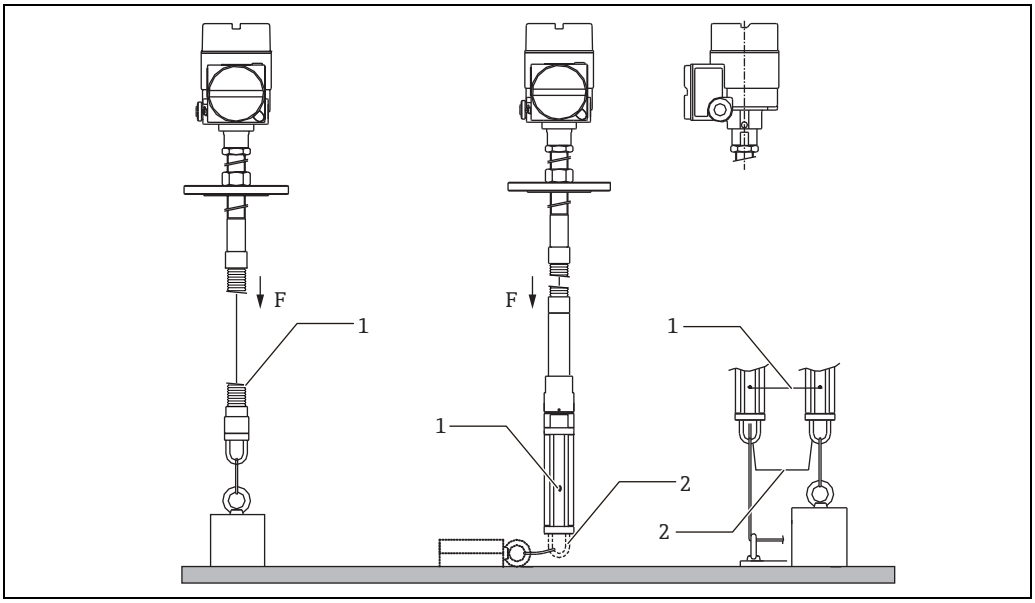


Figure 23: Mounting accessory

F *F* ≤ 16 kg (on setting/after setting)

1. *Lowermost element position*
2. *Hook*

Safety precaution for use of NMT539 at temperature of -170°C

When NMT539 is installed in cryogenic tanks, pressure in the flexible tube and electrical housing may decrease due to the rapid cooling of the tank processes. During commissioning of the temperature probe, loosen the terminal compartment cover to stabilize the pressure. When removing NMT539 from a cryogenic tank, the temperature and pressure in the flexible tube may rapidly increase due to an extreme temperature difference between the inside and outside of the tank. In this case, the flexible tube may move in an uncontrolled manner, and could lead to mechanical damage or personal injury. To prevent this, turn off the power and loosen the terminal compartment cover to stabilize the pressure.

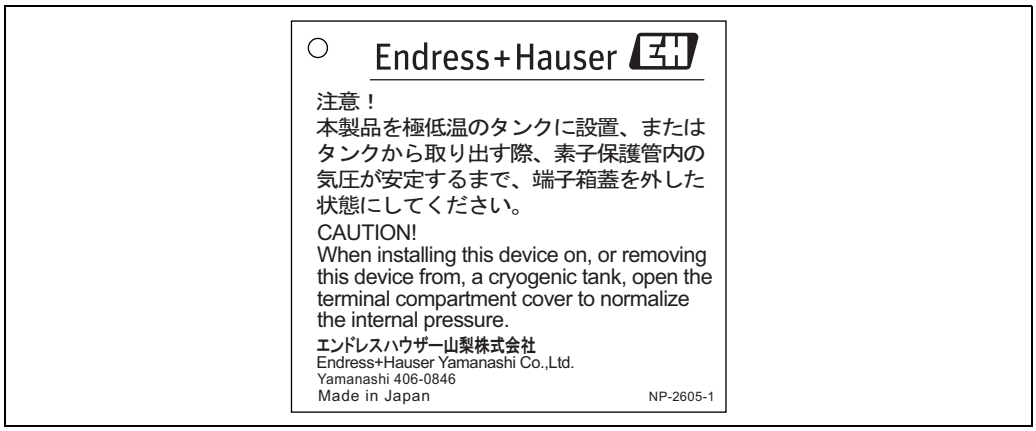


Figure 24: -170°C caution plate

3.3 Installation guide for NMT539

When installing water bottom, check "Zero" reference position of water bottom compared with manual dipping reference.

3.3.1 Mounting NMT539 on fixed roof tank

There are three methods for mounting NMT539 on a fixed roof tank

1. Top anchor method
2. Stilling well method
3. Anchor weight method

NOTICE If a heating coil is attached to the bottom of the tank, the clearance between the bottom hook of the flexible tube and the bottom of the tank may vary depending on the type of heating coil.

Top anchor method

The flexible tube and water bottom sensor are fixed with a wire hook and a top anchor.

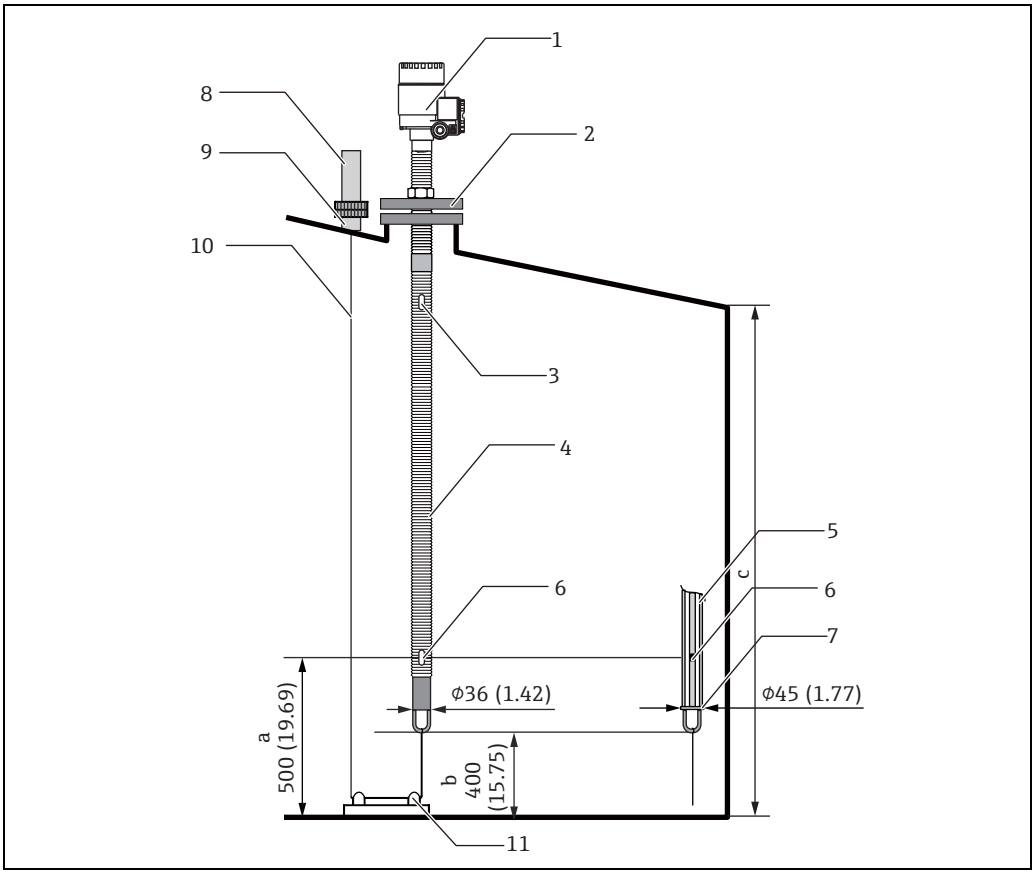


Figure 25: Top anchor method, Unit of measurement: mm (in)

a *Height from the bottom of the tank to the lowermost element*
b *Interval from the bottom of the tank*
c *Tank height*
1. *Electrical compartment*
2. *Flange*
3. *Uppermost temperature element*
4. *Temperature probe*
5. *Water bottom probe*
6. *Element position No.1 (lowermost element)*
7. *Reference position*
8. *Top anchor*
9. *Socket*
10. *Tensioning wire*
11. *Wire hook*

Top anchor attachment procedure

1. Insert a flexible tube and/or WB (Water Bottom) probe into a gasket and lower the flexible tube from the nozzle at the top of the tank.

NOTICE The flexible tube and/or WB probe must be lowered carefully without overbending and scratching the inner edge of the nozzle hole.

2. Rotate NMT539 for cabling in the most convenient way.
3. Straighten the tensioning wire, temporarily fix the end of the wire to the top anchor and lower the wire.
4. Put the tensioning wire into the wire hook at the bottom of the tank.
5. Secure the tensioning wire twice through the hole at the bottom hook
6. Wind the provided wire around the tensioning wire to secure the tensioning wire.

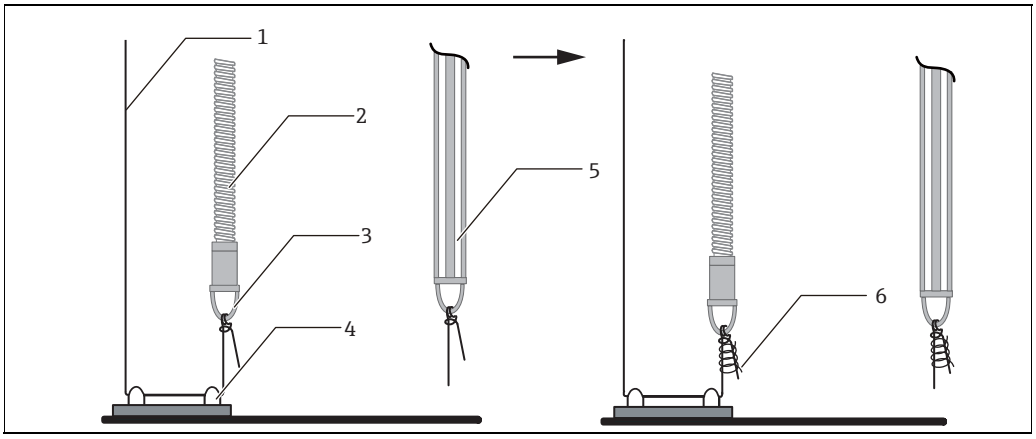


Figure 26: Top anchor attachment-1

1. *Tensioning wire*
2. *Temperature probe*
3. *Hook for wire*
4. *Wire hook*
5. *Water bottom probe*
6. *Provided wire*

1. Using bolts, fix the mounting flange of Prothermo to the nozzle at the top of the tank.

Keep the compression of the spring of 35 to 37mm (1.38 to 1.47 in). Compression exceeding the spring of 35 to 37 mm (1.38 to 1.47 in) may damage the sensor.

2. Wind the end of the wire once around the shaft of the top anchor and tighten it with nuts (2 pcs.).
3. Cut the excess wire.
4. Screw the nut to compress down the spring of the top anchor from 35 to 37mm (1.38 to 1.47 in).
5. Cover the top anchor.

This completes the mounting top anchor procedure.

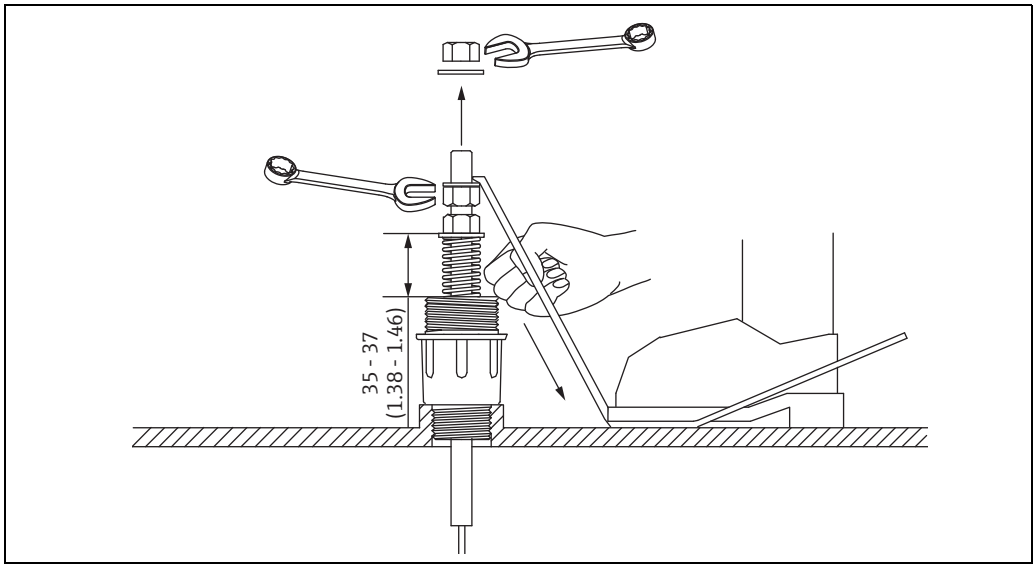


Figure 27: Top anchor attachment-2, Unit of measurement: mm (in)

Stilling well method

The flexible tube and/or WB sensor are inserted into a stilling well with a diameter of 2 inches (50A) or more.

