

# Technical Information

## Prothermo NMT539

Intrinsically Safe Multi-signal Converter with Precision Average Temperature and Water Bottom Sensor for Inventory Control and Custody Transfer Applications



### Application

Prothermo NMT 539 is based on API (American Petroleum Institute) Manual of Petroleum Measurement Standard, Chapter 7, and enables high accuracy temperature measurement. At the same time, it is an intelligent average temperature sensor for tank gauging with an optional WB capacitance sensor at the bottom of the temperature probe.

For average temperature measurement, it consists of precision multi-spot Pt100 elements.

NMT539 is a highly capable solution that provides both constant average temperature data and water interface data via local HART communication.

For accurate inventory measurement, it is best suited connected to Endress+Hauser's Proservo NMS5/NMS7 or Tank Side Monitor NRF590 with Micropilot radar.

### Features and Benefits

- 2-wire local HART communication is employed and complete digital design without data transmission error is used.
- Intrinsically safe device allowing for the safest electrical configuration possible
- Available in three different versions based on customer requirements:
  - Converter Only
  - Converter and Temperature probe
  - Converter, temperature and water bottom (WB) probe
- Converter is compatible with Pt100, Cu90, and PtCu100.
- Variety of process connections and cable entries available to meet worldwide classifications.

# Table of Contents

<b>Important Document Information</b> .....	<b>4</b>	<b>Operating Condition: Environment and Process</b> .....	<b>17</b>
Notes on Safety Conventions and Symbols .....	4	Ambient Temperature Range .....	17
<b>Function and System Design</b> .....	<b>5</b>	Storage Temperature .....	17
System Design .....	5	Climate Class .....	17
System Design 2 .....	6	Degree of Protection .....	17
NMT539 Ex ia and NMS5 Ex d [ia] Combination .....	7	Electromagnetic Compatibility .....	17
NMT 539 Converter + Temp. Probe Version .....	7	Process temperature Range .....	17
NMT539 Ex ia and NRF590 Ex d [ia] Combination .....	8	Process Pressure Limits .....	17
NMT 539 Converter + Temp. + WB version .....	8	Data Transmission .....	17
NMT539 Ex d [ia] and TMD1 Combination .....	9	<b>Operating Condition: Installation</b> .....	<b>18</b>
NMT539 Ex d [ia] and TGM5 or NMS5 Combination .....	9	Cable Grands .....	18
NMT539 TIIS Ex ia (High Temp.) and		Process Connection .....	18
NMS5 Ex d Combination .....	10	Height Adjustment for NMT539 .....	18
Installation to Fixed Roof Tank .....	10	WB Blocking Distance .....	18
Installation to Floating Roof Tank 1 .....	11	Recommended Installation Height .....	19
Installation to Floating Roof Tank 2 .....	11	Recommended Stilling Well Installation .....	20
Installation to Floating Roof Tank 3 .....	12	Installation Equipment .....	20
Application for Pressurized Tank .....	13	Mounting Attachment -1 .....	21
<b>Input and Output</b> .....	<b>14</b>	Mounting Attachment-2 .....	22
Measured Variables .....	14	#1 Element Position of NMT539 .....	23
Compatible Element (Converter Only Version) .....	14	Anchor Weight Method .....	23
Number of Elements .....	14	<b>Operating Condition: Wiring</b> .....	<b>24</b>
Communication .....	14	TIIS Ex d [ia] Wiring .....	24
Alarm Signal .....	14	Grounding Cable Construction (TIIS Ex d [ia]) .....	24
Output Signal .....	14	Connecting Diagram (TIIS Ex d [ia]) .....	25
Connection .....	14	<b>Operating Condition: Terminal Connection</b> .....	<b>26</b>
<b>Auxiliary Energy</b> .....	<b>15</b>	Ex ia NMT539 Terminal .....	26
Load HART .....	15	ATEX, IECEx FM, CSA, NEPSI Ex d [ia] NMS5 Terminal .....	26
Overtoltage Protection .....	15	TIIS Ex d [ia] NMT539 Terminal .....	27
Supply Voltage .....	15	Ex d NMS5 Connection .....	27
Power Consumption .....	15	TGM5/TMD1 Terminal .....	28
<b>Performance Characteristics</b> .....	<b>16</b>	Terminal Connection of NRF590 .....	28
Temperature Accuracy .....	16		
WB Accuracy .....	16		
Reference Operating Conditions .....	16		
Maximum Measured Error .....	16		
New Module .....	16		
All-in-one Program .....	16		





# Table of Contents

<b>Mechanical Construction</b> .....	<b>29</b>	<b>Certificates and Approvals</b> .....	<b>36</b>
Type 1: Converter Only Version .....	29	CE Mark .....	36
Type 1: Measuring Function .....	29	Ex Approvals .....	36
Type 1: Converter Only Version .....	30	PTB W&M Approval .....	36
Type 2: Measuring Function .....	30	External Standards and Guidelines .....	36
Converter + Average Temperature Probe Version .....	30	<b>Order Information</b> .....	<b>37</b>
Measuring Function .....	31	<b>Accessories</b> .....	<b>39</b>
W&M Function .....	31	Anchor Weight (High Profile, D120) .....	39
Converter + Average Temperature Probe + WB Probe Version .....	32	Anchor Weight (Low Profile, Hexagon H41) .....	39
Measuring Function .....	32	Wire Hook, Top Anchor .....	40
WB Probe Design .....	33	<b>Documentation</b> .....	<b>41</b>
Welding Flange Type .....	33	Technical Information .....	41
Protective Cover for TIIS Exd [ia] .....	34	Operating Instructions .....	41
Weight .....	34	Certificates .....	41
Material .....	34	<b>Appendix</b> .....	<b>42</b>
<b>Human Interface</b> .....	<b>35</b>	Stainless Steel Conversion Table .....	42
Operation Using FieldCare .....	35		





## Important Document Information

### Notes on Safety Conventions and Symbols

#### Symbols for Safety Conventions

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

#### Symbols for Certain Types of Information

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

## Function and System Design

### System Design

NMT 539 is available in three different versions:

- Converter Only
- Converter + Average Temperature Probe
- Converter + Average Temp Probe + Water Bottom Probe

The converter only version can be retrofitted without modifications onto existing third party average temperature probes, such as Whessoe Varec 9909 and 1700 and Weed Beacon MW type probes. The average temperature probe + converter inherits all the functionality of the former NMT 535/536/537 series. The average temperature + WB + converter is the ultimate multi-function sensor, transmitting temperature and water interface level data along only one pair of local HART signal cables to the host NMS5, Servo gauge TGM5, Digital Transmitter TMD1or Tank Side Monitor NRF 590.

### NMT 539 + WB Operation Principle (Converter + Temp + WB probe version)

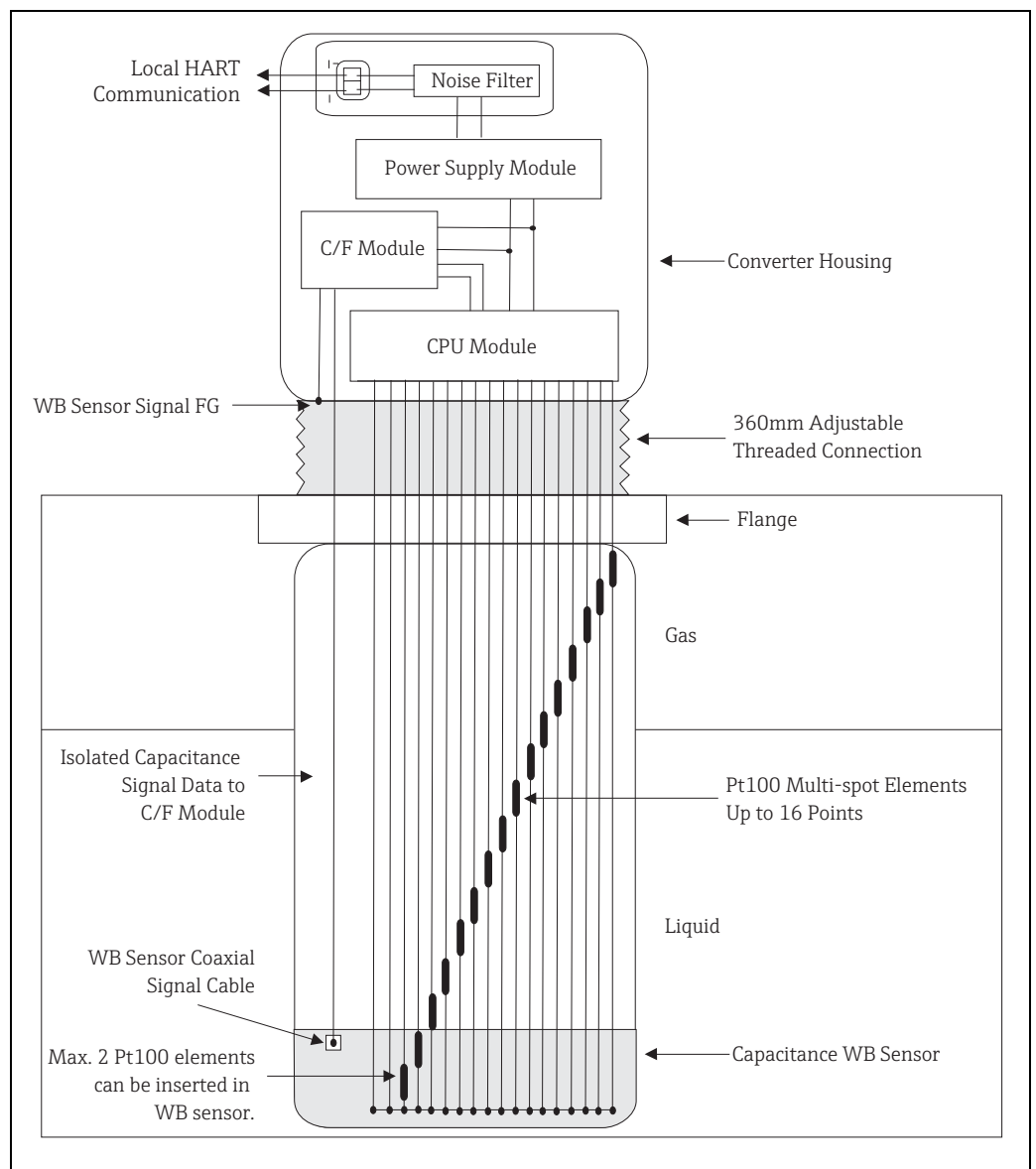


Figure 1: NRF560 System Configuration

**NOTICE**

Each type of NMT 539 including converter only or converter + average temperature are simplified versions for combination of converter + average temperature probe + WB (Water Bottom) Probe.

## System Design 2

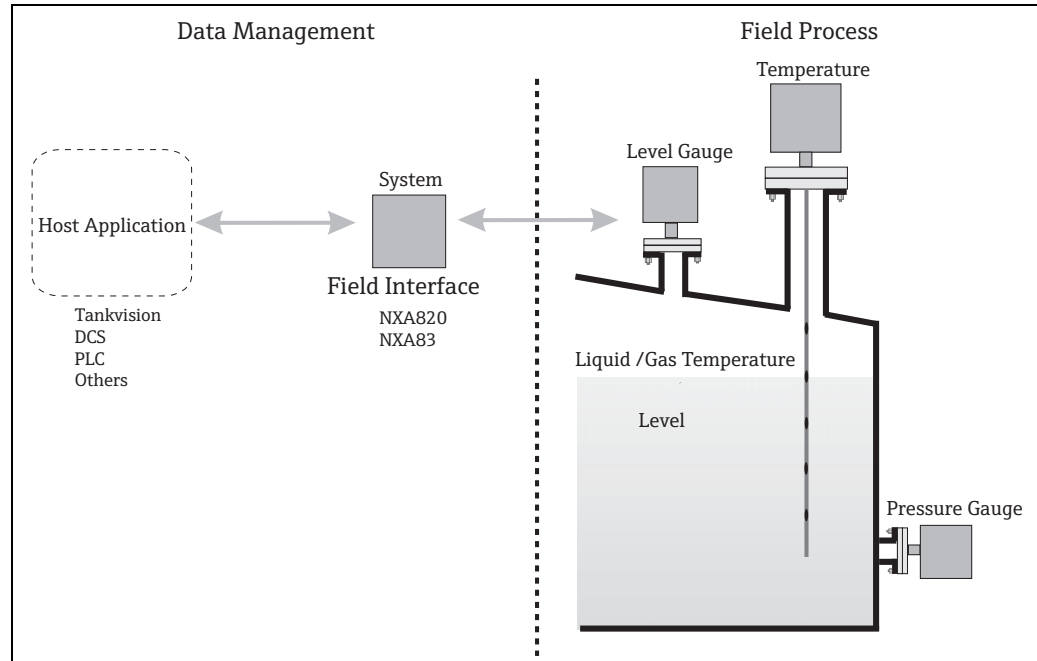


Figure 2: System Diagram

Endress+Hauser offers a wide range of solutions to integrate field data into the process management requirement.

The diagrams above describe some individual solutions according to various Ex concepts. For additional application requirements, contact local Endress+Hauser representatives.

### NMT539 Ex ia and NMS5 Ex d [ia] Combination

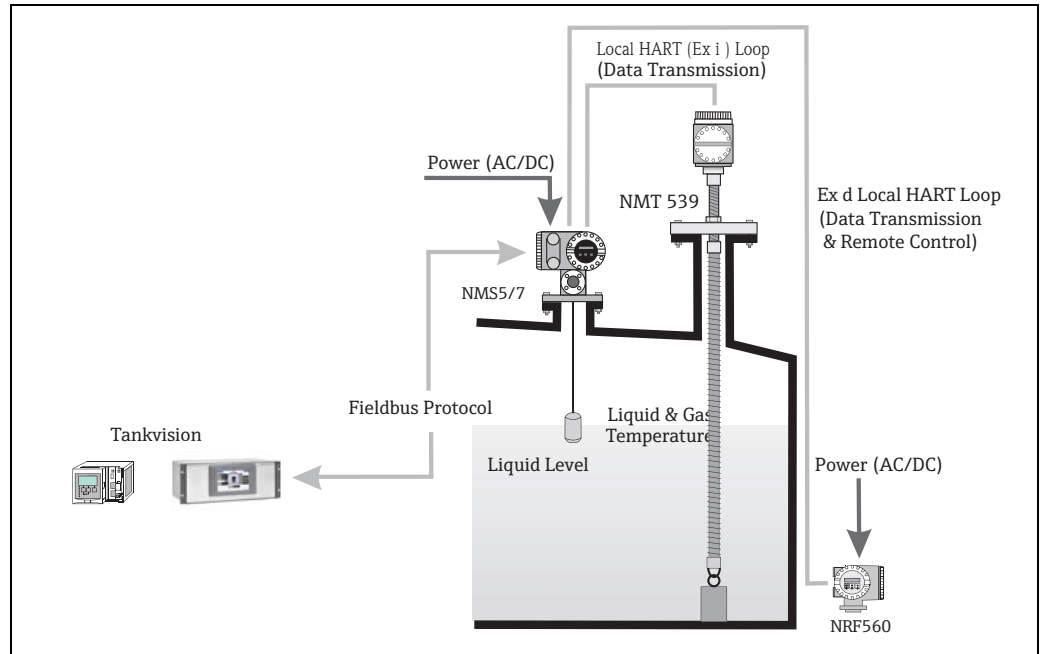


Figure 3: System Diagram with NMS5

#### NOTICE

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

### NMT 539 Converter + Temp. Probe Version

NMT 539 is the successor of the former NMT 535 Ex i version. For proper migration, NMT 539 has inherited all the functionality and specifications of NMT 535 including process connections, cable entries and wiring method.