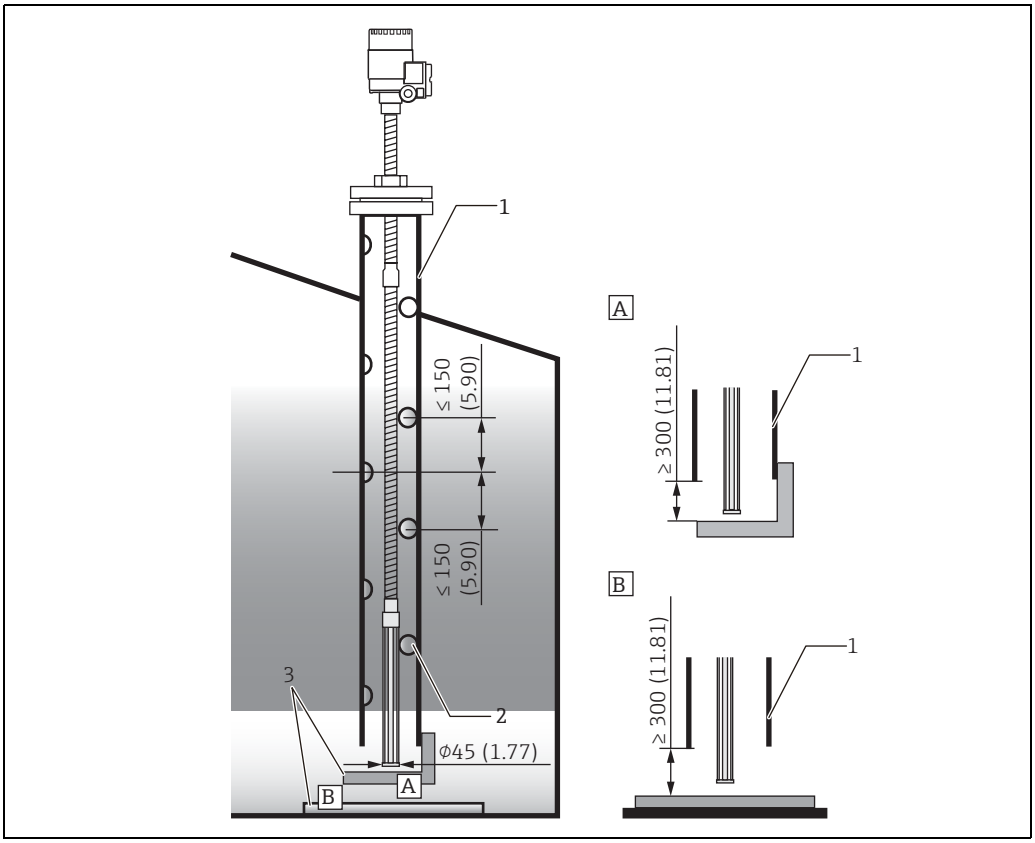


Figure 28: Stilling well method, Unit of measurement: mm (in)

A Base plate/datum plate case 1
B Base plate/datum plate case 2
1. Stilling well
2. Hole Ø25 (1)
3. Base plate/datum plate

Stilling well attachment procedure

1. Insert a gasket and lower the flexible tube and/or WB sensor probe from the inlet of the stilling well.
2. Rotate NMT539 so that you can set up the cable in the most convenient way.
3. Fix the mounting flange of NMT539 to the nozzle on the tank top using bolts.

This completes the stilling well attachment procedure.

NOTICE

- When anchor weight is not used in the stilling well method, install water probe into the place which is lower than the bottom of the stilling well to get the tip of the water probe.
- The stilling well of 2 inches (50A) (JIS, ASME) or more is available to install.
- When using anchor weight, use the pipe of 4 inches (100A) (JIS, ASME) or more.
- Do not move the flexible tube horizontally or swing it. This may cause turbulence of liquid, which may damage the flexible tube.
- The flexible tube and/or WB probe must be lowered carefully without overbending and scratching the inner edge of the nozzle hole.

Anchor weight method

The flexible tube is fixed with an anchor weight.

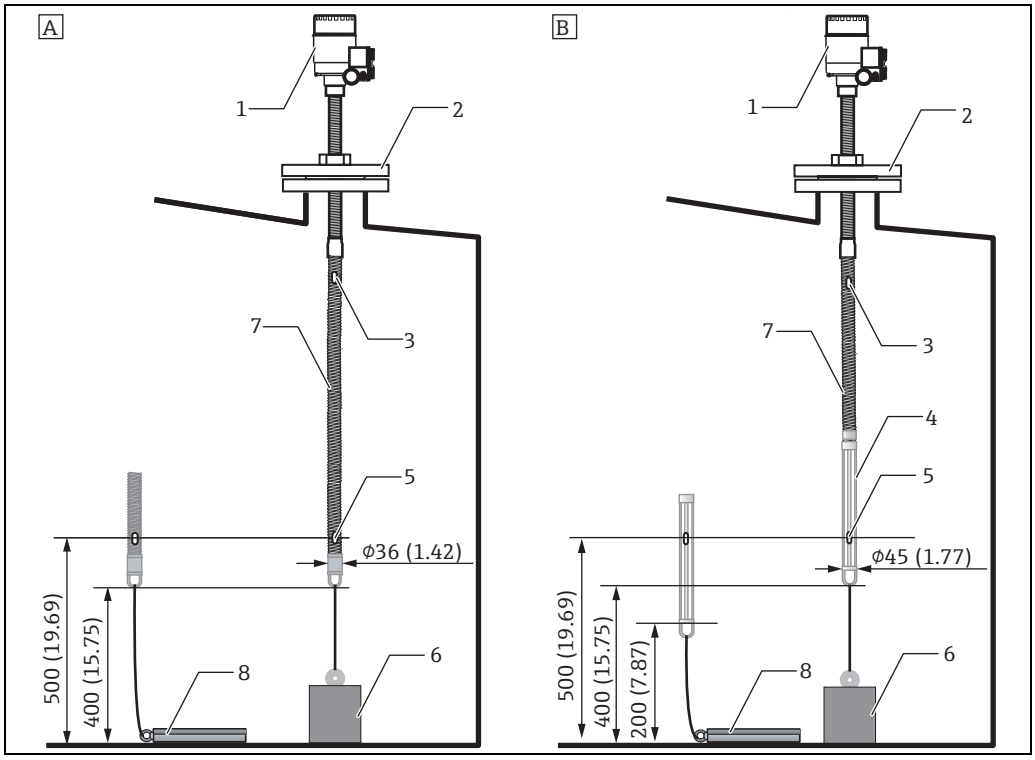


Figure 29: Anchor weight method, Unit of measurement: mm (in)

A *Without water bottom sensor*
B *With water bottom sensor*
1. *Transmitter (electrical compartment)*
2. *Flange*
3. *Uppermost element*
4. *Water probe sensor*
5. *Lowermost element*
6. *Anchor weight for high profile*
7. *Temperature probe*
8. *Anchor weight for low profile*

⚠ CAUTION

- Ensure to put the anchor weight at the bottom of the tank. When installing NMT539 with the suspended anchor weight, use the anchor weight of 16kg or less. Exceeding the limit may cause internal breakage in the flexible tube.
- The temperature probe and/or WB probe must be lowered carefully without overbending and scratching the inner edge of the nozzle hole.

Anchor weight attachment procedure

1. Insert the flexible tube and/or WB probe into a gasket and lower the flexible tube from the nozzle at the top of the tank.
2. Rotate NMT539 for cabling in the most convenient way.
3. Put the tensioning wire through the anchor weight hook twice and also tie the other end to the bottom hook.
4. Wind the provided wire around both ties of the hooks to secure the tensioning wire.
5. Using the bolts, fix the mounting flange of NMT539 to the nozzle at the top of the tank.

This completes the mounting anchor weight procedure.

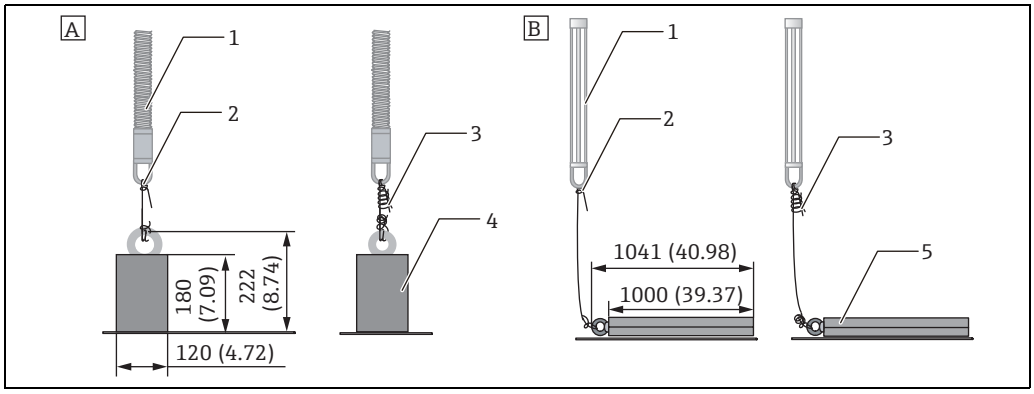


Figure 30: Anchor weight attachment, Unit of measurement: mm (in)

A *Weight for high pressure*
B *Weight for low pressure*
1. *Temperature probe*
2. *Bottom hook*
3. *Provided wire*
4. *Weight for high profile*
5. *Weight for low profile*

3.3.2 Mounting NMT539 on floating roof tank

There are three methods of mounting NMT539 on a floating roof tank:

1. Top Anchor Method
2. Stilling Well Method
3. Guide Wire Ring Method

If a heating coil is attached to the bottom of the tank, the clearance between the bottom hook of the flexible tube and the bottom of the tank may vary depending on the type of heating coil.

Top anchor method

The flexible tube or WB sensor is installed in a fixed pipe and fixed with a top anchor. NMS5, NMS7, NMS8x, and NMT539 can be mounted in the same fixed pipe.

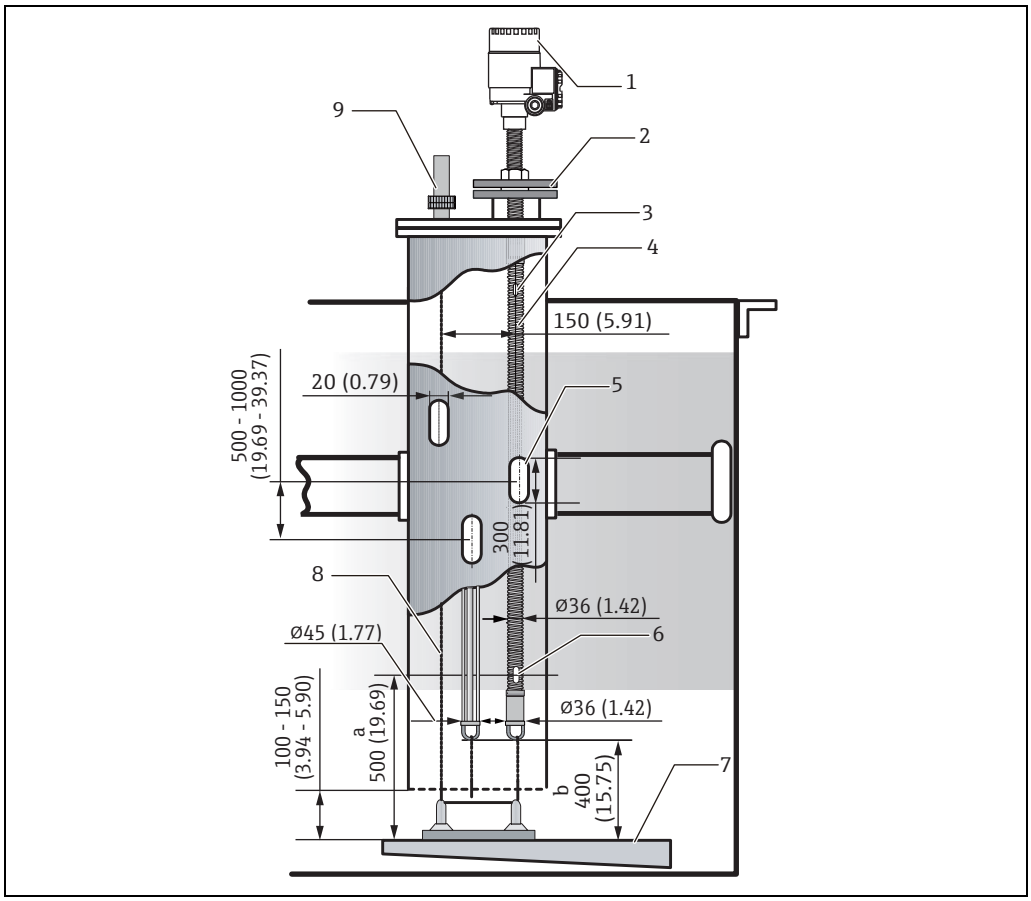


Figure 31: Top anchor method, Unit of measurement: mm (in)

a *Distance from the base plate/datum plate to the lowermost element*
b *Distance from the base plate/datum plate to the bottom hook*
1. *Transmitter (electrical compartment)*
2. *Flange*
3. *Uppermost element*
4. *Temperature probe without WB sensor*
5. *Stilling well holes/slits*
6. *Temperature probe with WB sensor*
7. *Element position #1 (Lowermost element)*
8. *Base plate/datum plate*
9. *Tensioning wire*
10. *Top anchor*

The installation procedure is the same as in the mounting on fixed roof tanks using the top anchor (refer to "3.3.1 Mounting NMT539 on fixed roof tank").

Stilling well method

The flexible tube and/or WB sensor probe are inserted into a stilling well with a diameter of 2 inches (50A) or more in the fixed pipe.

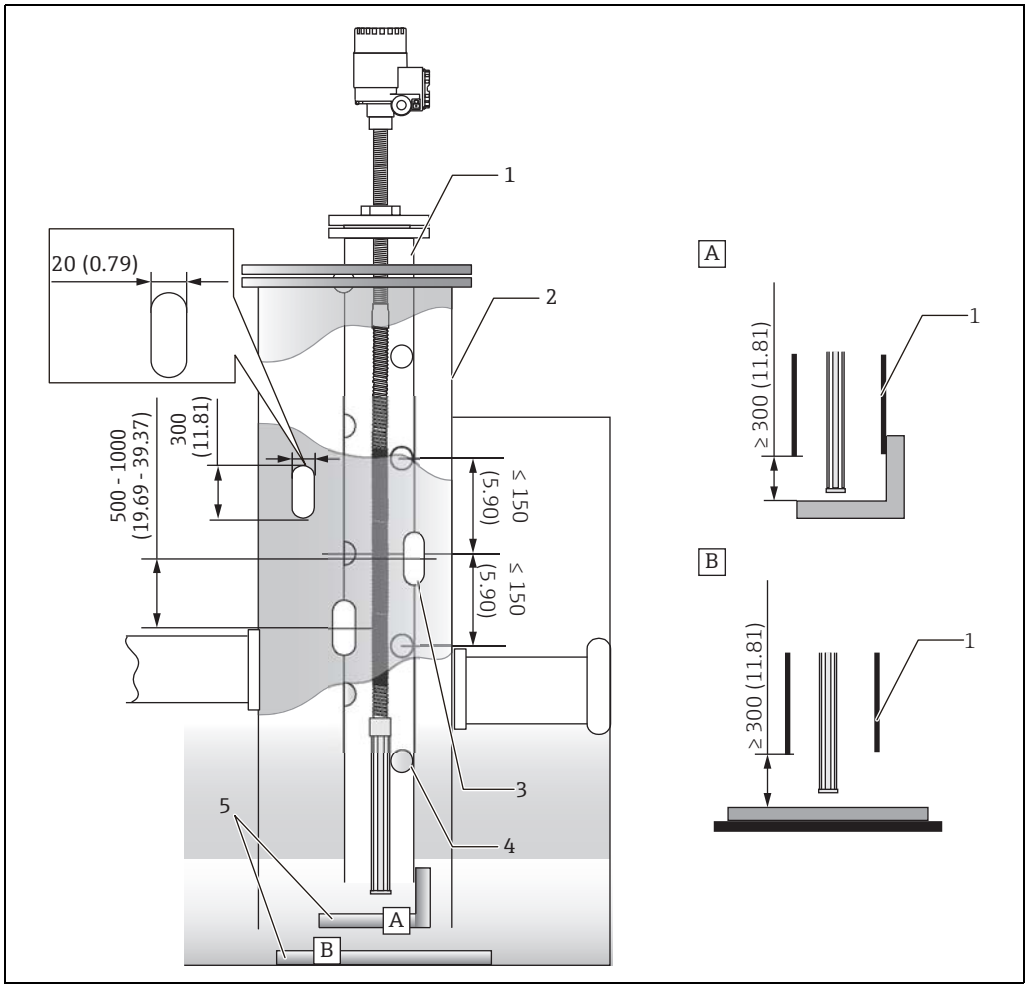


Figure 32: Stilling well method, Unit of measurement: mm (in)

A *Base plate/datum plate case 1*
B *Base plate/datum plate case 2*
1. *Stilling well*
2. *Fixed pipe/gauge pole*
3. *Stilling well hole/slit*
4. *Stilling well hole/slit*
5. *Base plate/datum plate*

The installation procedure is the same as in the mounting on fixed roof tanks using the stilling well.