Since NMS5 already provides water interface measurement, NMT 539 converter + average temperature may be the best version when used in combination with NMS5. When the converter + WB + average temperature version is used in combination with NMS5, the product in the tank will be thoroughly managed with level, continuous average temperature, and water interface measurement.

Most configuration and parameter settings for NMT539 can be performed via NMS5 programming matrix.

NMT 539 receives liquid level data from NMS5, then calculates liquid and gas phase average temperature. Calculated data and basic information including raw data for each temperature element and device status are transmitted to NMS5.

#### NOTICE

- Since NMS5 is a multi-functional device (measurement and data transmission), NRF 560 acts as a tank side remote data indicator and tank gauge operation terminal for NMS5.
- All gathered data in the field interface unit is sent to inventory management software, such as Endress+Hauser's Tankvision, Fuelsmanager, Tank computer or directly sent to the customer's specific DCS or PLC.

**NMT539 Ex ia and NRF590  
Ex d [ia] Combination**

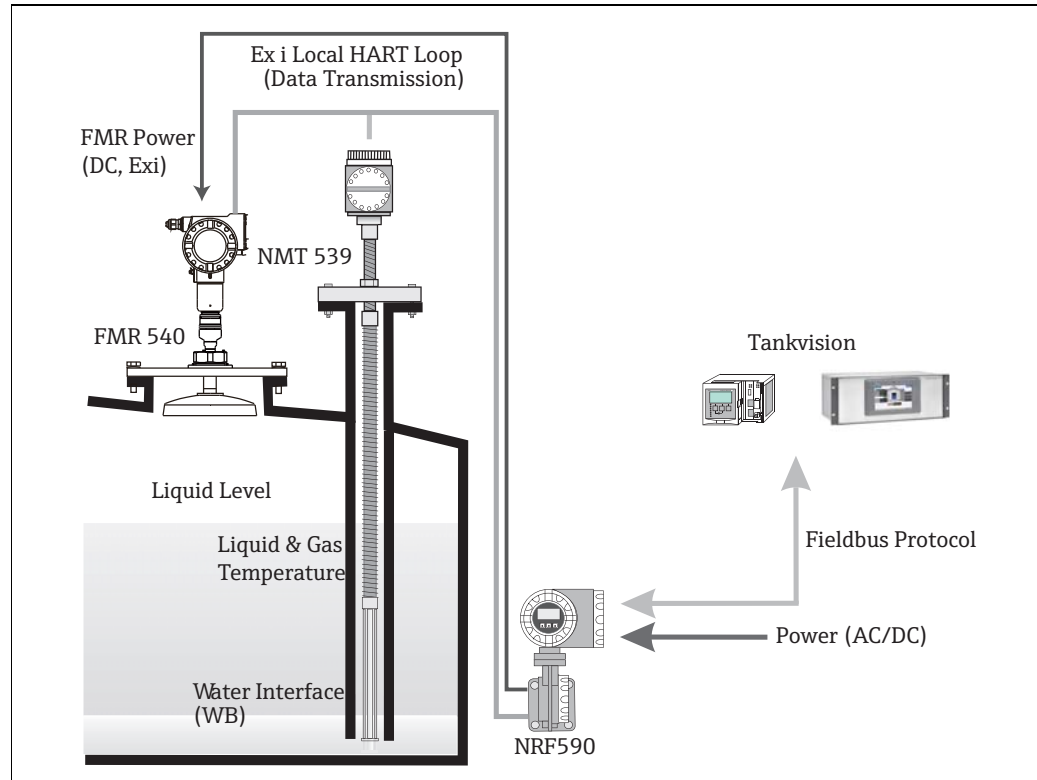


Figure 4: System Diagram with NRF590

**NMT 539 Converter + Temp.  
+ WB version**

NMT 539 Converter + Temp. + WB is utilized effectively in combination with radar level gauging. Water interface, temperature and level measurement, with data collection and calculations via the NRF 590, allow for optimal inventory control. Basic functionality of NMT 539 is displayed and configured on NRF 590. Detailed NMT 539 functionality and data access can be performed by FieldCare.

NMT 539 receives radar level data from the NRF 590 and then calculates liquid and gas phase average temperature. Calculated and standard data including temperature element raw data and device status are transmitted to NRF 590.

All gathered data in the field interface unit is sent to inventory management software, such as Endress+Hauser's Tankvision, Fuelsmanager, tank computer or directly sent to the customer's specific DCS or PLC.



**NMT539 Ex d [ia] and TMD1 Combination**

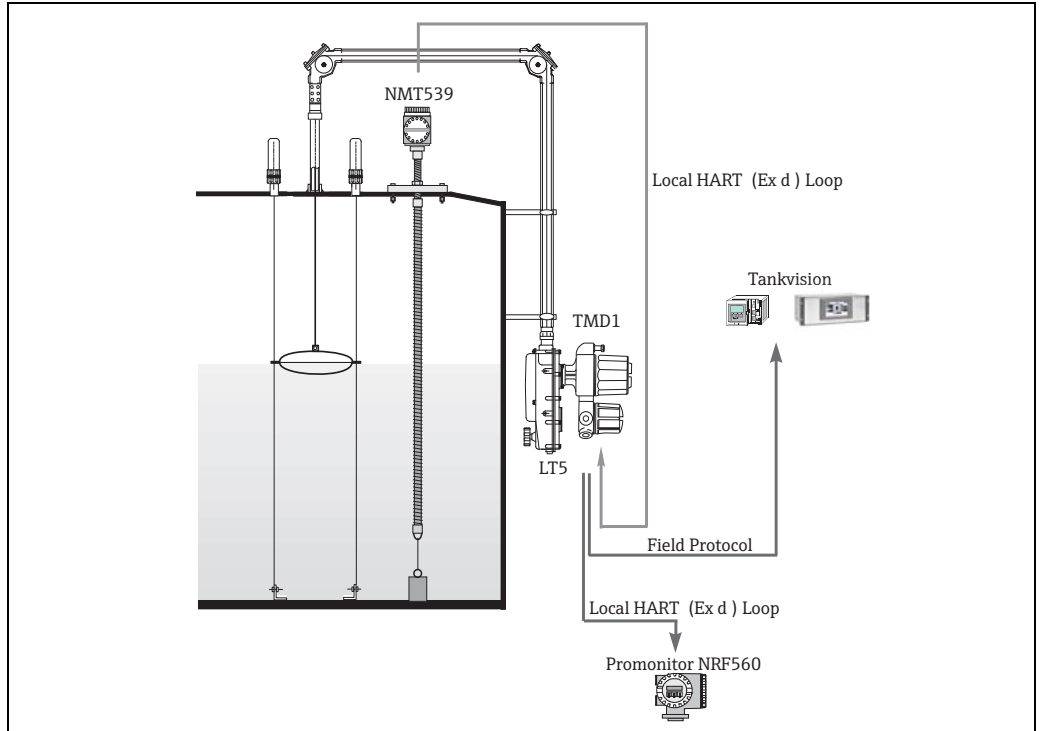


Figure 5: System Diagram with TMD1

Average temperature data is transmitted to transmitter TMD1 via local HART communication.

**⚠ CAUTION**

If NMT539 WB probe and NRF560 are used together, confirm that the supply voltage to TMD1 is stable at 100 VAC or more.

**NMT539 Ex d [ia] and TGM5 or NMS5 Combination**

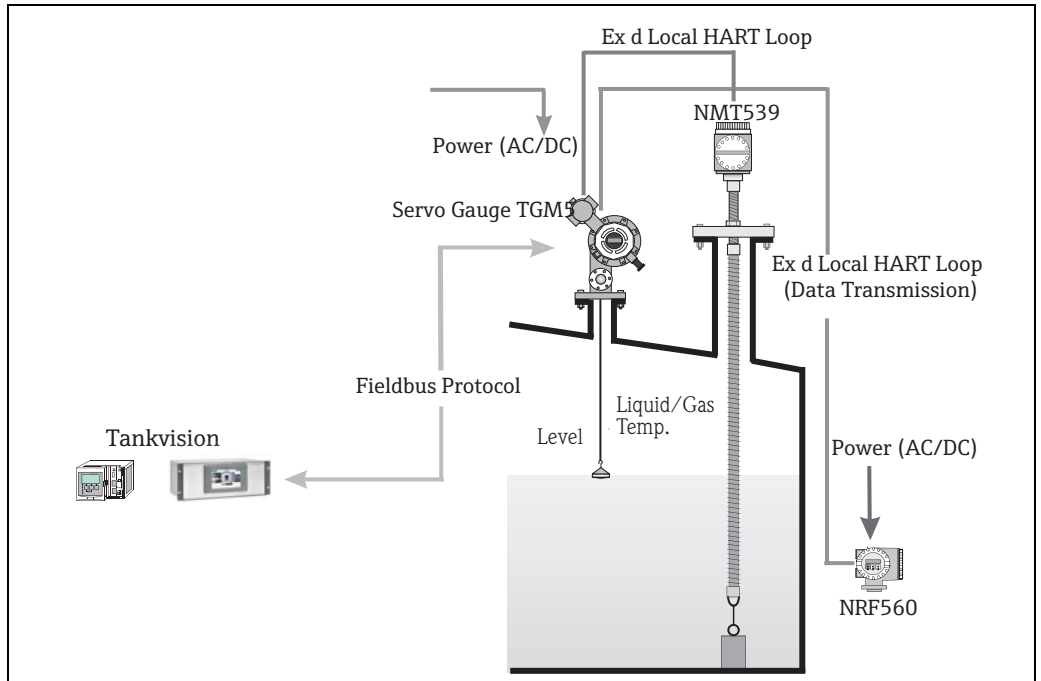


Figure 6: System Diagram with TGM5 or NMS5/NMS7

**⚠ CAUTION**

If NMT539 WB probe and NRF560 are used together, confirm that the supply voltage to TGM5 is stable at 100VAC or more.

**NMT539 TIS Ex ia (High Temp.) and NMS5 Ex d Combination**

NMT539 high temperature specification (application more than 100°C) is Ex i output. When using NMT539 with NMS5/NMS7, Barrier Box NAB560 is required.

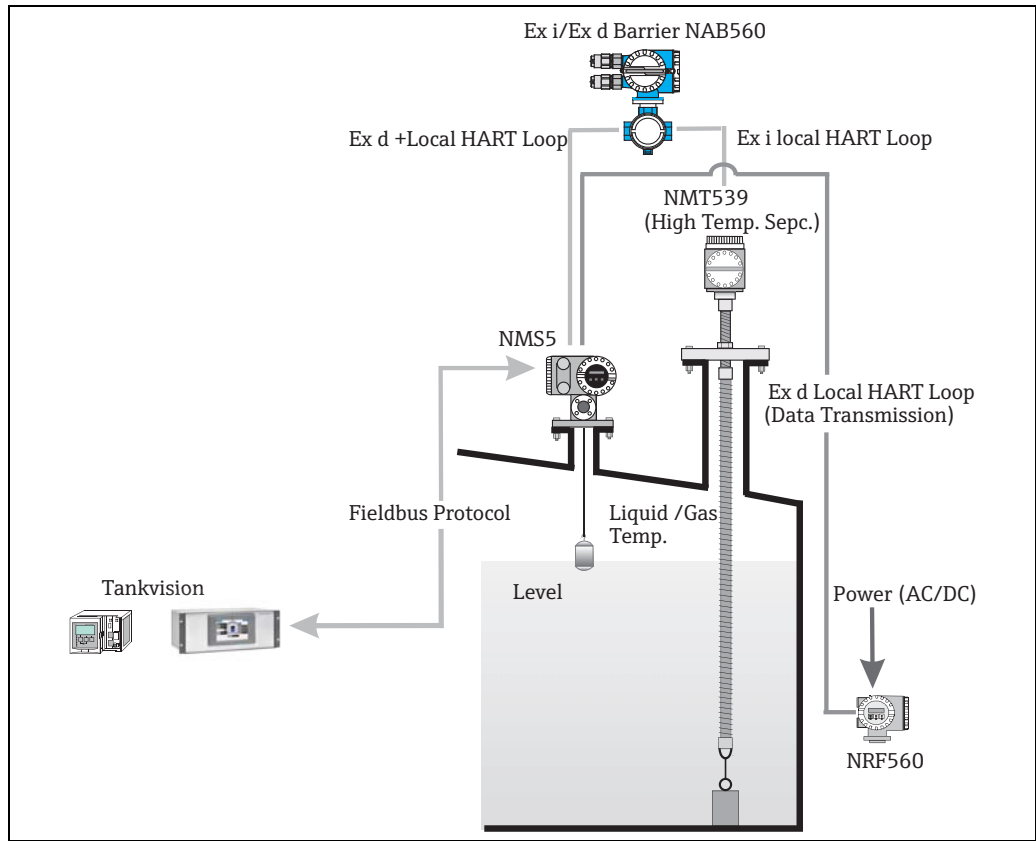


Figure 7: System Diagram with NMS5/NMS7 and NMT539

**Installation to Fixed Roof Tank**

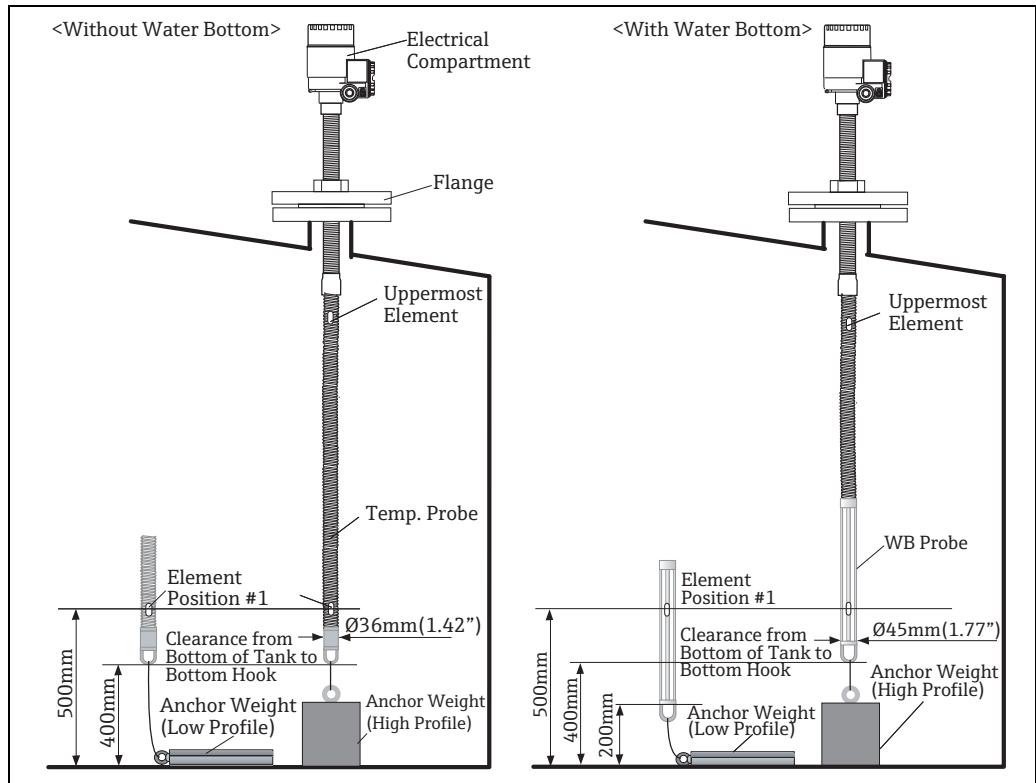


Figure 8: Fixed Roof Tank

**Installation to Floating Roof Tank 1**

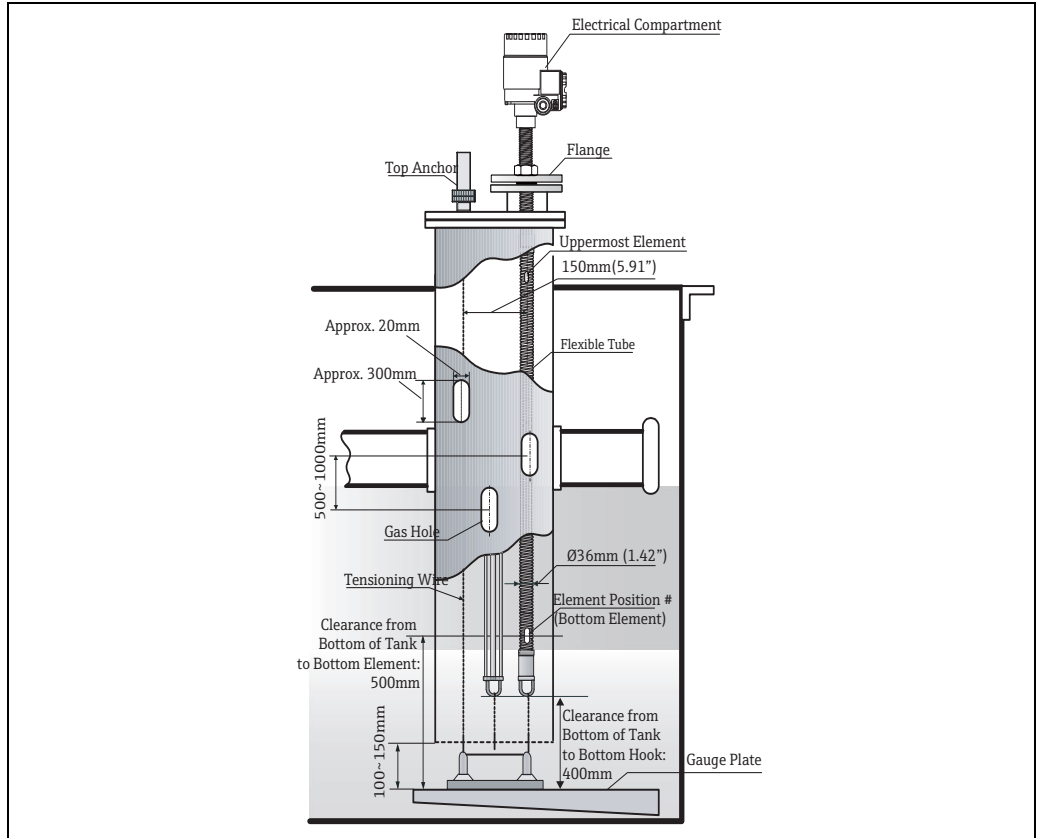


Figure 9: Floating Roof Tank 1

**Installation to Floating Roof Tank 2**

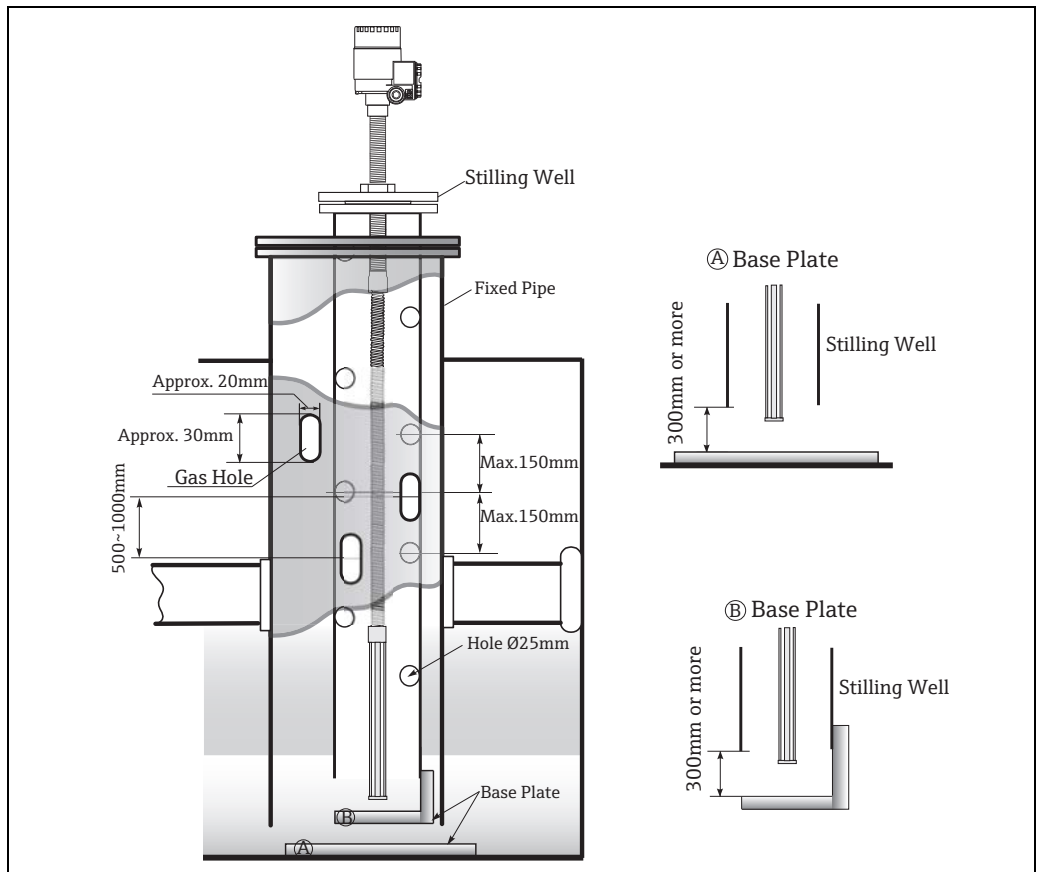


Figure 10: Floating Roof Tank 2

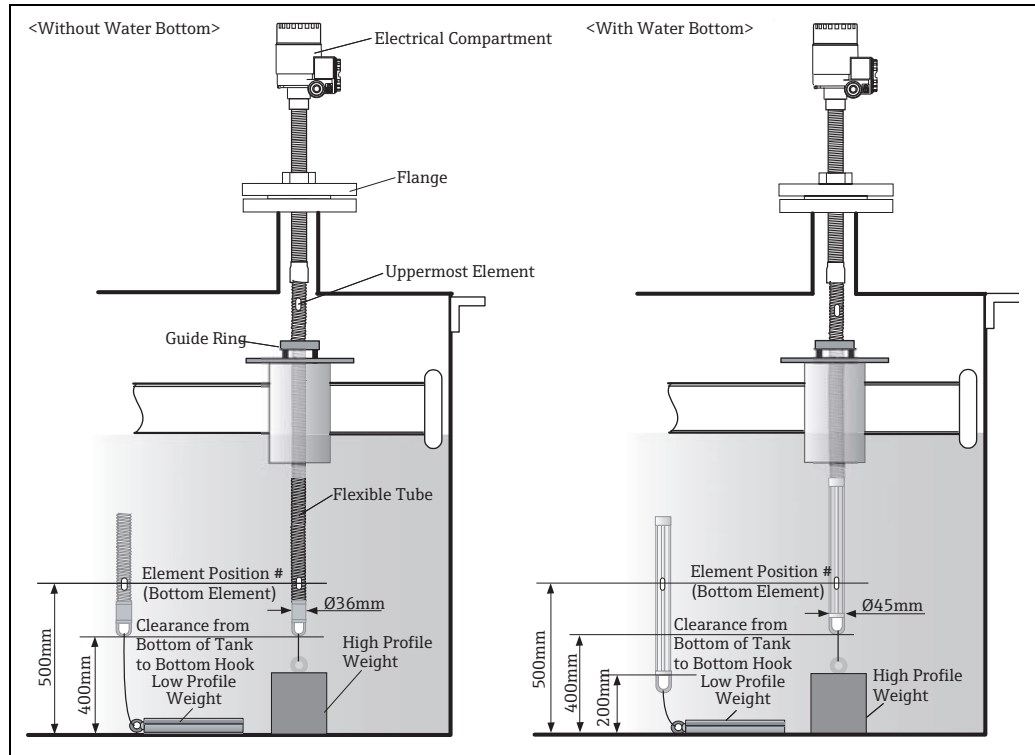
**Installation to Floating Roof  
Tank 3**

Figure 11: Floating Roof Tank 3

**Application for Pressurized Tank**

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

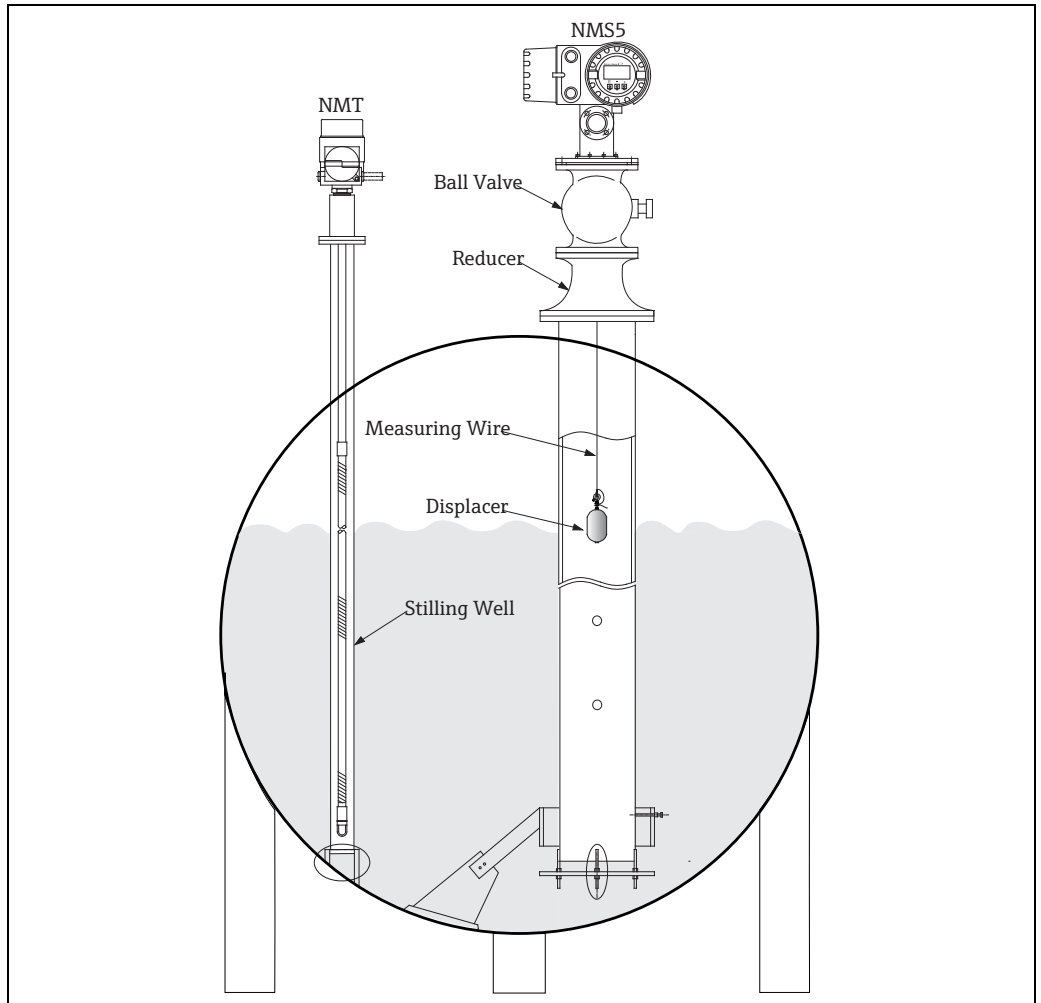


Figure 12: Stilling Well for Pressurized Tank

**⚠ WARNING**

- When the pressure inside the tank exceeds 1 bar (100KPa, 14.5psi), a thermo well which does not have any holes or slits must be installed.
- NMT539 is installed in the thermo well from the top of the tank nozzle.
- Cover the bottom of the thermo well and weld it to protect the probe from the pressure.