Guide ring and anchor weight method

Flexible tube and/or WB sensor are fixed with a guide ring and anchor weight.

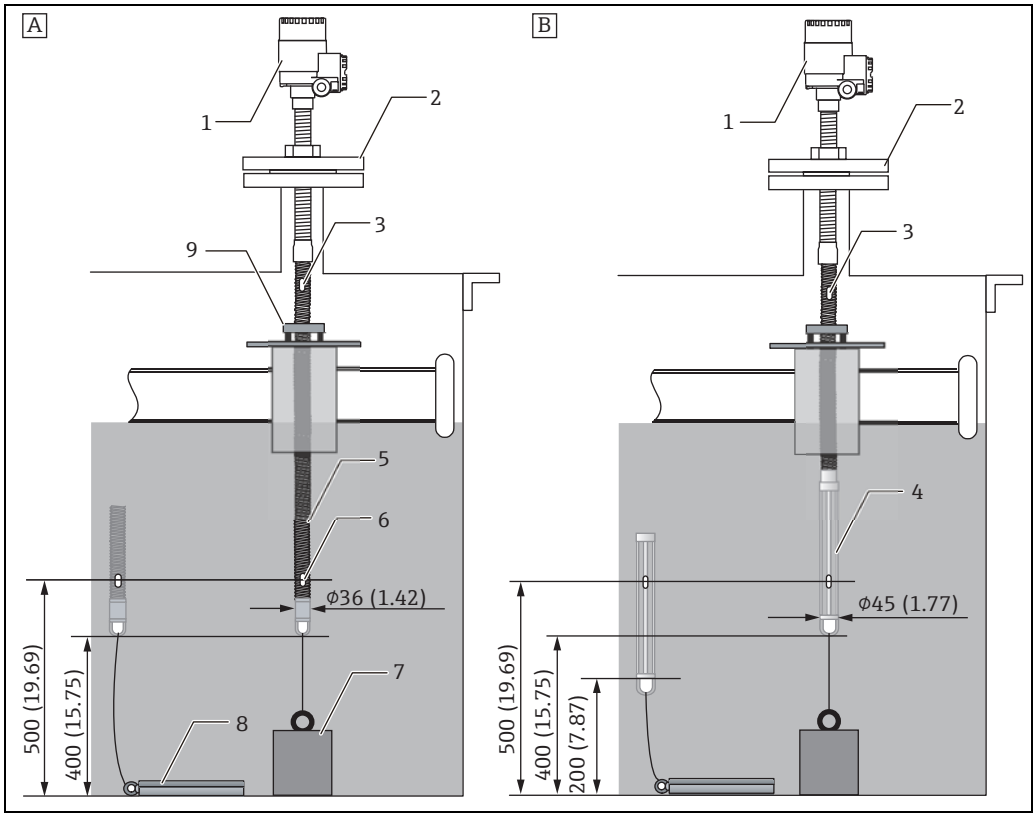


Figure 33: Guide ring and anchor weight, Unit of measurement: mm (in)

A *Temperature probe without WB sensor*
B *Temperature probe with WB sensor*
1. *Transmitter (electrical compartment)*
2. *Flange*
3. *Uppermost element*
4. *Water probe*
5. *Temperature probe*
6. *Lowermost element*
7. *Anchor weight for high profile*
8. *Anchor weight for low profile*
9. *Guide ring*

⚠ CAUTION

- Ensure to put the anchor weight at the bottom of the tank. When installing with the suspended anchor weight, use the anchor weight of 16kg or less. Exceeding the limit may cause internal breakage in the flexible tube.
- The flexible tube must be lowered carefully without overbending and scratching the inner edge of the nozzle hole.

Guide ring and anchor weight attachment procedure

1. Set the guide ring to the floating roof.
2. Insert the flexible tube and/or WB probe into a gasket and lower the flexible tube from the nozzle at the top of the tank.
3. Rotate NMT539 for cabling in the most convenient way.
4. Put the tensioning wire through the anchor weight hook twice and also tie the other end to the bottom hook.
5. Wind the provided wire around both ties of the hooks to secure the tensioning wire.
6. Using the bolts, fix the mounting flange of NMT539 to the nozzle at the top of the tank.

This completes the mounting guide ring and anchor weight procedure.

3.3.3 Mounting NMT539 on pressurized tank

Pressurized tank is required to install a stilling well to protect the probe from the pressure.

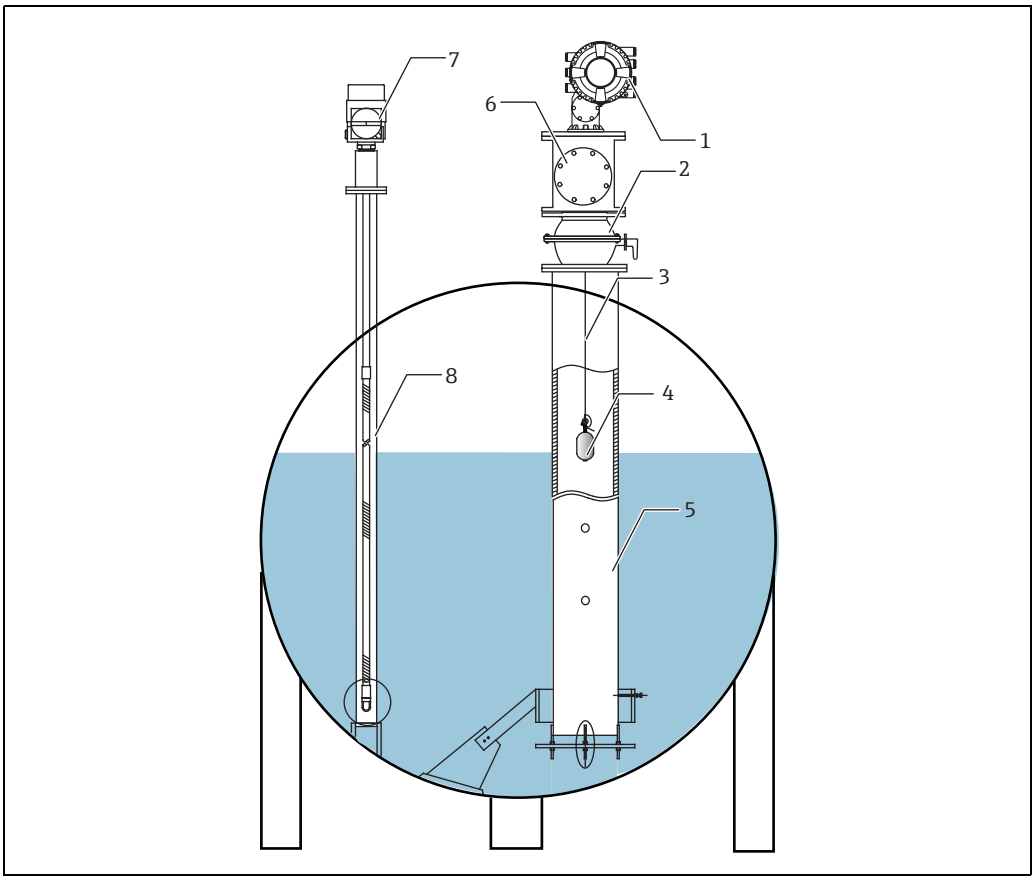


Figure 34: Stilling well for pressurized tank

1. *NMS8x/NM5*
2. *Ball valve*
3. *Measuring wire*
4. *Displacer*
5. *Stilling well*
6. *Calibration/Maintenance chamber*
7. *NMT539*
8. *Thermowell*

⚠ CAUTION

- When the pressure inside the tank exceeds atmospheric pressure (absolute pressure1 bar, 100KPa, 14.5psi), a thermowell that does not have any holes or slits must be installed for the NMT539. However the NMS8x requires a stilling well with holes or slits.
- The NMT539 is installed in the thermowell from the top of the tank nozzle.
- Cover the bottom of the thermowell of the NMT539 and weld it to protect the probe from the pressure.

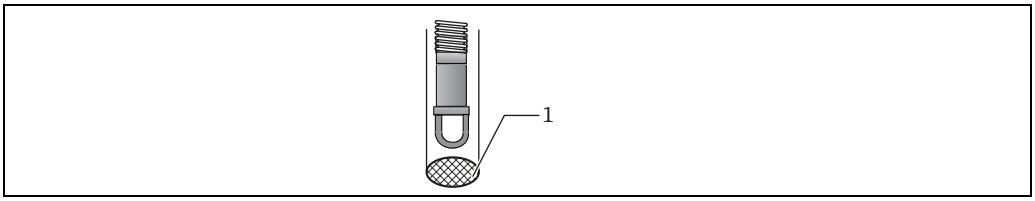


Figure 35: Welding part of thermowell

1. *Welding part*

3.4 Protective cover

In case of NMT539 TIIS Ex d [ia] only available in Japan, a protective cover is required.

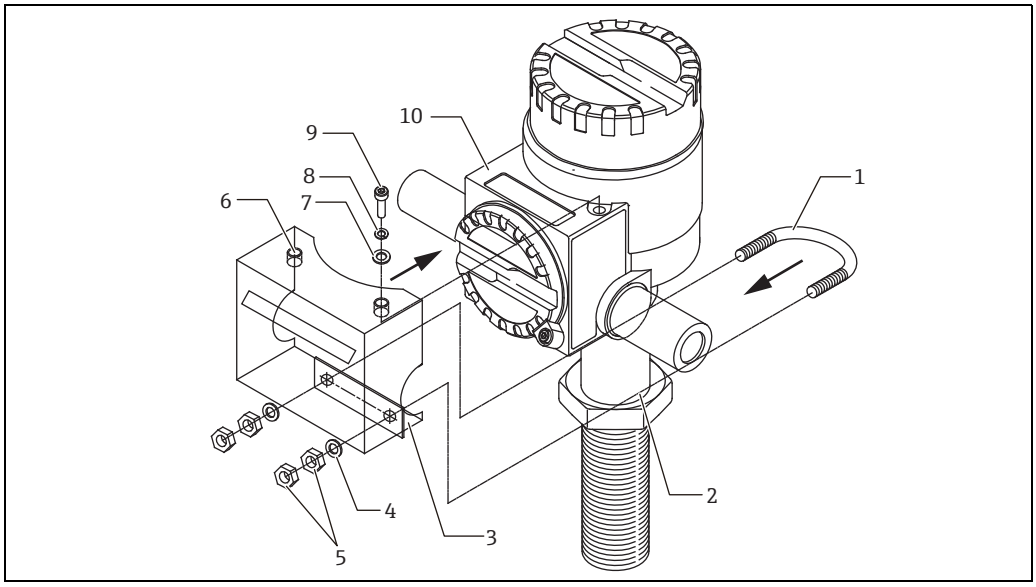


Figure 36: Protective cover

1. *U bolt*
2. *Water bottom adapter*
3. *Protect cover*
4. *Washer*
5. *Nut*
6. *Boss*
7. *Washer*
8. *Spring washer*
9. *Socket head cap screw*
10. *Housing*

Attachment procedure of protective cover

1. Place the protective cover on the housing.
2. Fix the protective cover with a socket head cap screw, a spring washer, and a washer.
3. Insert U bolt into the holes of the protective cover from the side of WB adapter.
4. Fix the protective cover with washers and double nuts.

This completes the protective cover attachment procedure.

⚠ CAUTION

- Over tightening nuts may damage the protective cover.
- Ensure to use the cable glands attached to NMT539.

4 Wiring

4.1 Mechanical connection for converter

Preparation of mechanical connection

Prior to the removal of the existing RTD temp. converter, check the following items. The items are also applicable for installation of converter of NMT539.

- Element type (material and structure)
- Total element number
- Presence of bottom and vapor spot elements
- Lowest element position
- Element intervals
- Cable color for each element

Prior to installation of NMT539, tie all RTD cables (and coaxial cables if the probe is equipped with a water bottom sensor) temporarily with zip ties or short string to avoid damaging cables during mechanical connection.

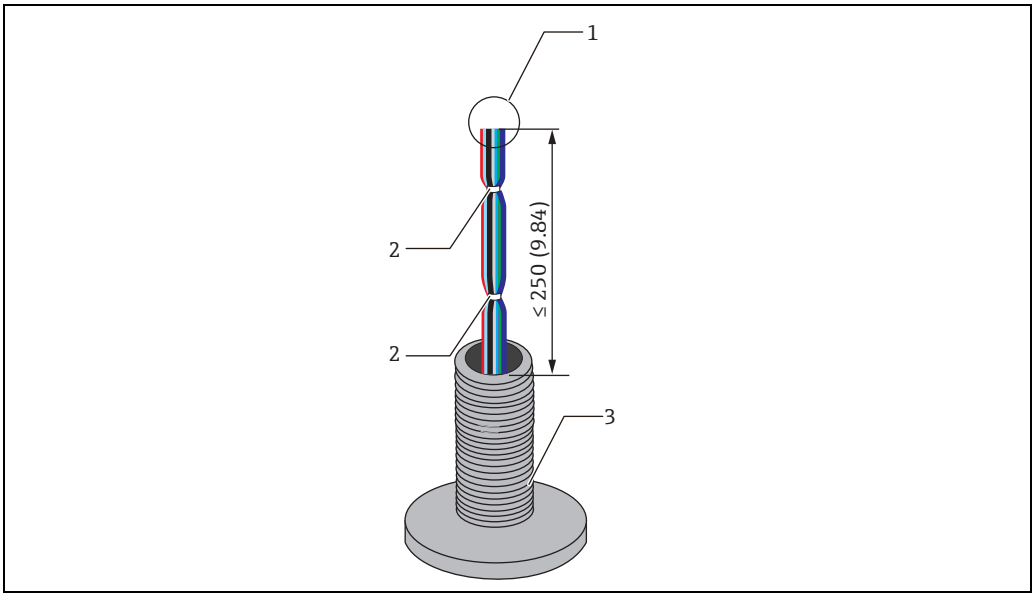


Figure 37: Tying cable

1. *Tip of the cable*
2. *Tying parts*
3. *NPS 3/4 connector*

Procedure of tying cable

1. Cut the tip of cables in the same length for all the cables to connect them to NMT539.
2. Tie all the cables to prevent damage due to mechanical connection.
3. Keep the distance between the end of the cables and the top of the threaded connector of NPS 3/4 at 250mm or more.