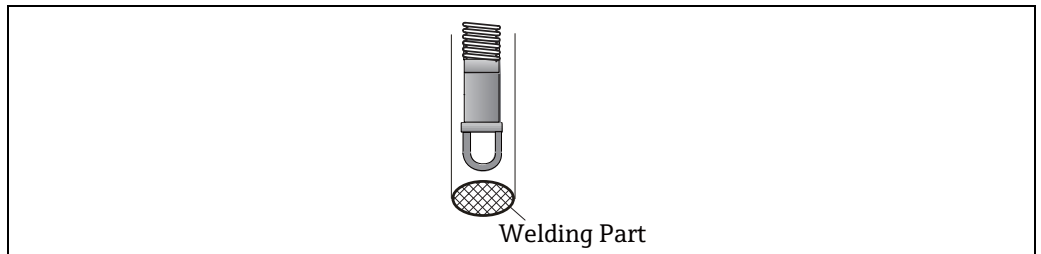


Figure 13: Welding Part of Stilling Well

## Input and Output

### Measured Variables

#### Temperature Measuring Range:

Temperature conversion: -200 to +235 °C (-328 to +455 °F), (-170 to +235°C TIIS)

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: 40m (131.2ft) or less

#### Water Interface Level (Water Bottom) Range

Standard: 1m to 2m (3.3 to 6.6 ft)

### Compatible Element (Converter Only Version)

- Pt100
- Cu90
- Cu100
- PtCu100
- JPt100

TIIS is only available for Pt100 and JPt100.

#### NOTICE

NMT 539 Converter + Temp. version has only Pt100 elements installed. The element types above can be utilized in third party temperature probes, such as the Endress+Hauser 9909, 1700 or Weed Beacon MWR. Other manufacturer multi-resistant and multi-spot average temperature probes may be compatible.

### Number of Elements

2 to 16 points

### Communication

- NMS5/NMS7
- NRF 590
- TMD1
- TGM5

#### Local HART

2 wire, Endress + Hauser local HART protocol to host commanding gauge

Local HART is used for communication in NMT539, NRF560, NMS5/NMS7, and NRF590.

### Alarm Signal

Error information via the following interface and transmission digital protocol. Refer to Operating Instructions for details of each device.

- NMS5: BA00401G, NMS7: BA1001N
- NRF590: BA256F (BA00256F), BA257F (BA00257F)

### Output Signal

- Local HART protocol

### Connection

- NMS5/NMS7
- NRF590
- TMD1
- TGM5

## Auxiliary Energy

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<b>Load HART</b>	Minimum loading for local HART circuit: 250Ω
<b>Overvoltage Protection</b>	NMT539 has internal surge arrester which complies with EN / IEC 61000-4-5 (Line to Line 1.0kV). Connect the metallic housing of the NMT539 to the tank wall or screen directly with an electrically conductive lead to ensure reliable potential matching.
<b>Supply Voltage</b>	DC16 to 30V: Ex ia DC20 to 24V: TIIS Ex d [ia] connectable only TGM5, TMD, NMS: Ex d
<b>Power Consumption</b>	Ex ia: 6mA (Temperature measurement) 12mA (WB measurement)  TIIS Ex d [ia]: 8mA (Temperature measurement) 14mA (WB measurement)

## Performance Characteristics

<b>Temperature Accuracy</b>	±0.1°C or better (under the reference condition)*1  Reference condition*1: Accuracy of RTD - Temperature conversion. Accuracy measurement shall be conditioned with precisely calibrated dial resistor or IEC60751/DIN EN 60751 class A Pt100 ohm temperature element.
<b>WB Accuracy</b>	±2mm or less (under the reference condition)*2  Reference condition*2: Measurement condition is based on 80% span of 1m probe in water / air interface at a temperature of 25°C.  The Factory default is adjusted based on DC (εr)=2.1
<b>Reference Operating Conditions</b>	<ul style="list-style-type: none"> <li>▪ Temperature = +25°C(77°F) ±5 (9°F)</li> <li>▪ Pressure = 1013mbar abs. ± 20mbar abs. (1013hPa abs. ± 20hPa abs., 14.7 psi abs ± 0.3 psi abs.)</li> <li>▪ Relative humidity (air) = 65% ± 20% (linearity)</li> </ul>
<b>Maximum Measured Error</b>	Typical statements for reference conditions, include linearity, repeatability, and hysteresis: <ul style="list-style-type: none"> <li>▪ Linearity: <ul style="list-style-type: none"> <li>- Temperature: ±0.15°C (0.27°F) + value of element deviation (based on IEC 60751/ DIN EN 60751) Standard version class A: ± (0.15 + 0.002 x ltl) PTB version class 1/10 B: ± (0.3 + 0.005 x ltl)/10</li> <li>- WB: ± 2mm *2</li> </ul> </li> </ul>
<b>New Module</b>	NMT 539 employs a completely new electronic module compared to the previous NMT 535.

	NMT 539	NMT 535
CPU Performance	16 bit	8 bit
Clock Speed	2.7648 MHz	0.9216 MHz
Memory Capacity (RAM)	20K bytes	176 bytes
EEPROM	2K bytes	256 bytes
Flash Memory	256K bytes	16K bytes
Total # of Print Boards	4 (5 with Capacitance board)	5
Current Consumption (Converter + Temp. Probe)	6mA: 16VDCEx ia 8mA: 16VDCEx d [ia]	10mA: 16VDC
Current Consumption (Converter + Temp. Probe + W.B. Probe)	12mA: Ex ia 14mA: Ex d [ia]	

**All-in-one Program** The powerful processor enables multi-function calculations under a single program. This means that there is no need for a variety of spare parts.

### RTD Temperature Calculation

The main CPU board now has all the required data processing functionality, including RTD - local HART conversion. With the NMT 538, various programs were required depending on temperature element characteristics, such as Pt100, Cu90, Cu100 and PtCu100. The new NMT 539 has all the programs in one powerful processor.

### Capacitance - Local HART Signal Conversion


A separate CF (Capacitance - Frequency) board can be connected directly to the CPU board when NMT 539 is equipped with WB sensor.



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## Operating Condition: Environment and Process

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<b>Ambient Temperature Range</b>	-40 to +85°C (-40 to +185°F) -20 to +60°C (-4 to +140°F) for TIS
<b>Storage Temperature</b>	-40 to +85°C (-40 to +185°F)
<b>Climate Class</b>	DIN EN 60068-2-38 (test Z/AD)
<b>Degree of Protection</b>	<ul style="list-style-type: none"><li>▪ Housing: IP65, (Converter only, open housing: IP20)</li><li>▪ Probe: IP68</li></ul>
<b>Electromagnetic Compatibility</b>	When installing the probes in metal and concrete tanks and when using a coax probe: <ul style="list-style-type: none"><li>▪ Interference Emission to EN 61326, Electrical Equipment Class B</li><li>▪ Interference Immunity to EN 61326, Annex A (Industrial)</li></ul>
<b>Process temperature Range</b>	Temperature probe: -170 to +235 °C (-274 to +455°F) WB probe: 0 to +100 °C (+32 to +212°F)
<b>Process Pressure Limits</b>	1 bar (100kPa, 14.5psi)  <b>WARNING</b> If the tank inside is over this process pressure, it is required to install stilling well to protect the probe from the pressure.
<b>Data Transmission</b>	2.5mm coaxial cable & common ground

## Operating Condition: Installation

### Cable Grands

Wiring of the NMT 539 must meet explosion proof or intrinsically safe requirements. The following cable entries are available:

- Thread G 1/2"
- Thread NPT 1/2"
- Thread M20

Only G1/2 is selectable for TIIS Ex d [ia] and for TIIS Ex d [ia], 2 cable glands SXC-16B are attached.

#### WARNING

Ensure to use the cable glands attached to NMT539.

Cable gland is not provided for other NMT 539 specifications excluding TIIS Ex d [ia].

Size and condition of the communication cable must meet the requirements of intrinsically safe local HART communication.

### Process Connection

#### Converter Only Version

NMT 539's local HART converter can fit onto third party average temperature probes with the following mechanical connection size and type:

- G 3/4" (equivalent to NPS 3/4") universal coupling: Housing type 1
- M20 threaded: housing type 2, specific design to fit to Varec 1700 terminal housing

#### CAUTION

- Use sealing tape to secure the connection between converter and temperature probe.
- Refer to the NMT 539 instruction manual for the detailed installation procedure.

#### Converter + Temp. , Converter + Temp. + WB Version

All versions have the same installation method to fit with the tank nozzle.

The following flange sizes are available:

- 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

### Height Adjustment for NMT539

When installing NMT539, height adjustment can be performed within approximately  $\pm 180$  mm (7") from the original height.

#### NOTICE

The height adjuster is not included in "Converter Only" version.

#### WARNING

Tighten the lock nut with sealing tape to secure NMT 539 flange at the end of installation. A loose lock nut may lead to improper tank sealing or unexpected leakage into the tank.

### WB Blocking Distance

The Water Bottom sensor can be set as low as zero clearance from the tank floor by using height adjuster. Due to mechanical design of WB sensor, bottom plate has approximately 10mm thickness. This will become a blocking distance (ineffective measuring range).

#### WARNING

Calculate vertical movement of NMT 539 installation height prior to setting the WB sensor bottom clearance. Typical tank shell deformation causes vertical movement at a minimum 20 ~ 30mm (1"). Excessive weight load of entire NMT 539 on WB sensor by contacting tank floor may cause critical damage that disables accurate & stable WB level measurement.

## Recommended Installation Height

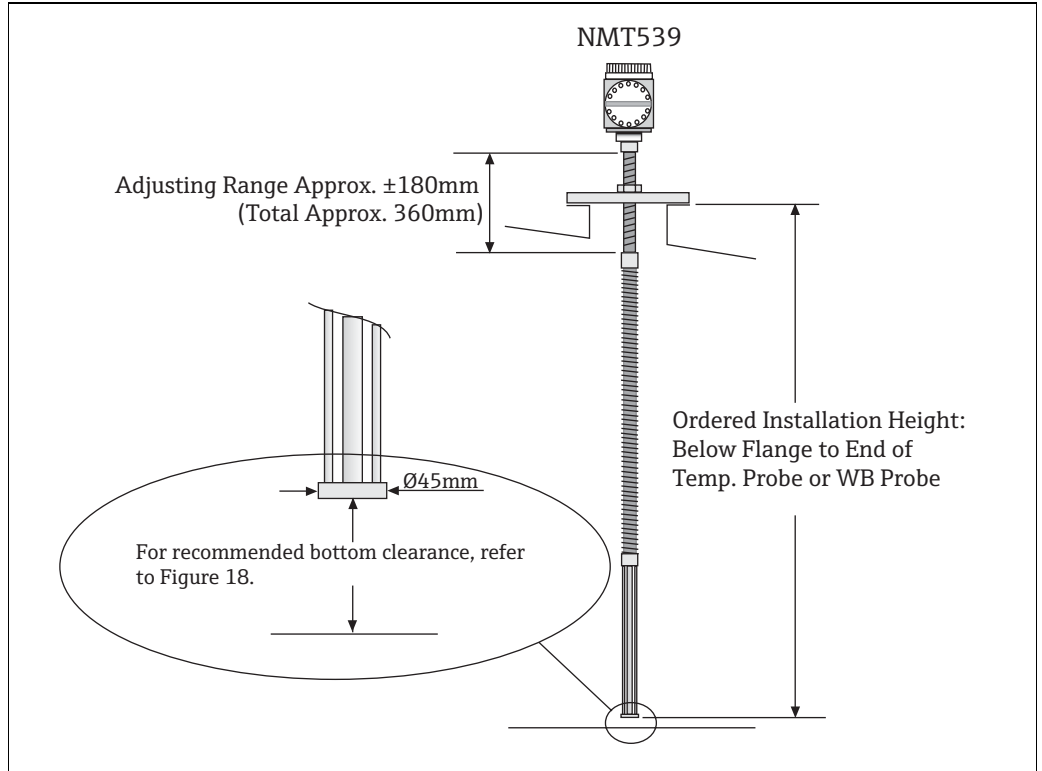


Figure 14: Recommended Installation

### NOTICE

- The required bottom clearances of both the temperature probe and WB sensor vary depending on the anchoring method. Consider the required bottom clearance when ordering NMT 539. See the recommended bottom clearance shown above and/or consult Endress+Hauser representatives for further information.
- When ordering NMT 539 with special element position and bottom clearance, refer to "Ordering Information," section 80, Element Spacing. Select 4, Equally spaced, defined by length.
- The standard location of the lowest temperature element should be set at 500 mm (20") from the bottom of the tank regardless of probe type.

**Recommended Stilling Well Installation**

Datum plate should be mounted on the bottom of the tank below the slotted stilling well (see (B) ) or located 300mm (12 inches) or more below the slotted stilling well (see (A) ).  
 If the anchor weight is not used when installing stilling well, the water should fill the tank up to the bottom from the end of the stilling well, enough to allow liquid to enter/exit the pipe.  
 When using stilling well, it is available from 2 inches (50A) (JIS, ANSI) pipe  
 When using anchor weight, use 4 inches (100A) (JIS, ANSI) pipe or more.

**⚠ WARNING**

Avoid turbulence in the water so that WB (Water Bottom) sensor will not be damaged.