This completes the tying cable procedure.

Procedure of connecting threaded type connector

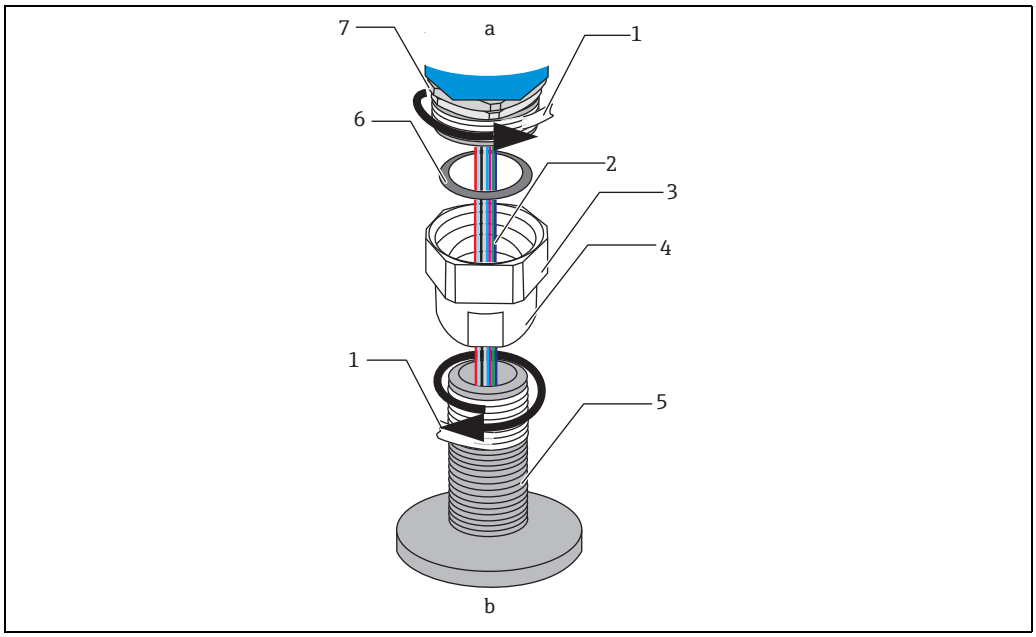


Figure 38: Connecting Threaded Type Connector

a. NMT539 connection side
b RTD probe connection side (To average temperature elements)
1. Seal tape (not supplied)
2. Cable for RTD signal, WB capacitance, probe
3. NPS 3/4 connector (RTD probe side)
4. Union
5. NPT3/4 nut (RTD probe side)
6. Gasket
7. Male threaded connector

- Take precautions prior to installation of NMT539 into RTD probe.
- Loosen the threaded female connector of lower NPS.
- Mount the threaded female connector on RTD probe to ensure that each connection can be smoothly attached.

1. Wrap the sealing tape around the threaded connector of NPS 3/4.
2. Insert the free spin union and the female threaded connector of NPS into the threaded connector of NPS 3/4 until they are completely secured.
3. Wrap the sealing tape around the male threaded connector of NMT539 side.
4. Insert the gasket into the union and mount NMT539 on RTD probe.
5. Tighten the union with hand until it is secured.
6. Remove the cover and confirm that both sides of the cables have enough length to be connected.
7. After completing of cable connection and position adjustment of NMT539, tighten the union with hand and tighten it 1/8 rotation securely using a wrench.

This completes the threaded connection procedure

CAUTION Do not pull both sides of the cables or subject them to over-tension during this procedure. Pulling cables or subjecting them to over-tension may damage the inside the cable, which makes it impossible NMT539 to measure the temperature.

4.2 Wiring connection for converter

Connection procedure of temperature signal cable

Temperature signal cable is directly connected to NMT539 (converter only) input cable with simple terminal connectors (included).

1. Select a pair cables.
2. Strip cable ends approximately 10mm (1/2").
3. Twist both ends together and install terminal connector [1].
4. Crimp the connected terminal with plier or any connector tool.

This completes the connection of signal cable procedure.

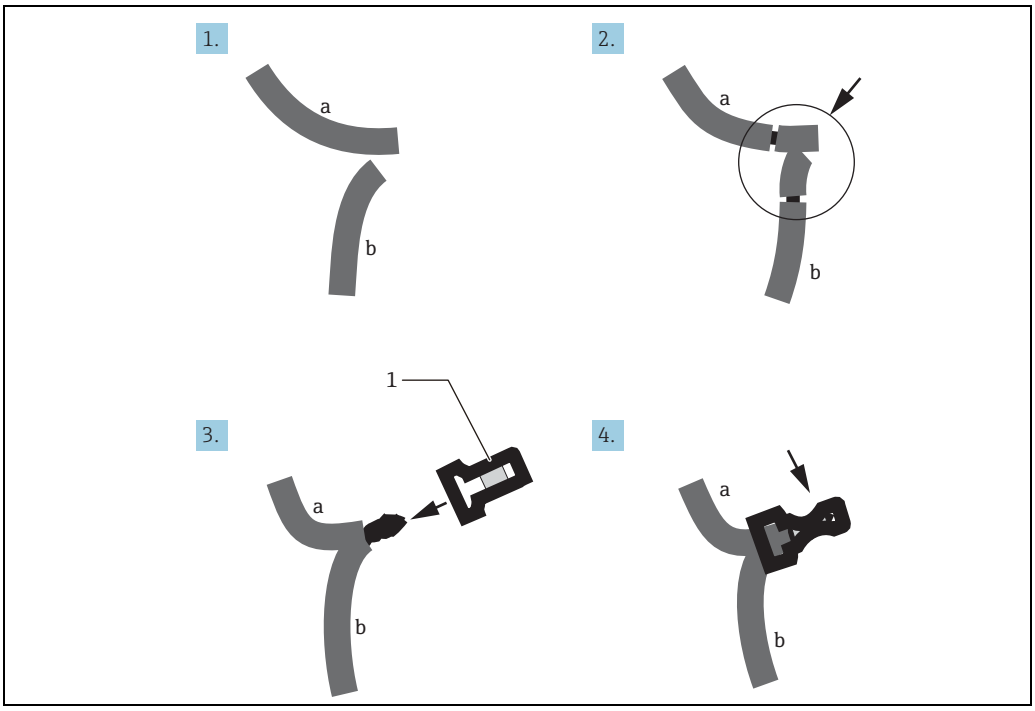


Figure 39: Connection of Signal Cable

a Cable from NMT539

b Cable from wine bottle

1. Terminal connector

The cabling color code is listed below.

NMT539 cable color: the principle is based on the A,B,b 3-wire cabling method.

No.	A: Cable color	No.	A: Cable color
No.1	Brown	No.9	White
No.2	Red	No.10	Black
No.3	Orange	No.11	Brown and black
No.4	Yellow	No.12	Read and white
No.5	Green	No.13	Orange and white
No.6	Blue	No.14	Yellow and white
No.7	Purple	No.15	Green and white
No.8	Gray	No.16	Blue and white
Symbol	**B: Cable color**	**Symbol**	**B: Cable color**
B	Purple and white	b	Black and white

4.3 Electrical connection (TIIS, Ex d [ia])

When NMT539 TIIS, Ex d [ia] is available only in Japan, Class A grounding directly from NMT539 is required.

- The grounding cable for safety barrier should be connected independent of any other devices or purpose, according to Class A grounding standards.
- Use a conductive grounding wire with cross-sectional dimensions 2 to 2.6mm^2. In an instrumentation room, a field device with Class A ground may be connected in common with the communication cable shield.

Class A grounding general description

Ground resistance value	10 Ω or less
Grounding cable	Tensile strength: 1.0 4kN metallic wire or more Cable core cross section diameter: 2 to 2.6mm copper wire or more Cable finished external diameter: more than Ø8 mm

Sample of grounding cable

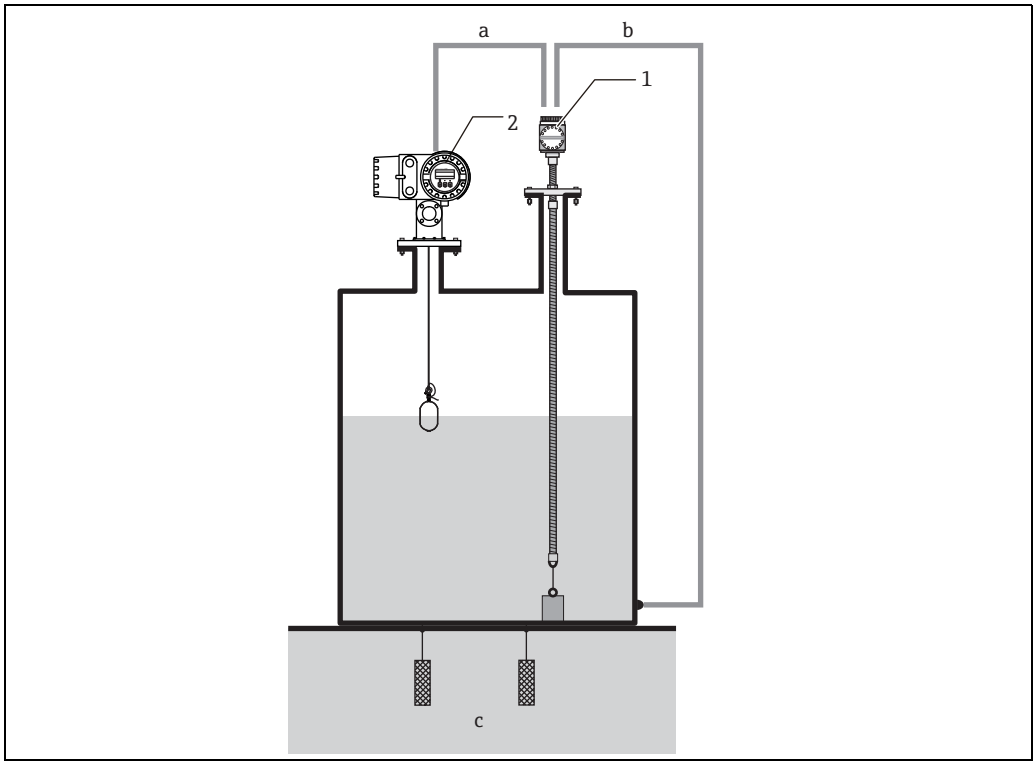


Figure 40: Grounding cable

a *Local HART (Ex d) communication*
b *Grounding cable (see Tip.)*
c *Non-hazardous area, Class A grounding, Under ground*
1. *NMT539*
2. *NMS5/NMS8x*

When installing safety barrier, use a cable with Ø8 mm (0.31 in) or more on connecting to the tank.

4.3.1 Connecting diagram

Install wiring in manner to prevent current or voltage from causing electro magnetic interference on the intrinsically safe circuit.

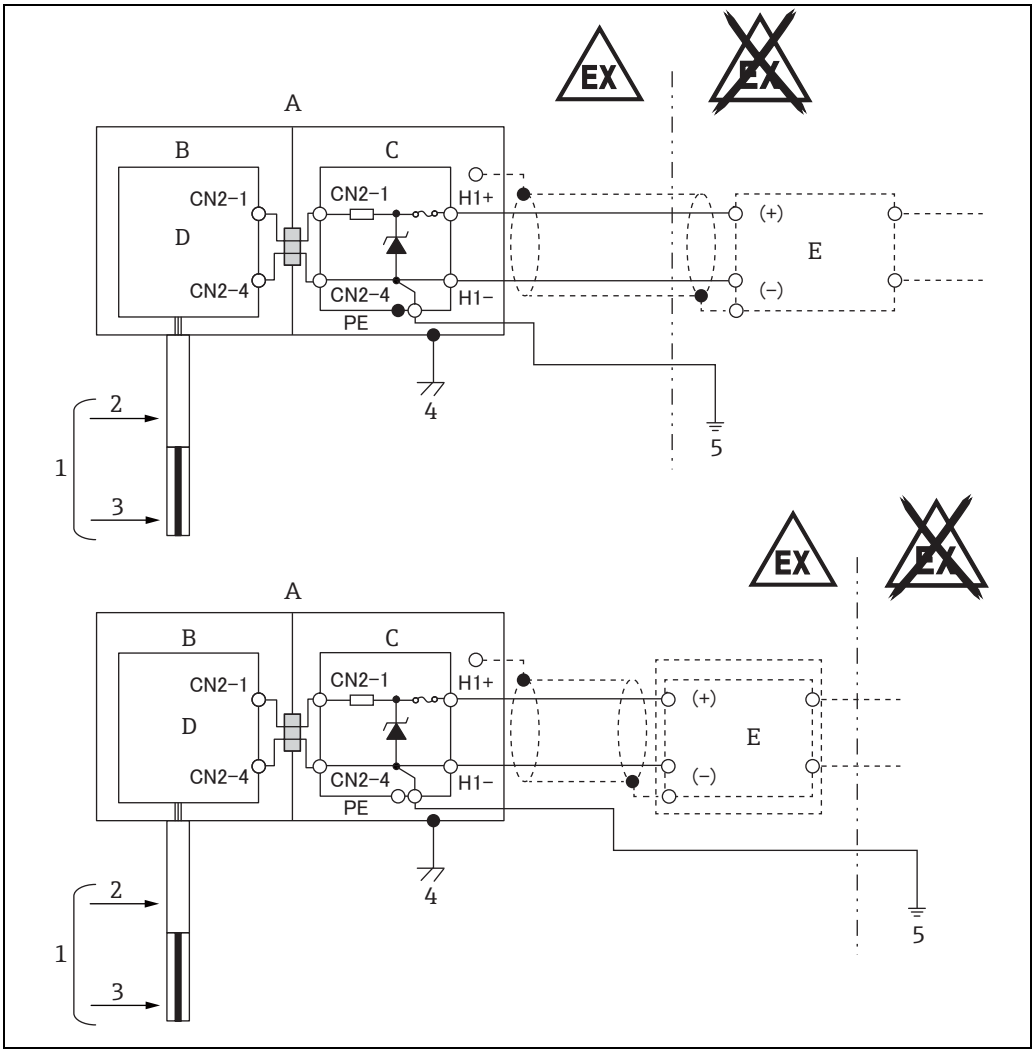


Figure 41: Connecting diagram

A *Measuring device in a tank*
B *Ex ia compartment*
C *Ex d compartment (Terminal box)*
D *Ex ia circuit*
E *General machinery (20 to 26.4 VDC)*
1. *Measuring part*
2. *Measuring temperature tube*
3. *Water bottom sensor*
4. *External grounding terminal*
5. *Class A grounding*

NOTICE

- In case of average temperature measuring, there is no water bottom probe.
- The grounding wire can be shared with safety barrier for use, however do not share the grounding wire with the arrester's.

4.4 Terminal connection

4.4.1 NMT539 terminal (Ex ia)

⚠ CAUTION NMT539 (Ex ia) allows an intrinsically safe local HART connection. Refer to the intrinsically safe regulation for establishing wiring and field device layout.

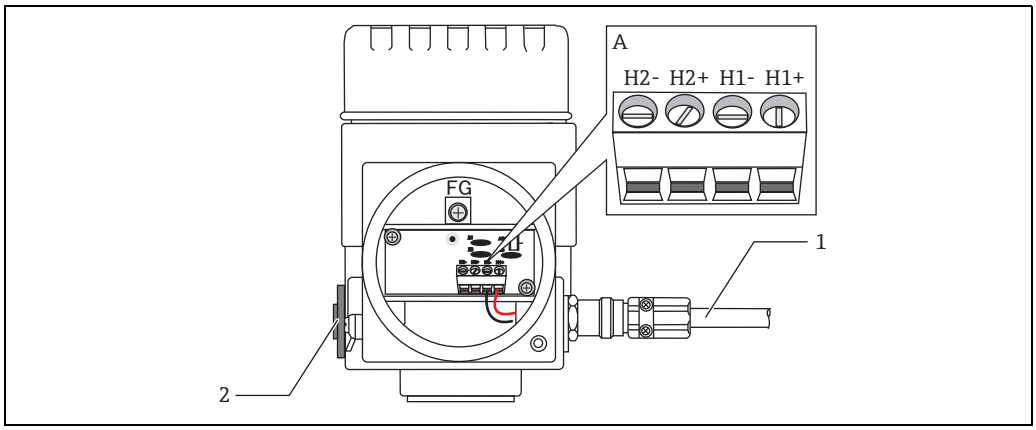


Figure 42: NMT539 Terminals (ATEX, Ex ia)

A Temperature (water bottom sensor) data/Intrinsically safe HART on NMT539 (See Tips).

1. Screened twisted pair or steel armored wire

2. Blind plug (standard aluminum)

Metal gland cable can only be used. Shield cable of HART communication line must be grounded.

Connection list of cable

Connection to NRF590		Connection to NMS5		Connection to NMS8x, NRF81	
+ terminal	24, 26, 28	+ terminal	24	+ terminal	E1
- terminal	25, 27, 29	- terminal	25	- terminal	E2

+H1 and +H2 show + terminal and -H1 and -H2 show - terminal.

4.4.2 NMS5/NMS7 terminal (ATEX, Ex d [ia])

Since NMT539 is an intrinsically safe instrument, the terminal connection to the Ex i side on local HART connection is allowed on NMS5 terminal housing.

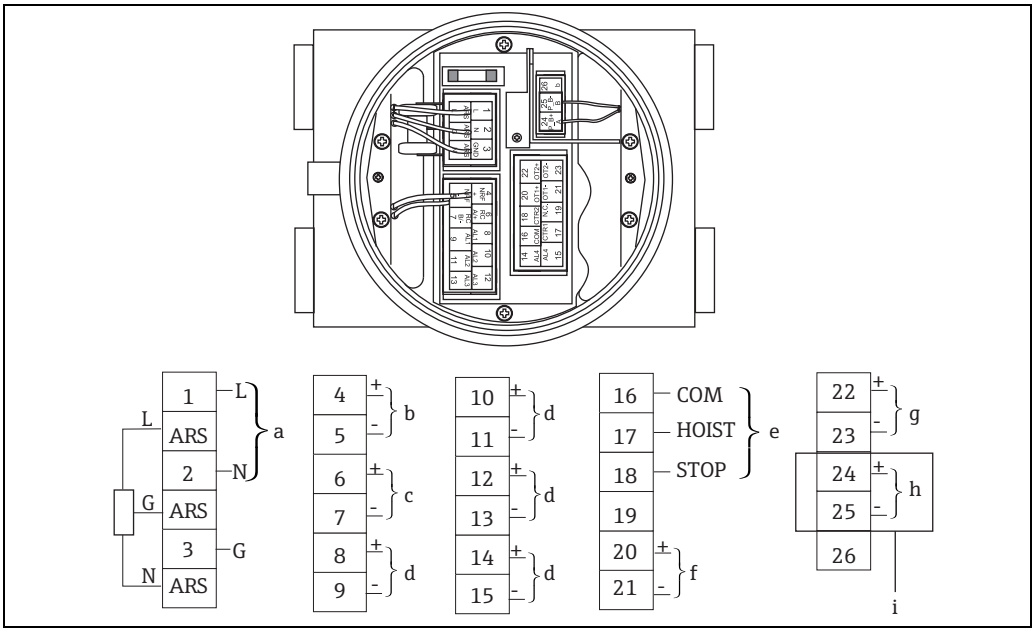


Figure 43: NMS5 terminal

a *Power supply: 85 to 264VAC, 50/60 Hz or 20 to 62 VDC, 20 to 55 VAC*
b *Non IS HART to NRF or others*
c *Digital output Modbus, RS485 Serial pulse or HART*
d *Alarm contact*
e *Operation contact input*
f *4 to 20 mA channel 1*
g *4 to 20 mA channel 2*
h *Ex i HART*
i *from NMT539 Ex ia*

CAUTION Do not connect NMT539 local HART communication on terminals 4 and 5 on NMS5. These terminals are designed to connect Ex d local HART communication.

4.4.3 NMS8x, NMR8x, NRF81 (Ex d [ia]) Ex i communication

NMT539 connection is E port 1 and 2 to NMS8x, NMR8x or NRF81.

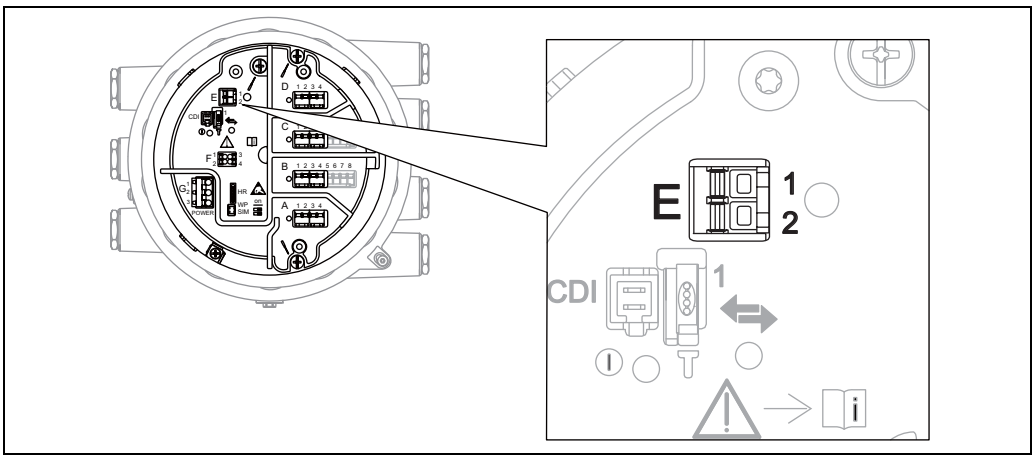


Figure 44: NMS8x terminal for NMT539

E1 *H+ terminal*
E2 *H- terminal*

4.4.4 NMT539 (TIIS, Ex d [ia]) terminal

NMT539 of Ex d [ia] allows a local HART connection available in Japan. Refer to the Local regulation for establishing wiring and field device layout. Local HART multi drop connection depends on approval type.

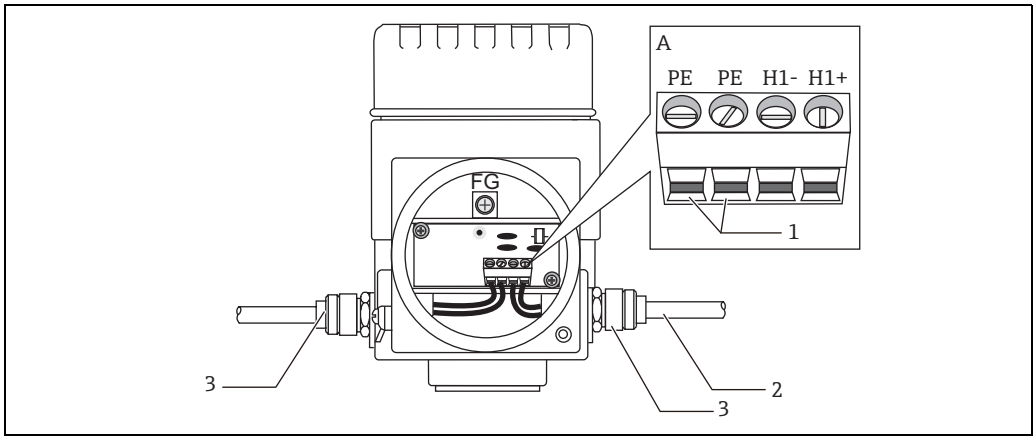


Figure 45: NMT539 terminal (TIIS Ex d [ia])

A Temperature (water bottom sensor) data/Intrinsically safe HART on NMT539 (See Tips).

1. Non-hazardous area, Class A grounding (1 to 1.5 mm², 2pcs.)

2. Screened twisted pair or steel armored wire

3. Cable gland (SXC-16B)

CAUTION

- Shield cable of HART communication line must be grounded.
- The grounding wire can be shared with safety barrier for use, however do not share the grounding wire with the arrester's.

Connection list of cable

Connection to NRF590		Connection to NMS5	
+ terminal	13	+ terminal	24
- terminal	12	- terminal	25

- +H1 shows + terminal and -H1 shows - terminal.
- According to the NMT539 specification that shows Ex d [ia], NMS5 specification must be Ex d HART.
- According to the NMT539 specification that shows Ex d [ia], Ex d [ia] HART module must be selected for slot B or C. + and - terminals also must be connected to the same module. H1+ and H- of NMT539 cannot be connected to B3 and C2.

4.4.5 NMS Ex d connection

Connect NMT539 Ex d [ia] to Proservo Ex d local HART terminals.

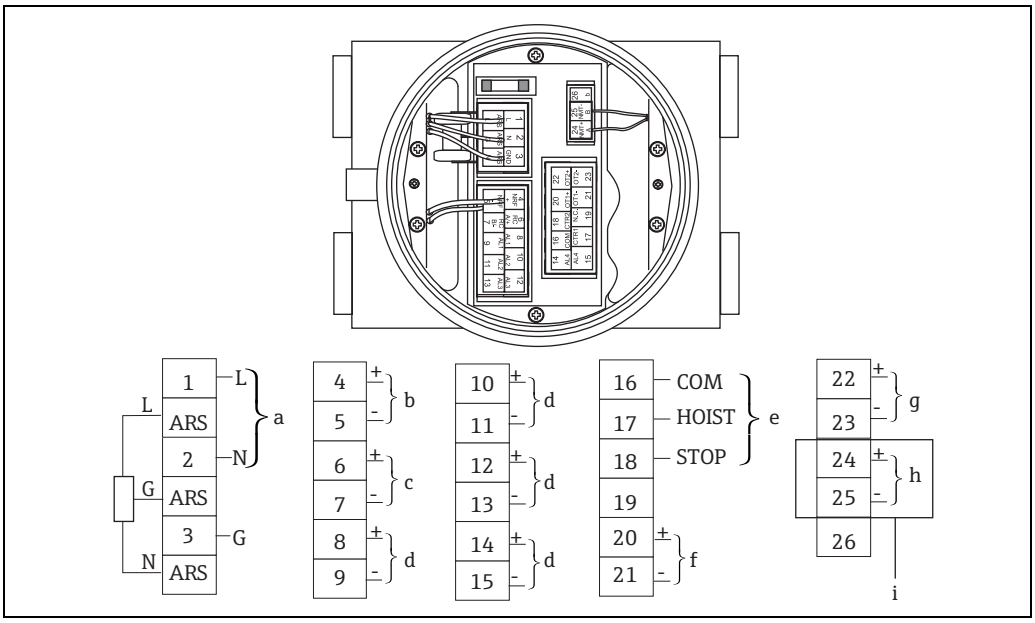


Figure 46: NMS Ex d connection

a *Power supply: 85 to 264VAC, 50/60 Hz or 20 to 62 VDC, 20 to 55 VAC*
b *Non IS HART to NRF or others*
c *Digital output Modbus, RS485 Serial pulse or HART*
d *Alarm contact*
e *Operation contact input*
f *4 to 20 mA channel 1*
g *4 to 20 mA channel 2*
h *Ex d HART*
i *from NMT539 Ex d*

4.4.6 TGM5 and TMD1 terminal

When TGM5 (except Sakura code (collector common), BCD (emitter common), BCD (collector common) is equipped with local HART communication, it is possible to connect Ex d [ia] equipment, however terminal number depends on the specification. See terminal figure for TGM5.

In case of TMD1-xBxxxxxxxxx (with local HART input), it is possible to connect Ex d [ia] equipment, however terminal number depends on the specification. See terminal figure for TMD1.

4.4.7 NRF590 terminal

NRF590 has three sets of intrinsically safe local HART terminals.