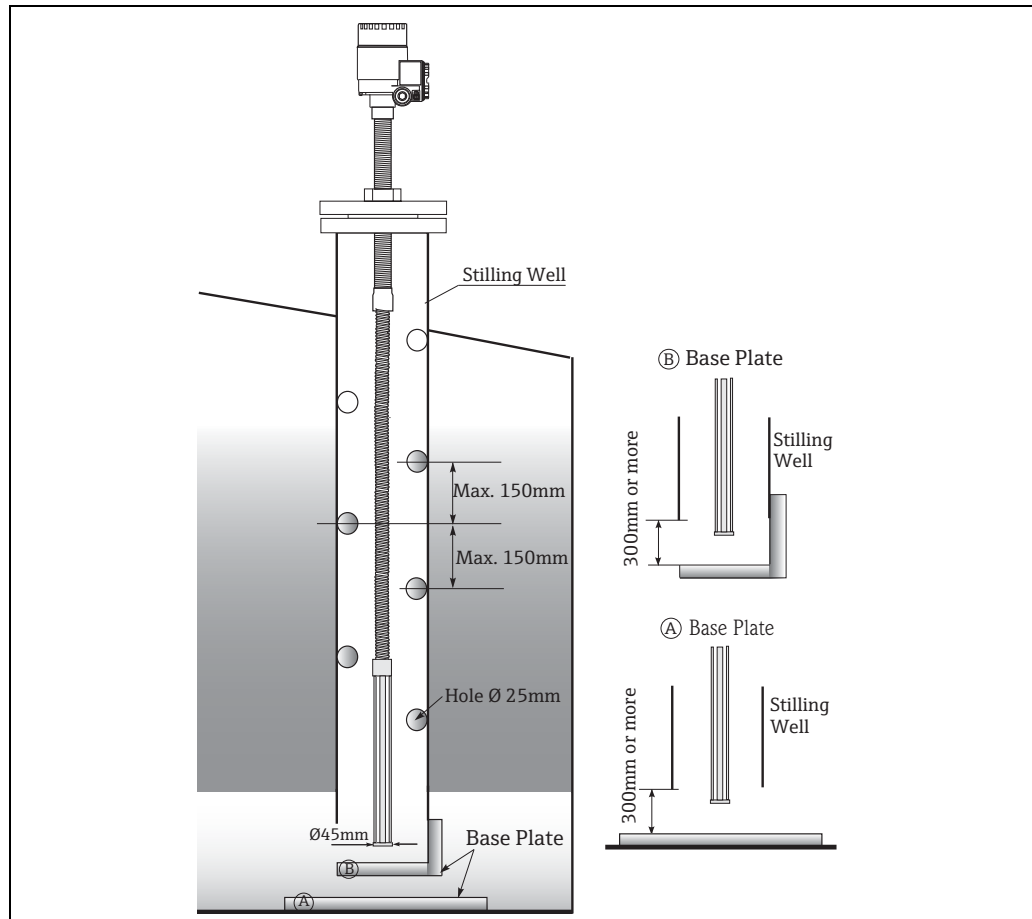


Figure 15: Recommended stilling well installation

**Installation Equipment**

The bottom anchor hook on WB sensor is not available when "A: no installation material" is selected. The Converter + Temp. probe version includes the bottom anchor hook as standard, although, "A: no installation material" is selected.

**Contents of Anchoring Hardware: Based on Choice of "100: Mounting Attachment"**

	<b>A:</b>	<b>B:</b>	<b>C</b>	<b>D</b>	<b>F:</b>	<b>G</b>
	<b>Not selected</b>	<b>Anchor weight (High profile, D120)</b>	<b>Anchor weight (Low profile, hexagon H41)</b>	<b>Tension wire + wire hook + NPT1 top anchor</b>	<b>Tension wire + wire hook + R1 top anchor</b>	<b>Bottom hook, Low profile</b>
<b>0: Converter only</b>	none	none	none	none	none	none
<b>1: Temp. + Converter</b>	bottom hook	bottom hook anchor weight sling wire	bottom hook anchor weight sling wire	bottom hook base plate wire hook NPT1 top anchor tension wire	bottom hook base plate wire hook R1 top anchor tension wire	-----
<b>3: Temp. + WB + Converter</b>	none	same as above	same as above	same as above	same as above	bottom hook

**Mounting Attachment -1**

A: "Not Selected", B: "High Profile Anchor, D120", D: "Tension Wire + Wire Hook +NPT1 Top Anchor" or F: "Tension Wire + Wire Hook + R1 Top Anchor"

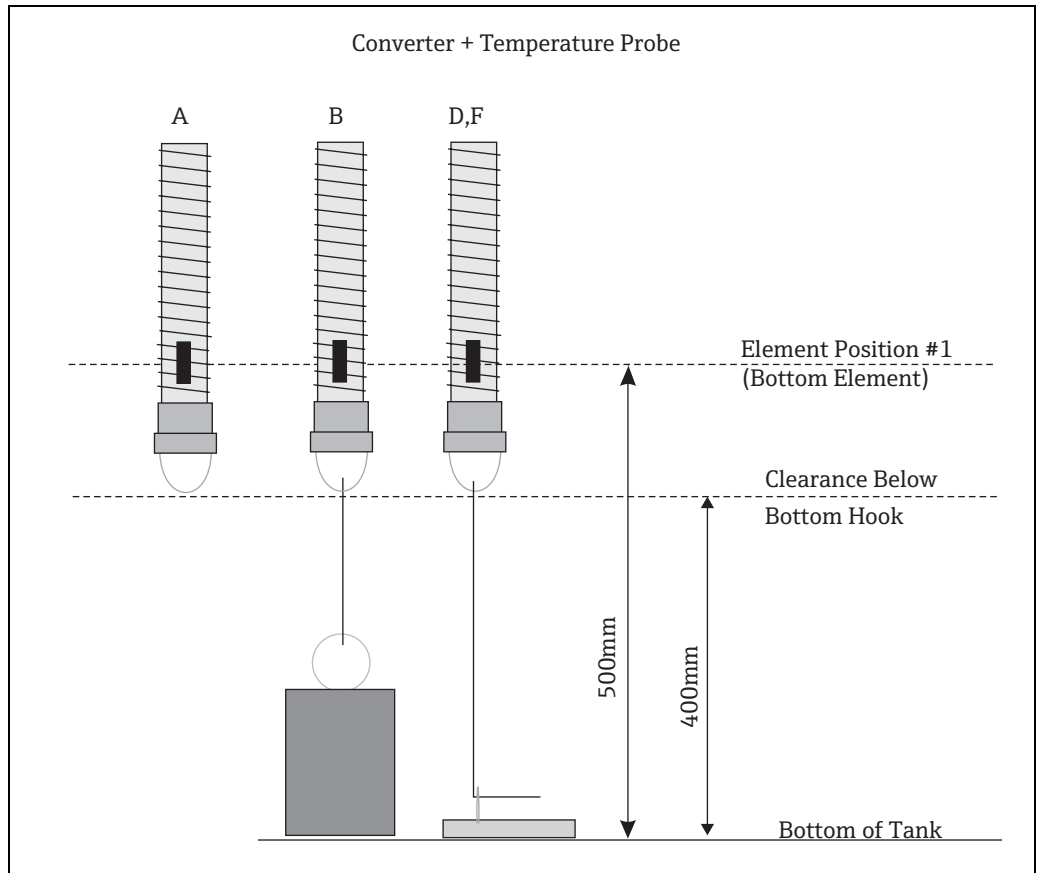


Figure 16: Attachment 1

"High profile anchor weight" is the anchor method designed for converter + temperature probe. Both temperature probe and WB sensor with "High profile anchor weight" and "Tension wire anchor" methods have a recommended clearance below the bottom of the anchor hook of approximately 400 mm (16"). This clearance can be easily changed by turning the height adjuster at the top of the tank.

**NOTICE**

When ordering NMT 539, refer to "Ordering Information," section 80 (Temperature Element Spacing).

**Mounting Attachment-2**

A: "Not Selected", B: "High Profile Anchor, D120", C: "Low Profile Anchor, Hexagon H41"  
 D: "Tension Wire + Wire Hook + NPT1 Top Anchor", F: "Tension Wire + Wire Hook + R1 Top Anchor" or  
 G: Bottom Hook, Low Profile

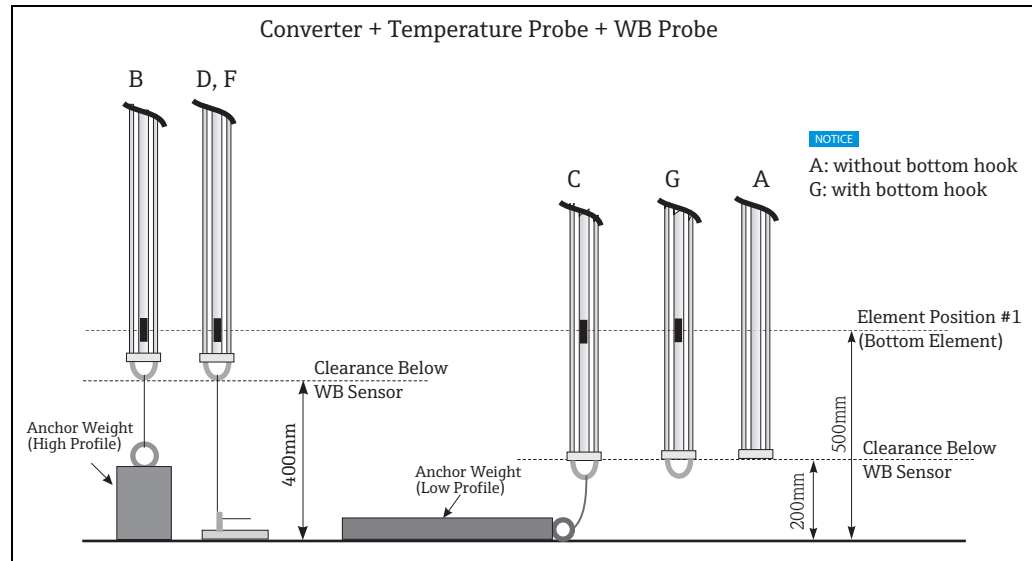


Figure 17: Attachment 2

"Low profile anchor weight" is provided to anchor WB probe and to measure accurately water bottom range. When installing NMT539 into the small tank nozzle [max. 2 inches (50A)] of operating tank, it is available as mounting attachment for converter + temperature probe version. Both the temperature probe and WB sensor with "Low profile anchor weight" at 100: Mounting attachment option (refer to Ordering Information) should have 200 mm (8") of bottom clearance from the edge of probes.

**NOTICE**

The lowest possible WB measuring point can be approximately 10 mm from the tank floor with "No installation material" selected (refer to Ordering Information). If necessary, use the height adjuster to set at the desired installation height. No bottom anchor hook is available with the WB sensor and 100: Mounting attachment "A : No installation material". A bottom hook is attached on WB sensor but a low profile anchor is not included to the option "G: Bottom hook, low profile"

#1 Element Position of NMT539

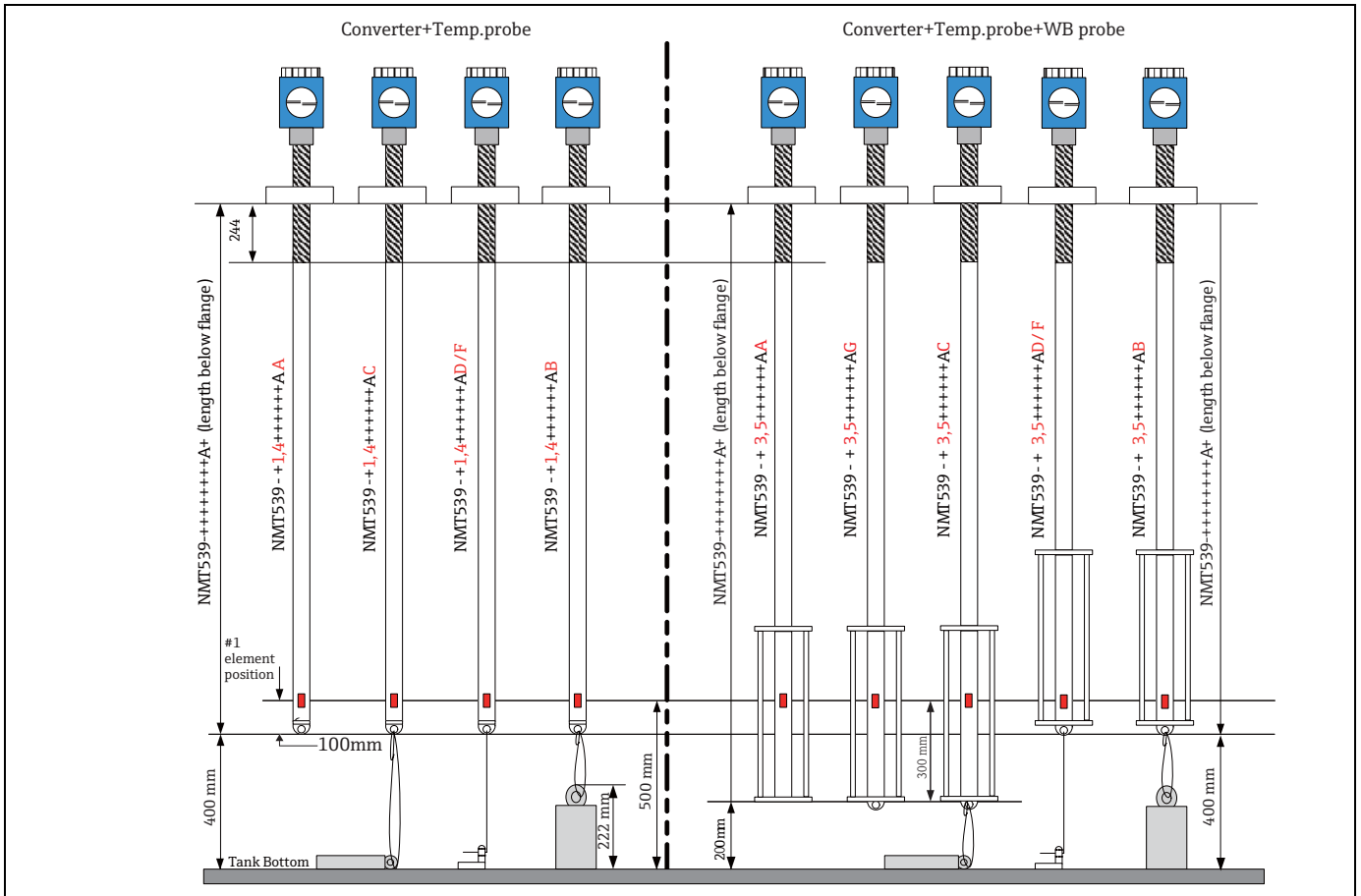


Figure 18: #1 Element Position

Anchor Weight Method

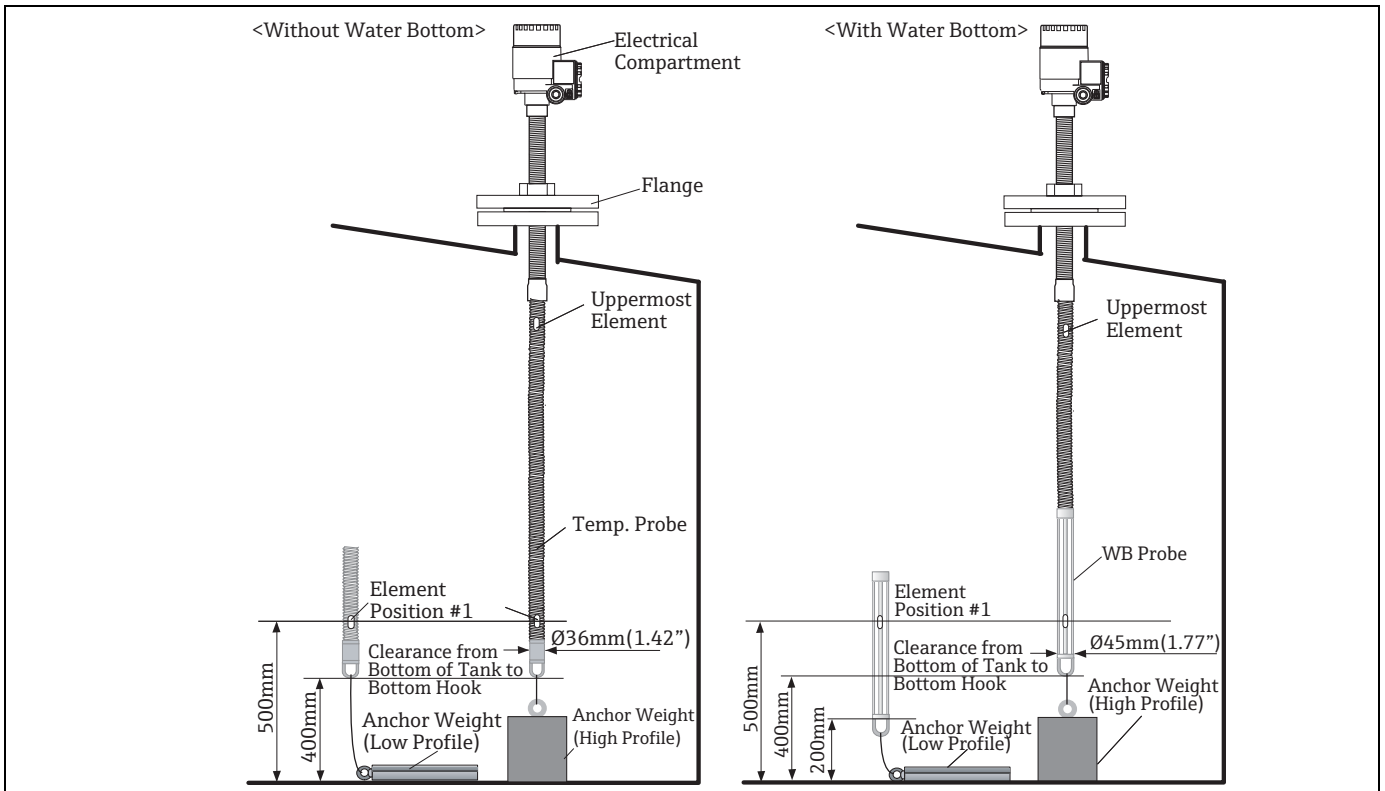


Figure 19: Anchor Weight Method

## Operating Condition: Wiring

### TIIS Ex d [ia] Wiring

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

#### **⚠ CAUTION**

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  $2 \sim 2.6 \text{mm}^2$ .

In an instrumentation room, a field device with Class A ground may be connected in common with the communication cable shield.

#### Class A Ground General Description

Ground Resistance Value	10Ω or less
Grounding Cable	Tensile strength: 1.04kN metallic wire or more Cable core cross section diameter: 2~2.6mm copper wire or more Cable finished external diameter: more than $\phi 8 \text{mm}$

### Grounding Cable Construction (TIIS Ex d [ia])

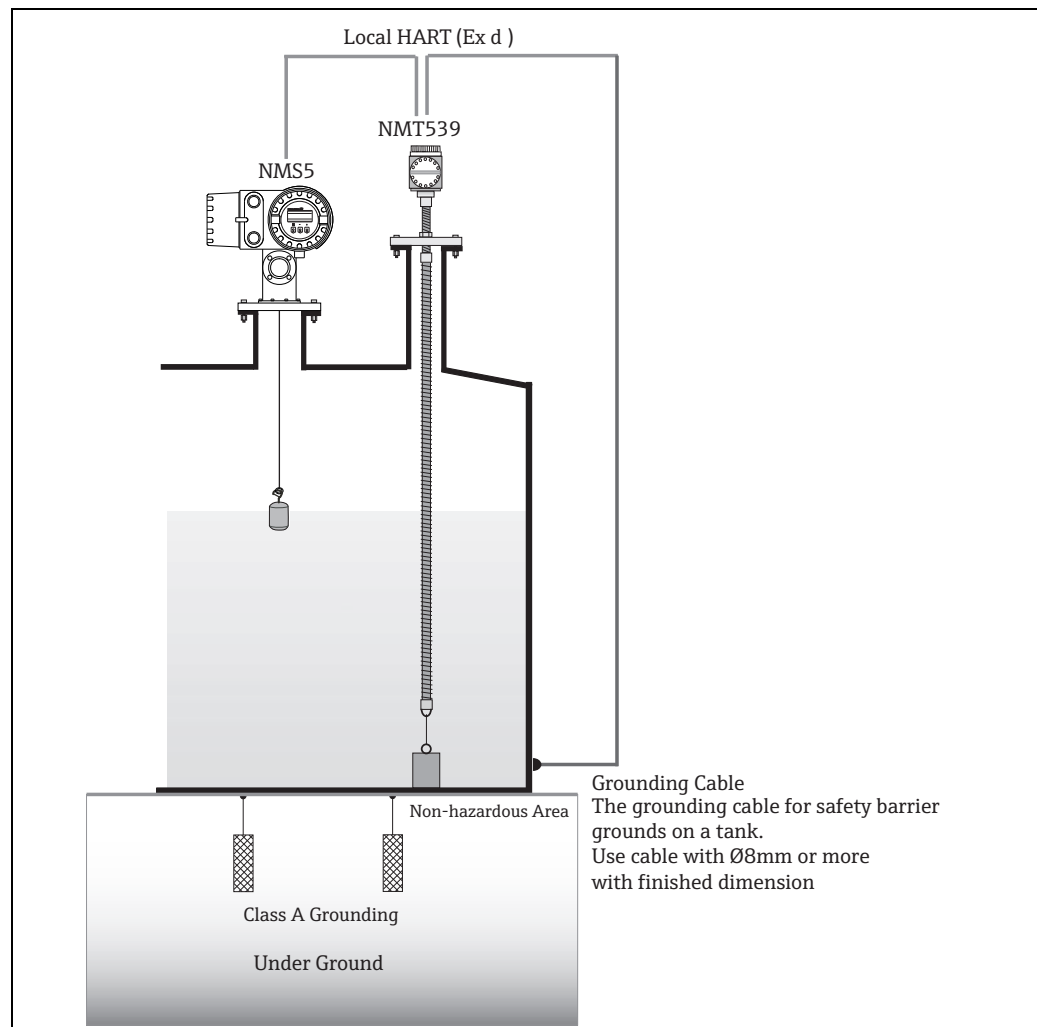


Figure 20: Grounding Cable



**Connecting Diagram  
(TIIS Ex d [ia])**

**CAUTION**

Install wiring in a manner to prevent current or voltage from causing electro magnetic interference on the i.s. circuit.

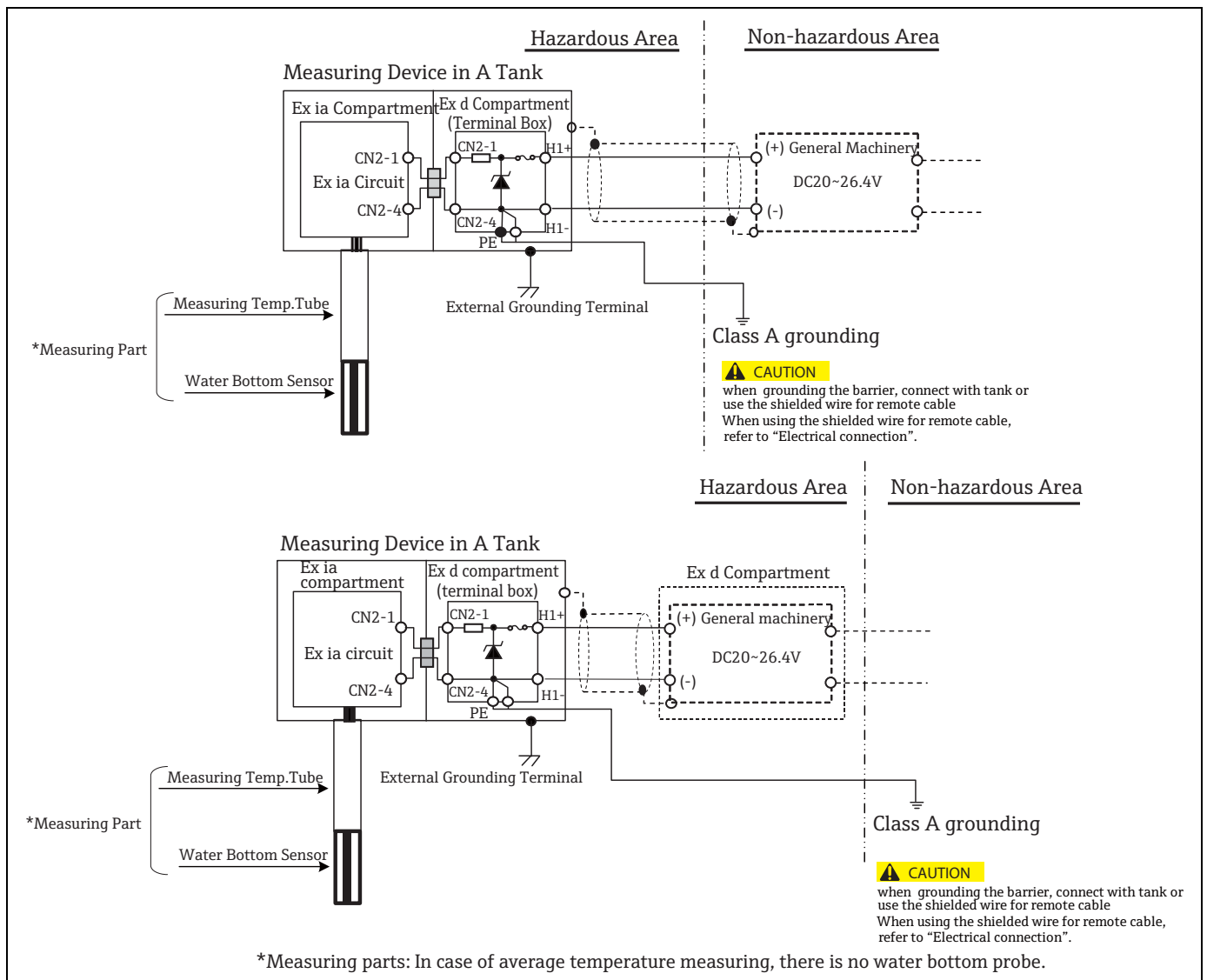


Figure 21: Connecting Diagram

## Operating Condition: Terminal Connection

### Ex ia NMT539 Terminal

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

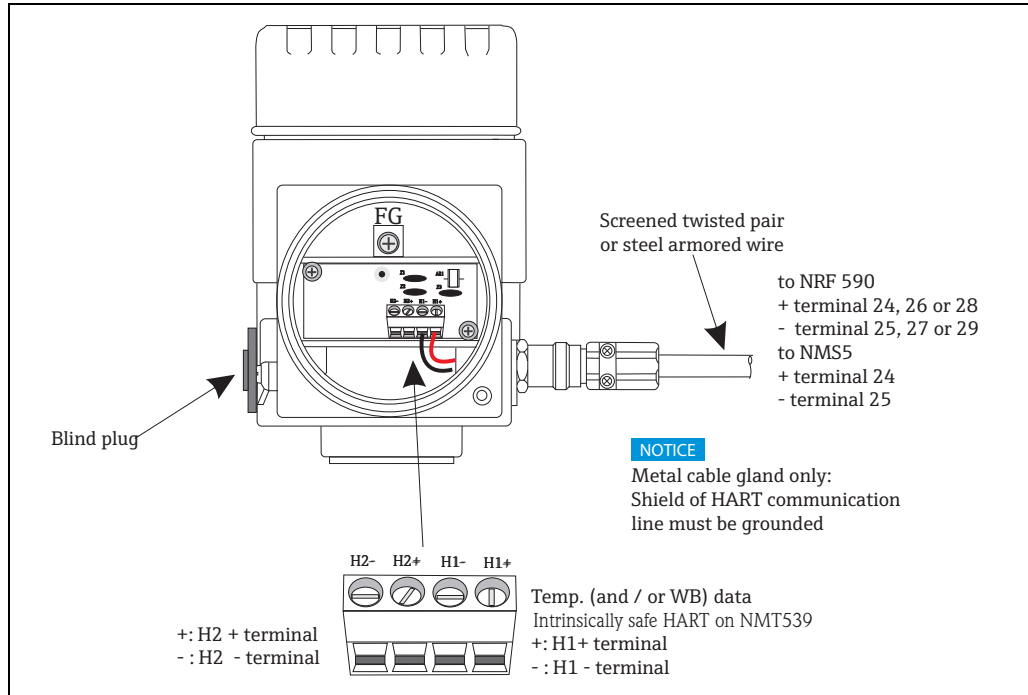


Figure 22: NMT539 Terminal (Ex ia)

### ATEX, IECEX FM, CSA, NEPSI Ex d [ia] NMS5 Terminal

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.