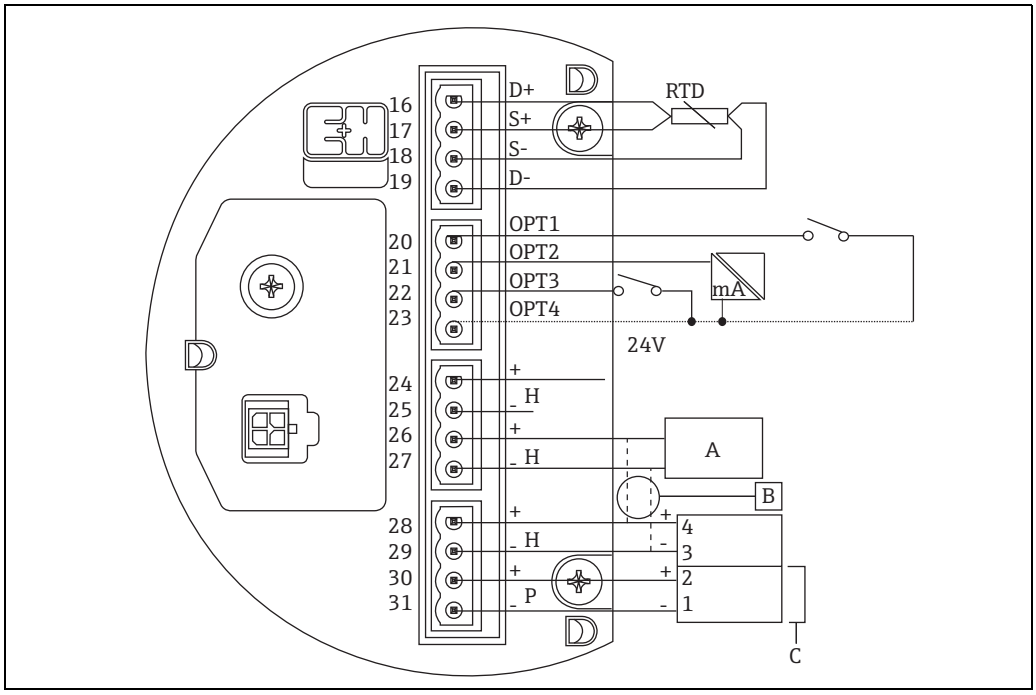


Figure 47: NRF590 terminals (Ex ia)

A HART sensor (internally interconnected as one HART Filedbus loop)

B Fieldbus loop

C For Micropilot S-series only

Do not connect signal local HART lines from NMT539 to terminals 30 and 31. These terminals are designed to supply drive power for the Micropilot S (FMR53x and FMR540).

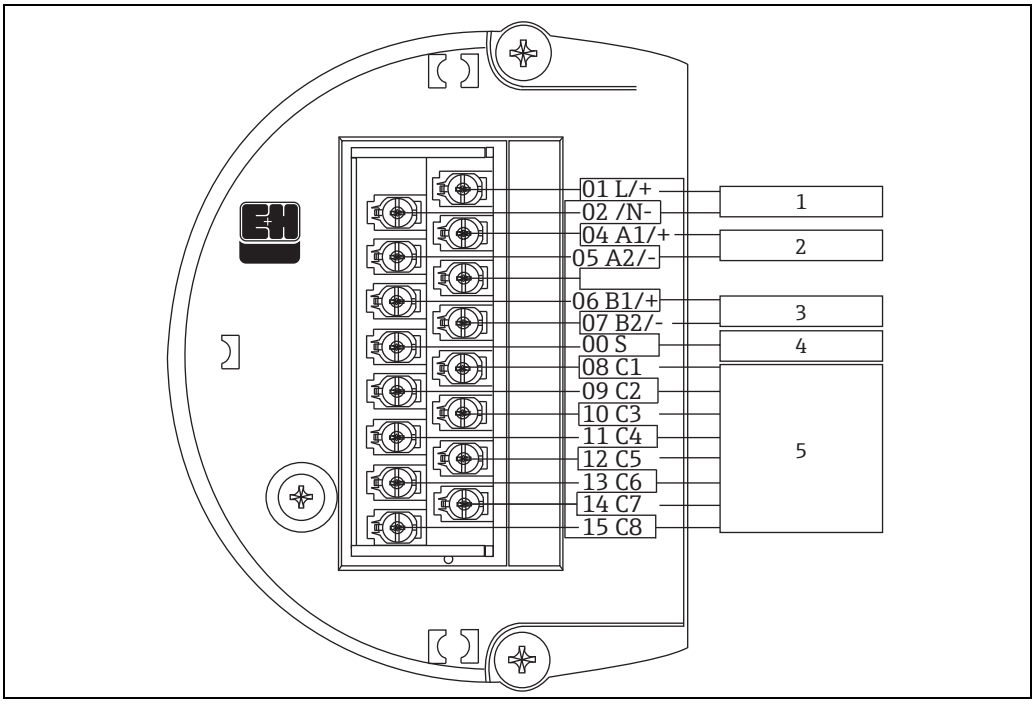


Figure 48: NRF590 terminals (TIIS Ex d)

1. *Power supply*
2. *Digital input/output A*
3. *Digital input/output B*
4. *Cable screened*
5. *Fieldbus protocol and analog input/output*

5 Maintenance

5.1 Periodic inspection

NMT539 requires no special maintenance.
Conduct all-round periodic inspection of equipment wiring etc. once a year as much as possible.

Periodic Inspection Item

- Check terminal parts and body cover loose
- Check damage or deterioration of cable and O-rings
- Check screw of adjustment parts

5.2 Repairs

The Endress+Hauser repair policy is based on the fact that the measuring devices have a modular design and that customers are able to undertake repairs themselves. Spare parts are contained in corresponding kits along with their related replacement instructions. Contact Endress+Hauser service representatives for further assistance regarding service and spare parts.

5.3 Repairs to Ex-approved devices

When performing repairs on Ex-approved devices, note the following:

- Repairs of Ex-approved devices may only be performed by trained personnel or by Endress+Hauser Service.
- Comply with the prevailing standards, national Ex-area regulations, safety instructions (XA) and other relevant rules.
- Only use original spare parts provided by Endress+Hauser.
- When ordering spare parts, note the device information on the nameplate. Replace parts only with parts that have the same device information.
- Perform repairs according to the instructions. When completing repairs, perform the specified routine test on the device.
- Only Endress+Hauser service representatives may convert a certified device into a different certified variant.
- Document all repair work and conversions.

5.4 Replacement

Refer to the separate instruction manual "Operating Instructions and Description of Instrument Function 3 Replacement" for NMT539 replacement.

6 Accessories

6.1 Anchor weight for high profile

This is the anchor weight designed for converter + temperature probe.

Installation of the anchor weight will cause the lowest temperature measurement position to be raised approximately 500 mm (16 in) from the tank floor.
For installing the high profile anchor from a tank top nozzle, confirm that the nozzle opening is 6 inches (150A) or more.

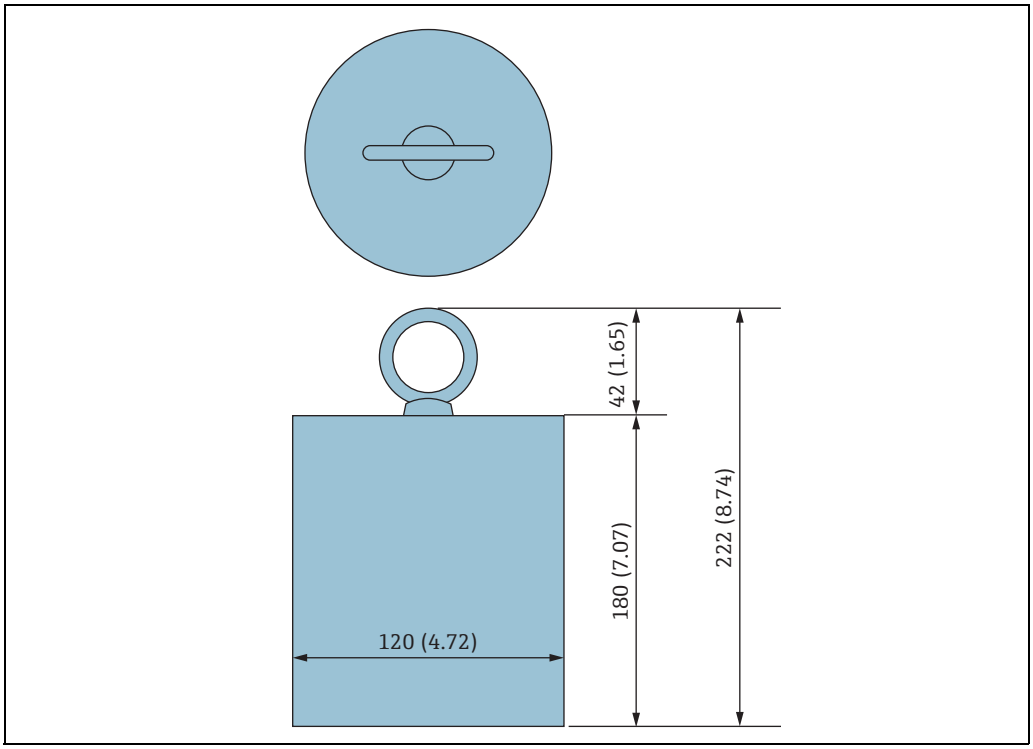


Figure 49: Anchor Weight for High Profile, Option B, Unit of measurement: mm (in)

Different dimensions, weight and material for the anchor weight are also available. Consult with Endress+Hauser representatives for further assistance.

Item	Description
Weight	JIS SS400 (Mild Carbon Steel)
Eye bolt	JIS SS400 (Mild Carbon Steel)
Weight	16 kg

6.2 Anchor weight for low profile

The low profile anchor weight is mainly designed to fix WB (Water Bottom) sensor, securing it straight up without shortening WB measuring range. It is also suitable for an existing tank installation with a small nozzle opening for converter and temperature.

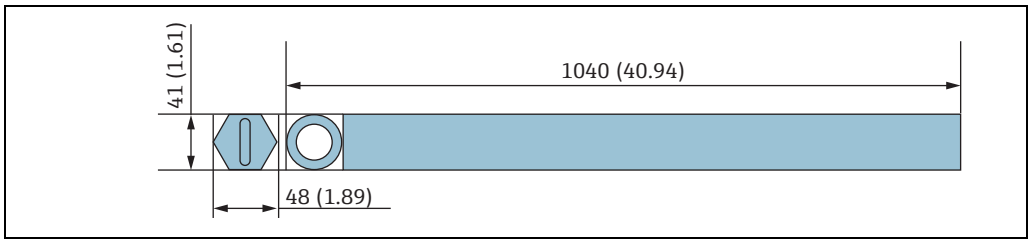


Figure 50: Anchor Weight for low profile, Option C and G, Unit of measurement: mm (in)

Item	Description
Weight	JIS SS400 (Mild Carbon Steel)
Eye bolt	JIS SS400 (Mild Carbon Steel)
Weight	12 kg

6.3 Wire hook

Actual tensioning can be completed with SUS316 stranded 3mm diameter tension wire between the wire hook and the top anchor.

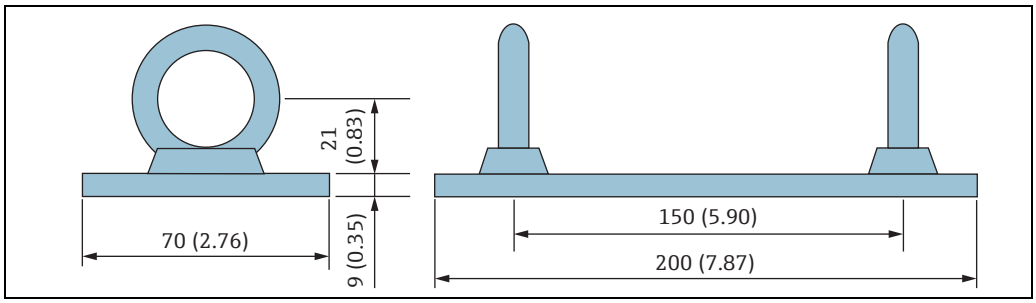


Figure 51: Wire hook, Option D and F, Unit of measurement: mm (in)

Item	Description
Weight	JIS SS400 (Mild Carbon Steel)
Eye bolt	JIS SS400 (Mild Carbon Steel)
Weight	1.5 kg

6.4 Top anchor

The standard process connection of the top anchor is NPT1 or R1 threaded connection. For top anchor and flange, different screw size, material, and special specification can be ordered.

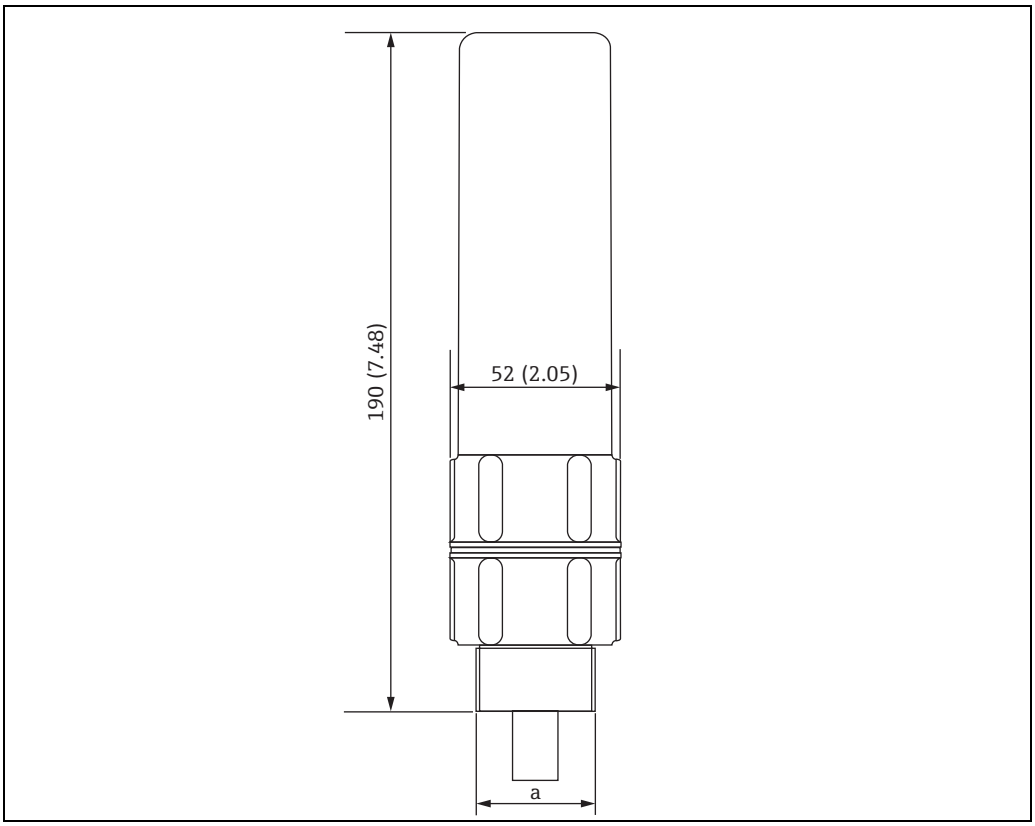


Figure 52: Top anchor dimensions, Unit of measurement: mm (in)

a R1 or NPT1 (specified by order code)

Item	Description
Exterior	ADC (Aluminum)
Internal parts	SUS316, Carbon steel
Weight	1.2 kg

7 Troubleshooting

7.1 System error messages

Code	Text	Description	Action
0	No Error presence	No error	Not necessary.
1	Common line open	Common line is open.	Check the module connector attachment, and check resistance on common (white/black spiral or white/violet spiral) cable to #1 temperature element cable (brown).
3	#1 element open	Temperature element cable (#1) is an open circuit.	Check the module connector attachment, and check resistance on common (white/black spiral or white/violet spiral) cable to #1 temperature element cable (brown).
4	#1 element short	Temperature element cable (#1) is short circuited.	Check the module connector attachment, and check resistance on common (white/black spiral or white/violet spiral) cable to #1 temperature element cable (brown).
5	#2 element open	Temperature element signal cable (#2) is an open circuit.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #2 temperature element cable (red).
6	#2 element short	Temperature element signal cable (#2) is short circuited.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #2 temperature element cable (red).
7	#3 element open	Temperature element signal cable (#3) is an open circuit.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #3 temperature element cable (orange).
8	#3 element short	Temperature element signal cable (#3) is short circuited.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #3 temperature element cable (orange).
9	#4 element open	Temperature element signal cable (#4) is an open circuit.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #4 temperature element cable (yellow).
10	#4 element short	Temperature element signal cable (#4) is short circuited.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #4 temperature element cable (yellow).
11	#5 element open	Temperature element signal cable (#5) is an open circuit.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #5 temperature element cable (green).
12	#5 element short	Temperature element signal cable (#5) is short circuited.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #5 temperature element cable (green).
13	#6 element open	Temperature element signal cable (#6) is an open circuit.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #6 temperature element cable (blue).
14	#6 element short	Temperature element signal cable (#6) is short circuited.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #6 temperature element cable (blue).
15	#7 element open	Temperature element signal cable (#7) is an open circuit.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #7 temperature element cable (violet).
16	#7 element short	Temperature element signal cable (#7) is short circuited.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #7 temperature element cable (violet).
17	#8 element open	Temperature element signal cable (#8) is an open circuit.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #8 temperature element cable (gray).

Code	Text	Description	Action
18	#8 element short	Temperature element signal cable (#8) is short circuited.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #8 temperature element cable (gray).
19	#9 element open	Temperature element signal cable (#9) is an open circuit.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #9 temperature element cable (white).
20	#9 element short	Temperature element signal cable (#9) is short circuited.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #9 temperature element cable (white).
21	#10 element open	Temperature element signal cable (#10) is an open circuit.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #10 temperature element cable (black).
22	#10 element short	Temperature element signal cable (#10) is short circuited.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #10 temperature element cable (black).
23	#0 element over range	The reference temperature element #0 on the module is broken.	Replace the electronic module.
24	Memory defect (ROM)	Program memory malfunction.	Replace the electronic module.
25	#11 element open	Temperature element signal cable (#11) is an open circuit.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #11 temperature element cable (white/brown spiral).
26	#11 element short	Temperature element signal cable (#11) is short circuited.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #11 temperature element cable (white/brown spiral).
27	#12 element open	Temperature element signal cable (#12) is an open circuit.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #12 temperature element cable (white/red spiral).
28	#12 element short	Temperature element signal cable (#12) is short circuited.	Check connector attachment, and check resistance on common (white/black spiral or white/violet spiral) line to #12 temperature element cable (white/red spiral).
29	Element exposed	Liquid level is below #1 element position.	No liquid temperature measurement is available. When liquid level goes over #1 element position, the error disappears.
32	Low power supply	The supply voltage from the host device via the multi drop HART loop is below the specification for Prothermo.	Check the power supply on the host instrument and the consumption of connected HART devices.
33	#13 element open	Temperature element signal cable (#13) is an open circuit.	Check connector attachment on the electronic module, and check resistance on common (white/black spiral or white/violet spiral) line to #13 element line (white/orange spiral).
34	#13 element short	Temperature element signal cable (#13) is short circuited.	Check connector attachment on the electronic module, and check resistance on common (white/black spiral or white/violet spiral) line to #13 element line (white/orange spiral).
35	#14 element open	Temperature element signal cable (#14) is an open circuit.	Check connector attachment on the electronic module, and check resistance on common (white/black spiral or white/violet spiral) line to #14 element line (white/yellow spiral).
36	#14 element short	Temperature element signal cable (#14) is short circuited.	Check connector attachment on the electronic module, and check resistance on common (white/black spiral or white/violet spiral) line to #14 element line (white/yellow spiral).
37	#15 element open	Temperature element signal cable (#15) is an open circuit.	Check connector attachment on the electronic module, and check resistance on common (white/black spiral or white/violet spiral) line to #15 element line (white/green spiral).
38	#15 element short	Temperature element signal cable (#15) is short circuited.	Check connector attachment on the electronic module, and check resistance on common (white/black spiral or white/violet spiral) line to #15 element line (white/green spiral).
39	#16 element open	Temperature element signal cable (#16) is an open circuit.	Check connector attachment on the electronic module, and check resistance on common (white/black spiral or white/violet spiral) line to #16 element line (white/blue spiral).

Code	Text	Description	Action
40	#16 element short	Temperature element signal cable (#16) is an short circuit.	Check connector attachment on the electronic module, and check resistance on common (white/black spiral or white/violet spiral) line to #16 element line (white/blue spiral).
41	Memory defect (RAM)	Data memory malfunction.	Replace the electronic module with new one.
42	Memory defect (EEROM)	Non-volatile data memory malfunction.	Replace the electronic module with new one.
43	WB line open	WB line is an open circuit in the probe.	Replace the module. If the problem is not solved by replacing the module, replace the entire unit.
44	WB line short	WB line is short circuited in the probe.	Replace the electronic module. If the problem is not solved, it is necessary to replace entire unit.

NOTICE These error code will be mainly displayed on FieldCare displays when the tool is properly connected. Method and description of error display on host instrument, refer to documentation of NRF590 or NMS5/NMS7.

7.2 Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Endress+Hauser, as an ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with medium.
To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website at www.services.endress.com/return-material

7.3 Disposal

Observe the following notes during disposal:

- Observe valid federal/national regulations.
- Ensure proper separation and reuse of the device components.

7.4 Software history

Software version/date	Software changes	Documentation changes
V01.41.00 / 2003.10	Original software	BA1025N(Installation Instructions) BA1026N(Operation, function Instructions)
V01.45.00 / 2006.3	Set default to UK element interval, Cu90, multi elements with access code 164	BA1025N (Installation Instructions) BA1026N(Operation, function Instructions)
V01.50.00 / 2008.7	W&M, PTB, Lock function with hardware	BA1026N(Operation, function Instructions)
V01.51.00 / 2011.1	HART ID configuration, FieldCare support updated	BA01026G(Operation, function Instructions)
V01.52.00 / 2014.8	Software update	BA01025G (Installation Instructions) BA01026G(Operation, function Instructions)
V01.53.00 / 2017.7	Software update (improved ave. temp. calculation and right protect switch functionalities)	BA01025G (Installation Instructions) BA01026G(Operation, function Instructions)

8 Technical data

Item	Description
Application	NMT539 performs precise liquid and gas phase average temperature measurement in custody transfer bulk storage tank applications. Along with capacitance water to oil interface measurement probe, complete temperature and WB (BSW) level measurement in crude oil and other bi-layer liquid tank application are accomplished. ▪ Flange: standard 2" flange installation ▪ Measurement range: Max. 99.999m (333.33ft) (ATEX, IECEx, NEPSI), Max. 40.000m (133.33ft) (TIIS, FM C/US) ▪ Up to 1m or 2 m of BSW measurement range
Measuring principle	▪ Temperature Measurement NMT539 consists of platinum characterized temperature element "Pt100" up to 16 elements in SUS316 protection tube. Pt100 has an unique characteristic of linear resistance change across surrounding ambient temperature change. Module in NMT539 converter head receives this resistance signal change as input variable and converts to temperature data. Then, converted and calculated data are transmitted on loop powered local HART signal to designated host instrument ▪ WB (water interface) measurement An attached capacitance level measurement probe detects presence of water. The level of water is converted into given frequency variable (default setting) and its data is transmitted via local HART converter to connected host instrument.
Equipment architecture	▪ RTD average temperature signal to local HART conversion ▪ RTD average temperature measurement + local HART converter ▪ Average temperature & Water interface measurement + local HART converter
Measured variable	▪ Temperature Measuring Range: – Temperature conversion: -200 to +235 °C (-328 to +455 °F), (-170 to +235°C TIIS) RTD signal – Standard: -40 to +100°C (-20 to +100°C TIIS) – Wide range: -55 to +235°C (-20 to +235°C TIIS) – Cryogenic: -170 to +60°C – Probe length: 99.999m (333.33ft) (ATEX, IECEx, NEPSI), Max. 40.000m (133.33ft) (TIIS, FM C/US) ▪ Water Interface Level (Water Bottom) Range – Standard: 1m or 2m (3.3 or 6.6 ft)
Output signal	local HART protocol
Signal on alarm	Error information can be accessed via the following interfaces and transmitted digital protocol (refer to "Prothermo NMT539 Operating Instructions and Description of Instrument Function" for the following instruments) ▪ NRF590 (BA00256F, BA00257F) ▪ NMS5 (BA00401G) ▪ NMS8 (BA1456G, BA1459G, BA1462G)
Load HART	Minimum load for local HART communication: 250 Ω
Cable entry	▪ Thread G1/2 ▪ Thread NPT1/2 ▪ Thread M20
Supply voltage	16 to 30VDC: Ex ia DC20 to 24V: TIIS Ex d [ia]
Current consumption	▪ Ex ia: 6mA (temperature measurement)/12mA (WB measurement) ▪ Ex d [ia]: 8mA (temperature measurement)/14mA (WB measurement)
Reference operating conditions	▪ Temperature = +25 °C (77 °F) ±5 °C (9 °F) ▪ Pressure = 1013mbar abs. ±20mbar abs. (1013hPa abs. ±20hPa abs., 14.7psi abs. ±0.3psi abs.) ▪ Relative humidity (air) = 65% ± 20% (Linearity)
Maximum measured error	Typical statements for reference conditions, include linearity, repeatability, and hysteresis: ▪ Linearity: – Temperature: ±0.15°C (0.27°F) + value of element deviation (based on IEC 60751/ DIN EN 60751) Standard class A: ± (0.15 + 0.002 x ltl) PTB class 1/10 B: ± (0.3 + 0.005 x ltl)/10 – WB: ±2mm
Ambient temperature	▪ -40 °C to +85 °C (-40°F to +185°F) ▪ -20 °C to +60 °C (-4°F to +140°F) for TIIS

Item	Description	
Storage temperature	-40 °C to +85 °C (-40 °F to +185 °F)	
Climate class	DIN EN 60068-2-38 (test Z/AD)	
Degree of protection	▪ IP66/68 NEMA4X/6P: Temperature and converter are installed. ▪ IP 65 NEMA4X: Converter only (Open housing: IP20)	
Electromagnetic compatibility	When installing the probes in metal and concrete tanks and when using a coax probe: ▪ Interference Emission to EN 61326, Electrical Equipment Class B ▪ Interference Immunity to EN 61326, Annex A (Industrial)	
Temperature range	▪ -40 to +85 C° (-40 to +185°F) ▪ -20 to +60 C° (-4 to +140°F) for TIIS	
Pressure limit	Atmosphere pressure (Absolute pressure 1 bar, 100 kPa, 14.5 psi) ⚠ CAUTION ▪ Pressurized tank: When using a pressurized tank that exceeds this process pressure, install a thermowell that does not have any holes or slits for the NMT539 to protect the probe from the high pressure inside the tank. ▪ Static head pressure: Since NMT539 has been tested for air-tightness under an absolute pressure of 7 bar, it is capable of withstanding static head pressure at the 50 m (meter) level in petrochemical product applications.	
Data transmission	2.5mm coaxial cable & common ground	
Weight	▪ Approx. 13 kg ▪ Condition: 16 elements ▪ Temp. probe: 10 m ▪ WB sensor: 1 m ▪ Flange: 2" 150lbs RF, SUS316	
Material	▪ Elements: Class A Pt100, IEC 60751/DIN EN 60751/ JIS C1604 ▪ Housing: Aluminum die cast ▪ Temp probe: SUS316 flexible tube ▪ WB sensor: SUS316 (center rod SUS 304 & PFA protected)	
Process connection	▪ 10K 50A RF, 316, flange JIS B2220 ▪ NPS 2" Cl.150 RF, 316 flange ASME B16.5 ▪ DN50 PN10 B1, 316, flange EN1092-1 (DIN2527 B) ▪ 50A 150lbs RF, 316, flange JPI 7S-15 ▪ Universal coupling, G3/4, (Converter only) ▪ Thread M20 (converter only) ▪ Special, TSP-no. to be spec.	
Ex approval	ATEX	II 1/2 G Ex ia IIB T2 - T6 Ga/Gb (converter with temperature and/or WB) II 2G Ex ia IIB T2 - T6 Gb (converter only)
	IEC	Ex ia IIB T2 - T6 Ga/Gb (converter with temperature and /or WB) Ex ia IIB T2 - T6 Ga/Gb (converter only)
	NEPSI	Ex ia IIB T2 - T6 (converter with temperature and /or WB) Ex ia IIB T2- T6 Ga (converter only)
	FM C/US	Converter with temperature or WB IS Cl. I, Div. 1, Gr. C, D T2-T6 IS Cl. I, Zone 0, AEx ia IIB Ga T2-T6 NI Cl. I, Div. 2, Gr. C, D T2-T6
		Converter only IS Cl. I, Div. 1, Gr. C, D T4 IS Cl. I, Zone 0, AEx ia IIB Ga T4 NI Cl. I, Div. 2, Gr. C, D T4
	TIIS	Ex ia IIB T4 (Converter with temperature or WB) or (Converter only)
		Ex ia IIB T2 (Converter with temperature)
		Ex d[ia] IIB T4 (Conveter with temperature or WB)

9 Appendix

9.1 Description of functions

A detailed description of the function groups, functions and parameter is given in the documentation "Operating Instructions and Description of Instrument Functions" for NMT539.

When NMT539 with WB probe and NRF590 are used together, confirm that the supply voltage to TMD1, NMS, TGM, or NRF590 is stable at a voltage of 100VAC or more.