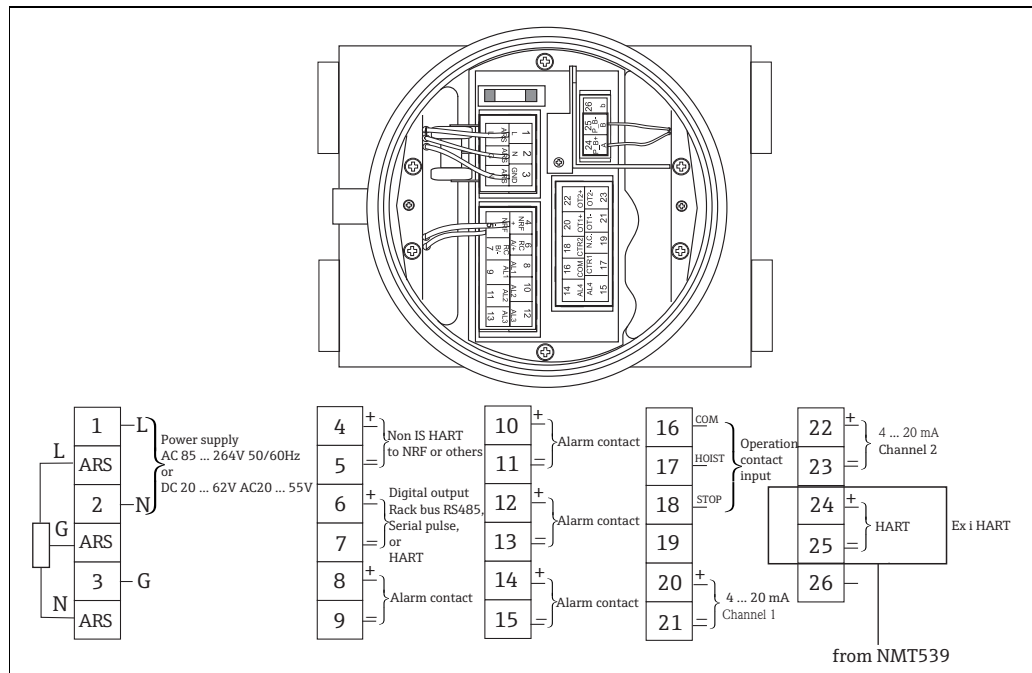


Figure 23: NMT5 Terminal (ATEX, FM, CSA, Ex d [ia])

### 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.

**TIIS Ex d [ia] NMT539 Terminal**

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

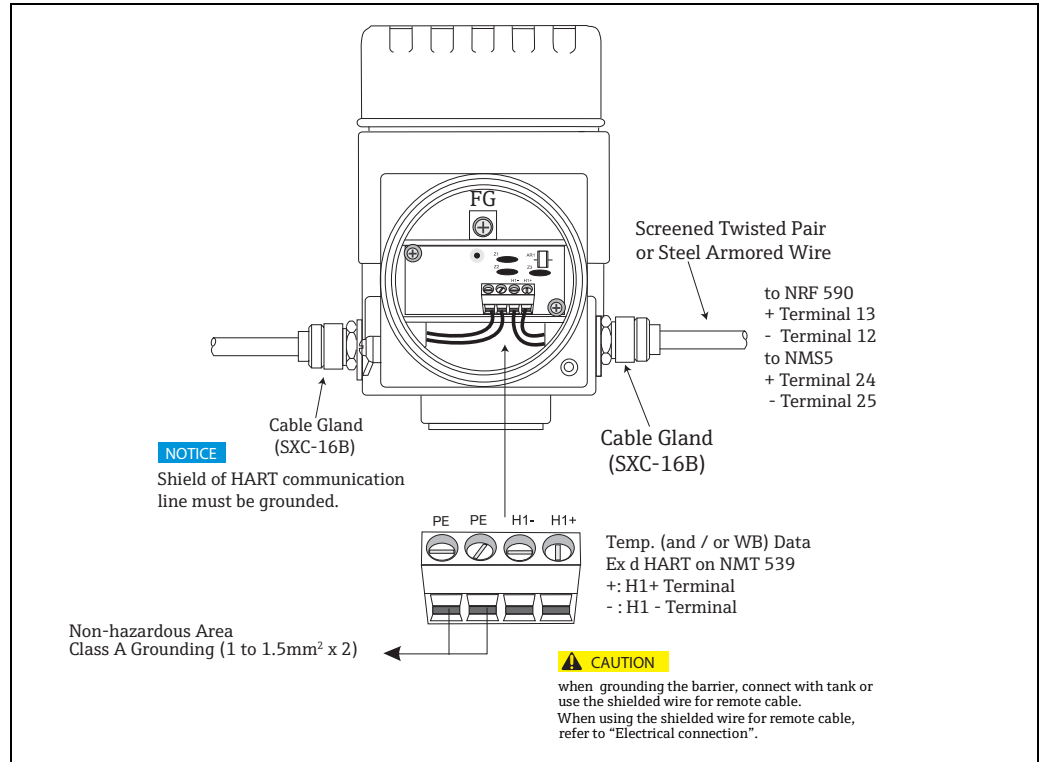


Figure 24: NMT539 Terminal (TIIS Ex d [ia])

**Ex d NMS5 Connection**

Connect NMT539 Ex d [ia] to NMS5 Ex d terminals.

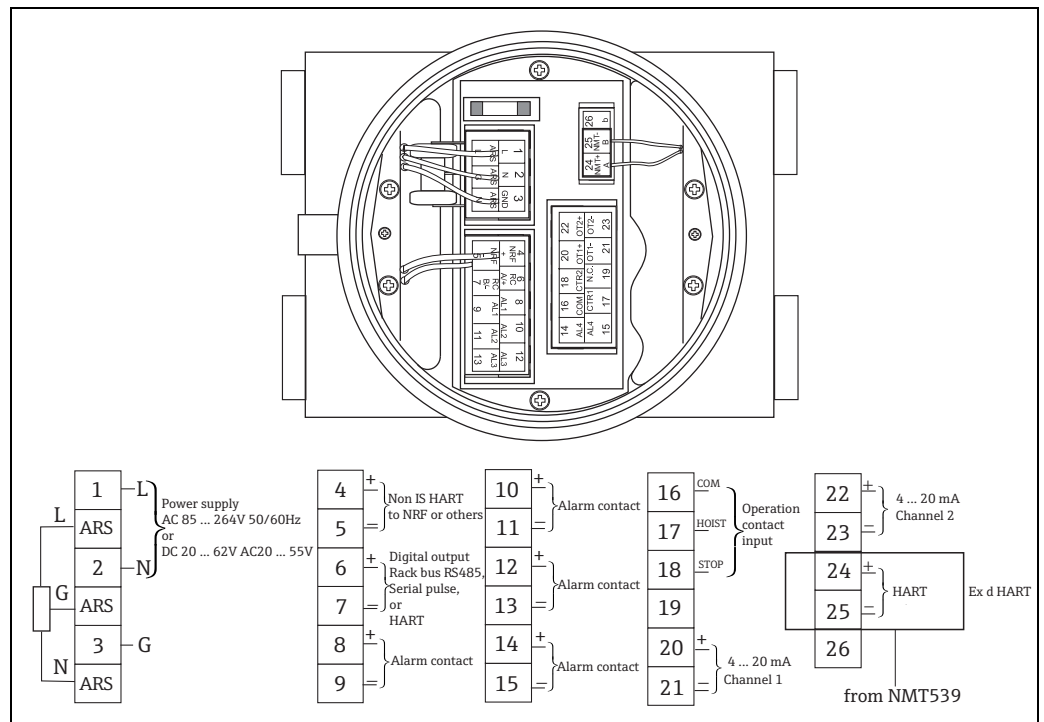


Figure 25: NMS5 Terminal (Ex d)

**TGM5/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-xBxxxxxxxx (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.

**Terminal Connection of NRF590**

**Ex ia Terminal**

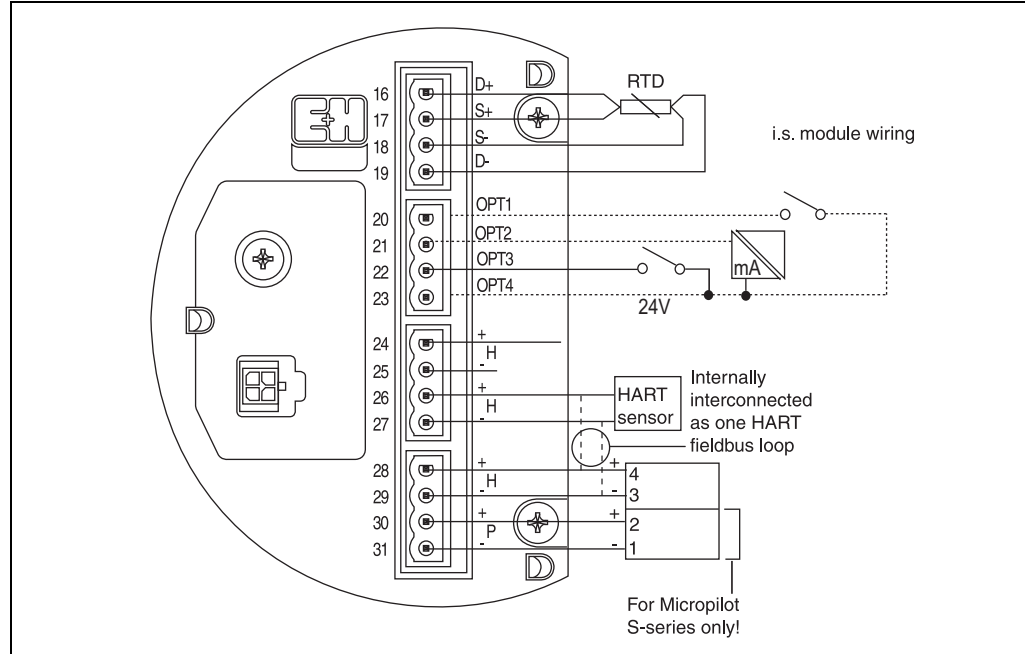


Figure 26: NRF590 Terminal (Ex ia)

**NOTICE**

NRF590 has three sets of i.s. local HART terminals.

**CAUTION**

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

**TIIS Ex d Terminal**

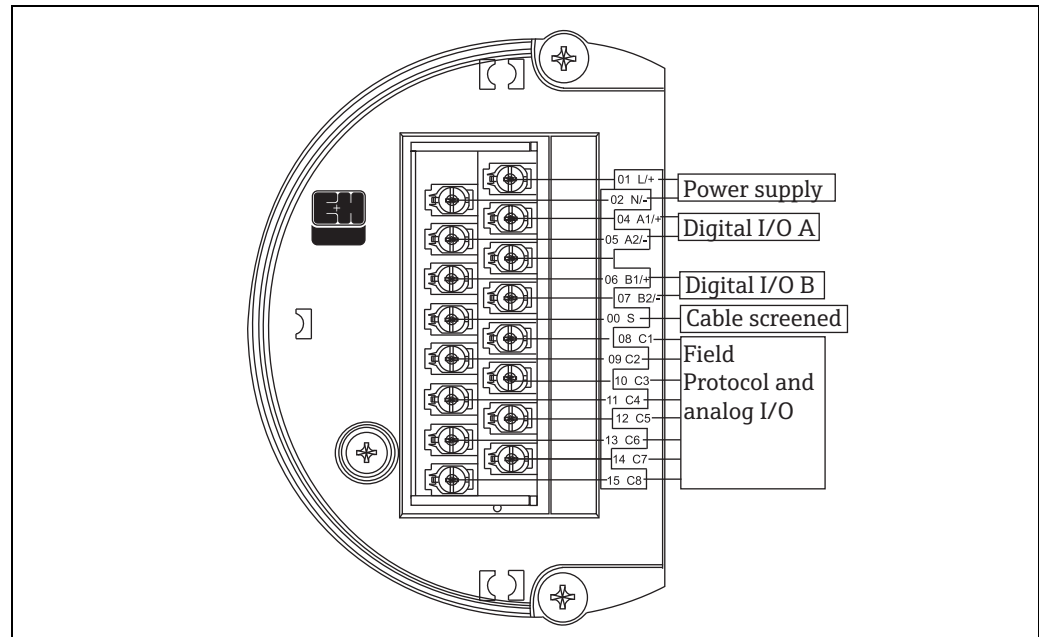


Figure 27: NRF590 Terminal (TIIS Ex d)

## Mechanical Construction

### Type 1: Converter Only Version

Standard G (NPS) 3/4" Universal Coupling Connection

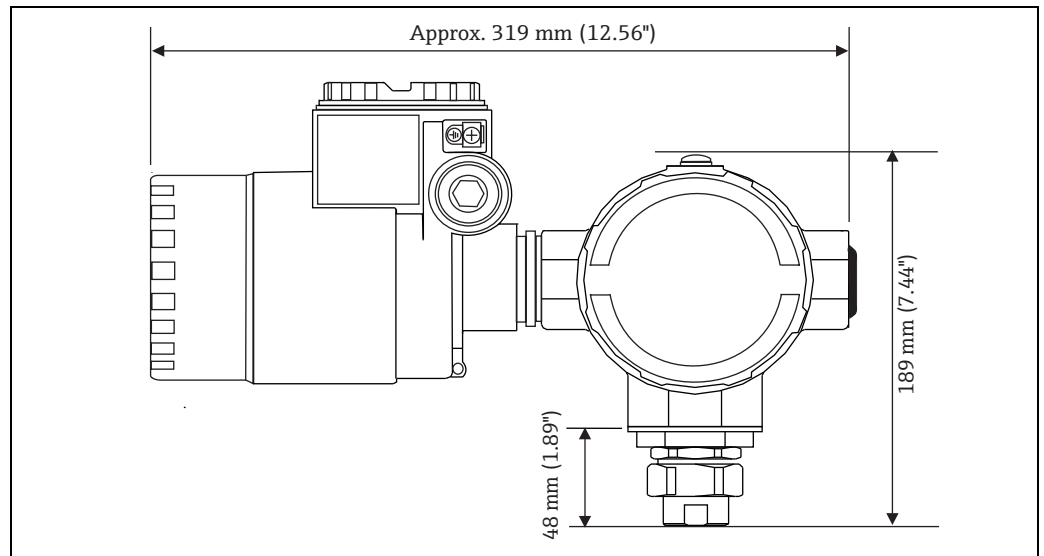


Figure 28: Type 1 Dimensions

### Type 1: Measuring Function

The Converter only version is the direct replacement of the previous NMT 538 series. Connection and compatibility are provided to third party temperature probes with various element types. Unlike the NMT 538, the powerful processor of the NMT 539 calculates and converts the following element types without altering the program (EPROM installed software):

- Pt100
- Cu100
- Cu90
- PtCu100

The type 1 converter also enables connection to a dual function average temperature and capacitance WB probe, such as Weed Beacon MWR. Wiring, however, requires the isolation of the RTD temperature signal from the capacitance WB signal on coaxial cable. The wiring of the temperature signal is exactly the same as Endress+Hauser's 1700, 9909 and other RTD probes. The coaxial (WB) cable must be routed from the existing auxiliary capacitance to local HART (or 4 - 20 mA) converter via NMT 539's terminal compartment.