9.2 Function and system design

9.2.1 NMT539 Ex ia and NMS8 and NM5 Ex d [ia] combination

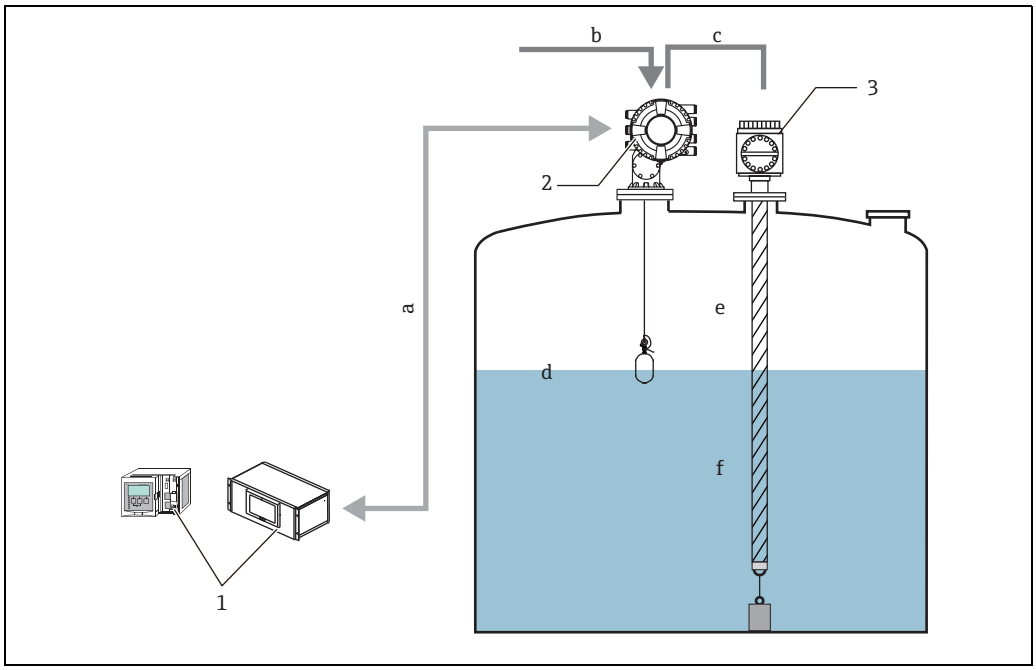


Figure 53: System layout NMT539 with NMS8x

a *Filedbus protocol*
b *Power supply*
c *Local HART (Ex i) loop power communication (Data transmission)*
d *Liquid level*
e *Gas temperature*
f *Liquid temperature*
1. *Tankvision*
2. *NMS8x*
3. *NMT539*

The connection of NMT539 shown above is only available to connect with NMS5 or NMS8x.

NMT539 Converter + temperature typical installation

NMT539 is the successor of the former NMT535, and inherits all the functionality and specifications of NMT535 including connection flange specifications, cable entries and wiring method.

Since NMS5 or NMS8x already provides water bottom measurement, they can be used in combination with the NMT539 converter + average temperature probe. When the converter + WB + average temperature version is used in combination with NMS5 or NMS8x, the level, continuous average temperature, and water bottom measurement of the liquid in the tank can be measured at the same time.

Most configuration and parameter settings for NMT539 can be performed via NMS5 or NMS8x. NMT539 receives liquid level data from NMS5, then calculates liquid and gas phase average temperature. The average temperature data of liquid phase and gas phase will be transferred to NMS5 or NMS8x together with the measured temperature at each temperature element and the status information of NMT539.

All of the data collected by field interface units is transmitted to the inventory management software (Tankvision) via NM8x, NMS5, NMS7, NMR8x, NRF8x, or NRF590.

9.2.2 NMT539 Ex ia and NMR8x Ex d [ia] combination

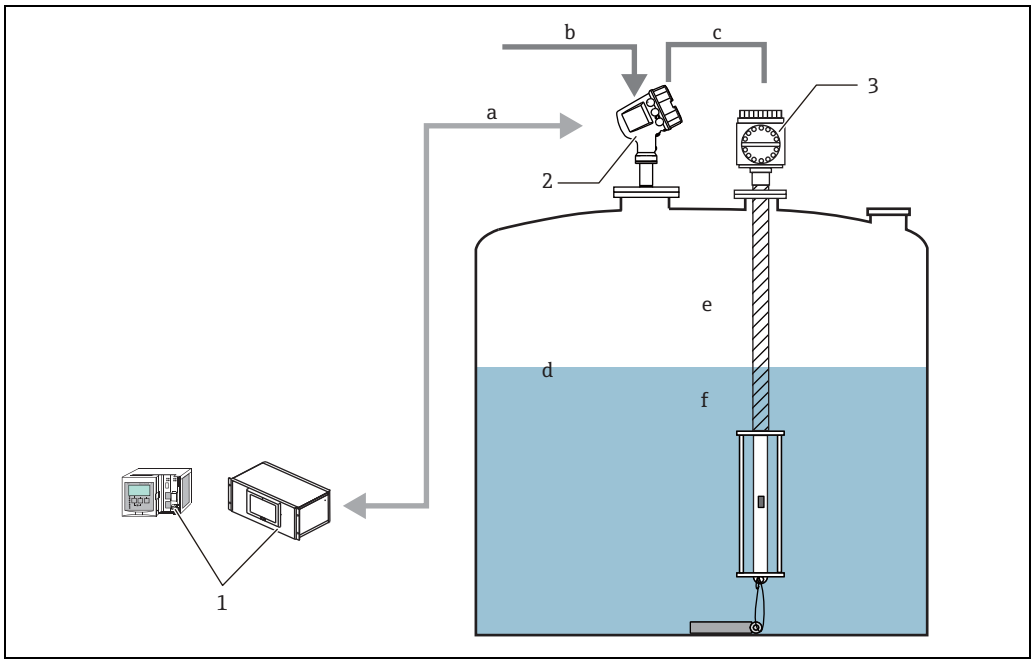


Figure 54: System layout NMT539 with NMR8x

a *Filedbus protocol*
b *Power supply*
c *Local HART (Ex i) loop power communication (Data transmission)*
d *Liquid level*
e *Gas temperature*
f *Liquid temperature*
1. *Tankvision*
2. *NMR8x*
3. *NMT539*

The connection of NMT539 shown above is only available to connect with NMR8x Ex d [ia].

When using FMR5xx Ex ia radar, NRF81 is required to connect FMR5xx and NMT539 as a gate way to Tankvision.

9.2.3 NMT539 Ex ia and NRF81 Ex d [ia] combination

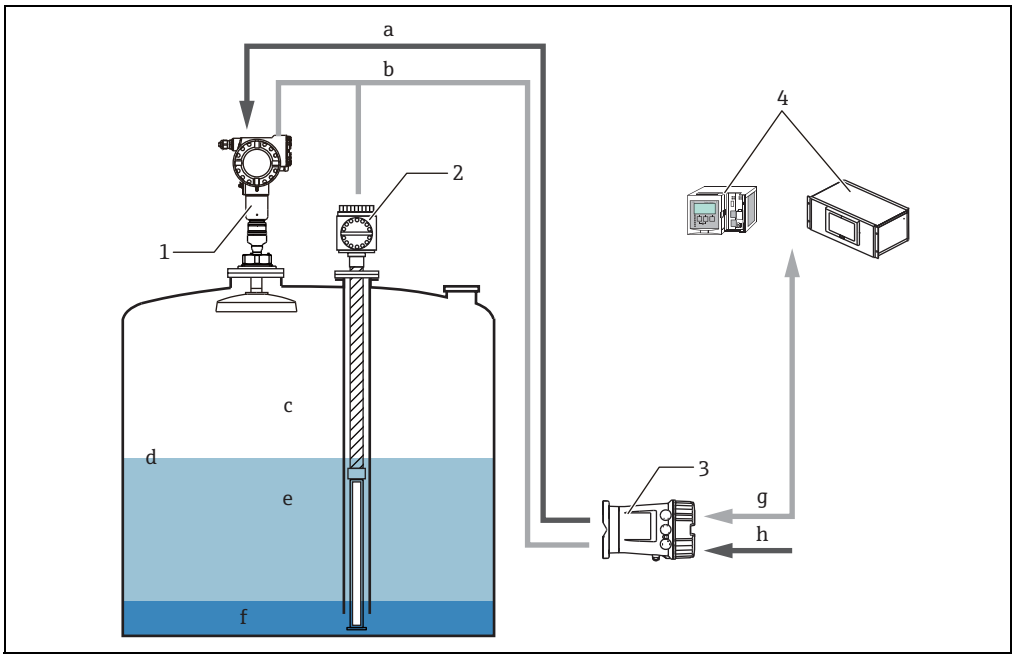


Figure 55: System layout NMT539 Ex ia + NRF81 Ex d [ia]

a *FMR power supply (DC/Exi)*
b *Local HART (Ex i) communication (Data transmission)*
c *Gas temperature*
d *Liquid level*
e *Liquid temperature*
f *Water*
g *Filedbus protocol*
h *Power supply*
1. *FMR540*
2. *NMT539*
3. *NRF81/NRF590*
4. *Tankvision*

NMT539 Converter + temperature + water bottom sensor installation

NMT539 converter + temperature + WB version is optimal for combination with radar. For optimal inventory management, NMT539 can collect data via NRF590 or NFR81 and calculate it, while performing WB measurement, temperature measurement, and liquid level measurement. NMT539's detailed functions and data can be accessed from NRF81 or NRF590. NMT539 receives radar meter level data from NRF590 or NRF81, and calculates the average temperature of the liquid and gas phases. The liquid and gas phase average temperature data is transmitted to NRF81 or NRF590 together with the measured temperature at each temperature element and the status information of NMT539.

All of the data collected by field interface units is transmitted to the inventory management software (Tankvision) via NM8x, NMS5, NMS7, NMR8x, NRF8x, or NRF590.

9.2.4 NMT539 Ex d [ia] and TMD1 Ex d combination

NMT539 can be connected with transmitter TMD1 or Servo gauge TGM5 via local HART (Ex d) communication. Local HART communication, a digital communication method, which enables larger volume of information transfer compared to the traditional simple RTD method, allows NMT539 to work with NRF560 for DRM9700.

When NMT539 with WB probe and NRF590 are used together, confirm that the supply voltage to TMD1 is stable at a voltage of 100VAC or more.

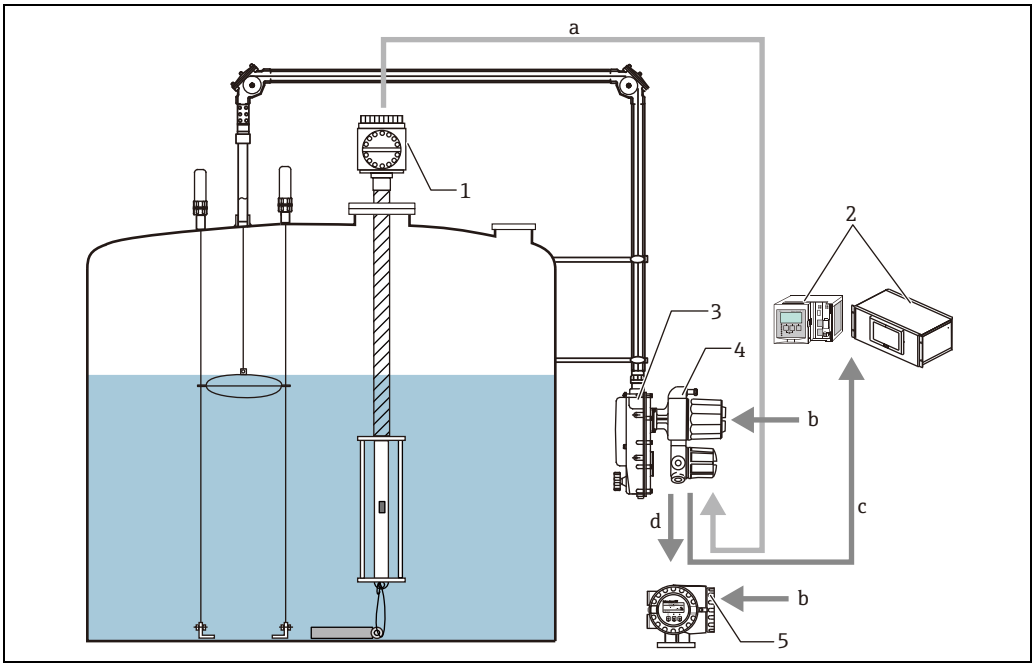


Figure 56: System layout NMT539 Ex d [ia] + TMD1 Ex d

a *Local HART (Ex d) communication (Data transmission)*
b *Power supply*
c *Fieldbus protocol*
d *HART (Ex d) communication (Data transmission)*
5. *NMT539*
6. *Tankvision*
7. *LT5*
8. *TMD1*
9. *NRF560*

9.2.5 NMT539 Ex d [ia] and TGM5 or NMS5 combination

When NMT539 with WB probe and NRF590 are used together, confirm that the supply voltage to TGM5 is stable at a voltage of 100VAC or more.

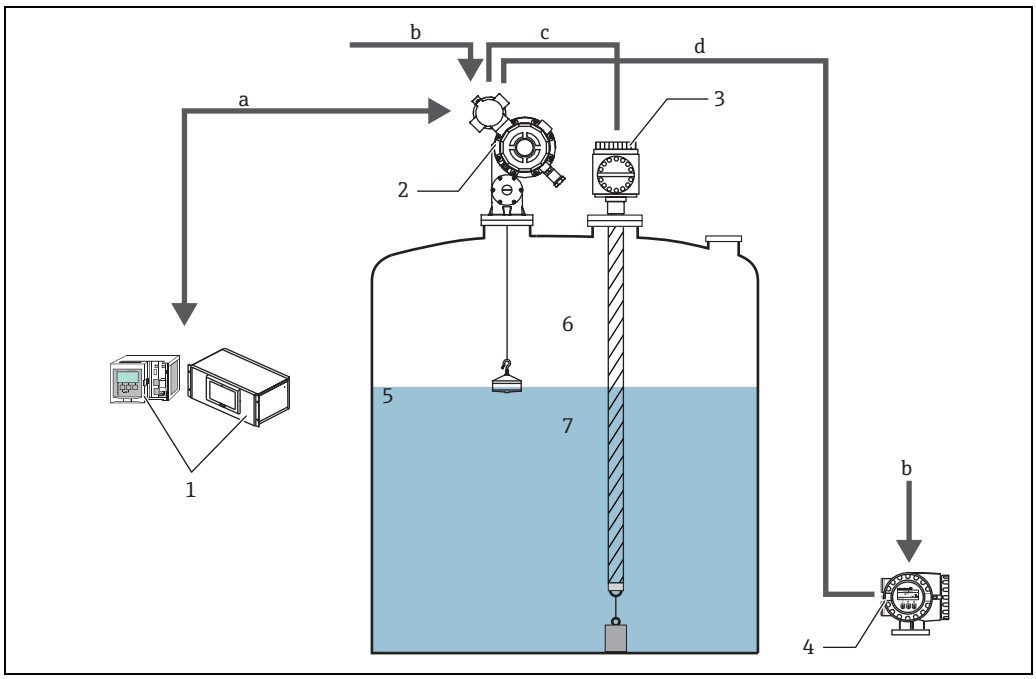


Figure 57: System layout NMT539 Ex d [ia] + TGM5 Ex d

a *Filedbus protocol*
b *Power supply*
c *Local HART (Ex d) communication (NMT539 and TGM5)*
d *Local HART (Ex d) communication (TGM5 and NRF560)*
10. *Tankvision*
11. *TGM5*
12. *NMT539*
13. *NRF560*
14. *Liquid*
15. *Gas temperature*
16. *Liquid temperature*

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