#### NOTICE

- NMT 539 is only compatible with MRTs (Multi-Resistance Thermometers) and/or MSTs (Multi-Spot Thermometers). It is not designed to work with "Thermocouple" type thermometers.
- The physical connection between probe to NMT 539 is completed by Zinc plated carbon steel G 3/4" (NPS 3/4") universal threaded coupling. In case a different thread size is required, Endress+Hauser can provide the simplest and most efficient solution by adapting a variety of coupling sizes and materials based on existing temperature probe specifications.
- The power supply and data transmission lines are both fed to the host gauge, NMS5 or NRF 590, by one pair of local HART loop connections. In addition to the user-friendly display, NMT 539 can also be configured and operated via FieldCare. Type 2: Converter Only Version for Varec 1700, M20 threaded connection

**Type 1: Converter Only Version**

**For Varec 1700, M20 Threaded Connection**

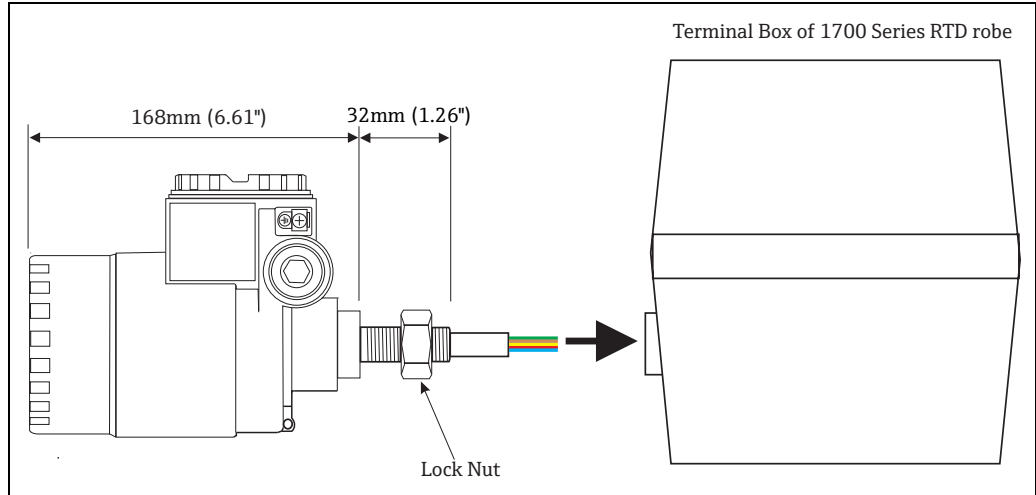


Figure 29: Type 2 Converter Only Version

**Type 2: Measuring Function**

Type 2 has the same function as Type 1, however type 2 is designed in a way so that special M20 threaded connection allows NMT 539 converter to fit directly onto the current terminal housing of 1700.

The wiring of RTD signals from the probe to NMT 539 must be done in the terminal box of 1700. Type 2 converter has a primary housing which contains NMT 539 electronics. Therefore no secondary housing is needed.

**CAUTION**

Secure the threaded connection with sealing tape and tighten the lock nut at the time of actual installation. A loose connection of NMT 539 & Varec 1700 terminal housing may cause serious electrical damage depending on environmental conditions.

**Converter + Average Temperature Probe Version**

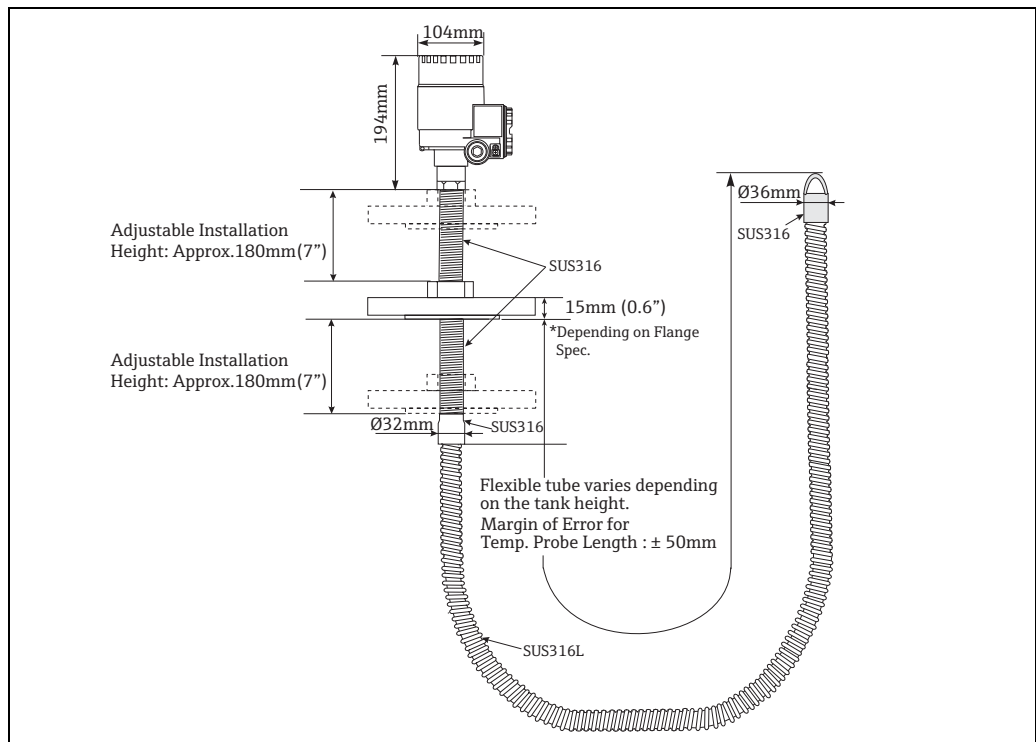


Figure 30: Converter + Probe Version

**NOTICE**

The position of the welded flange can not be adjusted.

**Measuring Function**

W&M approved high accuracy temperature device is well suited for both custody transfer and inventory control applications. Based on the product temperature range and specific application, NMT 539 has several different temperature ranges to meet application requirements:  
Temperature and Approvals

030: Temperature Measuring Range		Application	010: Approval								
			TIS Ex ia IIB T4	ATEX Ex ia IIB T2-T6	TIS Ex ia IIB T2	TIS Ex d (ia) IIB T4	IEC Ex ia IIB T2-T6	NEPSI Ex ia IIB T2 - T6	Weather proof, IP65 NEMA4X	FM IS Cl.I Div.1 Gr.C-D	CSA IS Cl.I Div.1 Gr.C-D
			A	B	C	E	F	G	O	7	8
1	-40 to +100 °C (-40 to +212 °F)	Most standard temperature range for inventory control applications.	-	✓	-	-	✓	✓	✓	✓	✓
2	-55 to +235 °C (-67 to +455 °F)	Capability of high and / or low temperature product applications like sulfur & asphalt and moderate liquid / gas application.	-	✓	-	-	✓	✓	✓	✓	✓
3	-170 to +60 °C (-274 to 140 °F)	Cryogenic, e.g. LNG, ethylene.	✓	✓	-	-	✓	✓	✓	✓	✓
4	-20 to +120 °C (-4 to 248 °F)	PTB (Germany): W&M certified applications.	-	✓	-	-	✓	✓	✓	✓	✓
5	-20 to +100 °C (-4 to +212 °F)	Most standard temperature range for inventory control applications.	✓	-	-	✓	-	-	✓	-	-
6	-20 to +235 °C (-4 to +455 °F)	Capability of high and / or low temperature product applications like sulfur & asphalt and moderate liquid / gas application.	-	-	✓	-	-	-	✓	-	-

NMT 539 converter and average temperature probe consists of up to 16 IEC60751/DIN EN 60751 class A Pt100 elements in the protection tube. The very sensitive sensor elements change resistance values depending on the surrounding temperature. Therefore, applied voltage through this sensor deviates based on resistance change at the element.  
As a specific design to meet intrinsically safe standards, NMT 539 converter and temperature version is built with a very efficient power management concept.  
In order to achieve the highest degree of measurement accuracy and mechanical & electrical durability, NMT539 employs a powerful processor, large storage capacity, and simple module structure.  
To achieve the user-friendly concept, the newly adopted height adjuster allows the adjustment of the installation height up to approximately 360mm (14") at the process connection (flange) depending on the tank shape and condition.

**W&M Function**

NMT 539 converter and temperature probe is custody transfer approved. Once NMT 539 is configured to "W&M mode", all the changeable parameters are frozen by software and mechanical switch protection.

### Converter + Average Temperature Probe + WB Probe Version

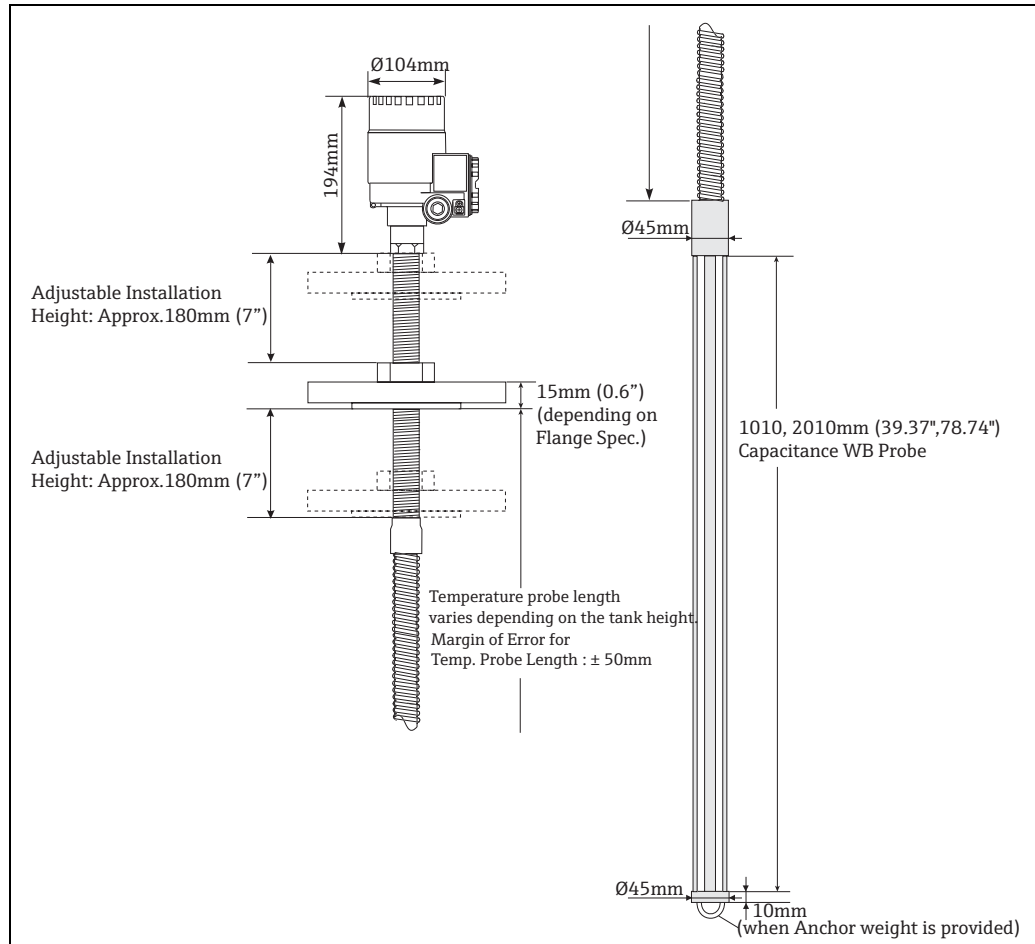


Figure 31: Converter + Probe + WB Probe Version

#### NOTICE

The position of the welded flange can not be adjusted.

### Measuring Function

NMT 539 is available in the ultimate all-in-one "Converter + Temp. + WB" version. Both temperature and WB data are fully accessible on one pair of local HART communication lines. Parameters can be configured via NMS5/NMS7, NRF 590, and FieldCare.

The integrated WB sensor (capacitance water interface measurement) is set at the bottom of the average temperature probe. The standard WB measurement ranges are 1m (3.3 ft) and 2m (6.6 ft). The tube structured WB sensor is made of SUS304 pipe and exterior is protected by an additional 1mm thick PFA tube. Pt 100

elements are set inside of this tube structure, meaning that temperature measurement is not disturbed due to WB functionality.

#### CAUTION

- Due to the characteristic of capacitance measurement, precise initial calibration must be performed in order to achieve the maximum measurement accuracy. The condition of tank contents (both oil & water), liquid temperature and individual probe characteristic can greatly effect the measurement performance. Specific accuracy & repeatability measurement must be taken within the same environment in order to perform data comparison.
- If water in the tank freezes, it is not possible to measure the water interface. Protect the water in the tank from freezing.



**WB Probe Design**

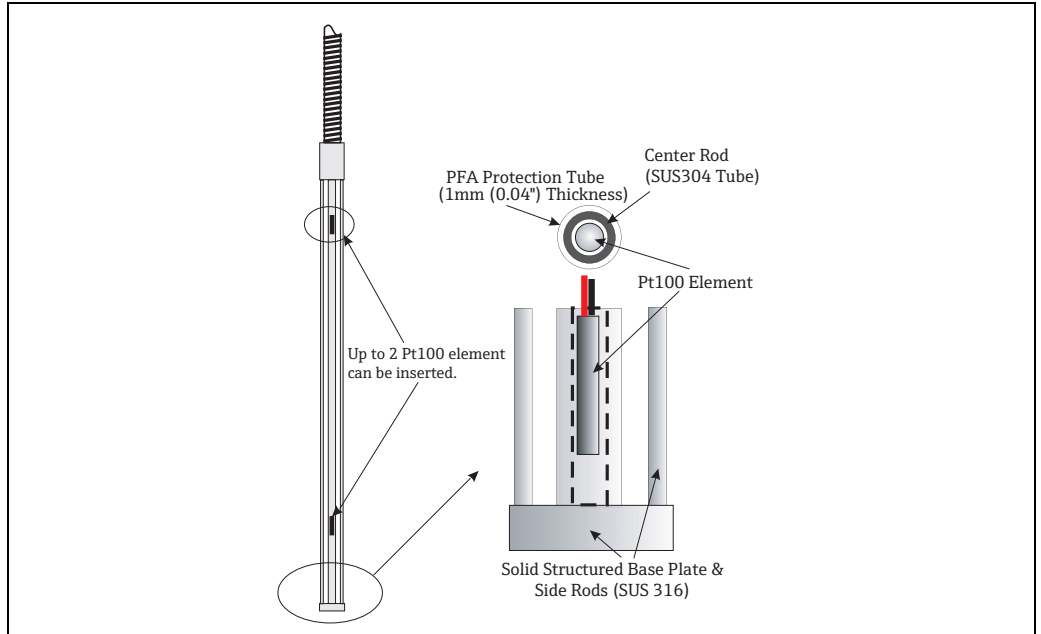


Figure 32: WB Prove Design

**Welding Flange Type**

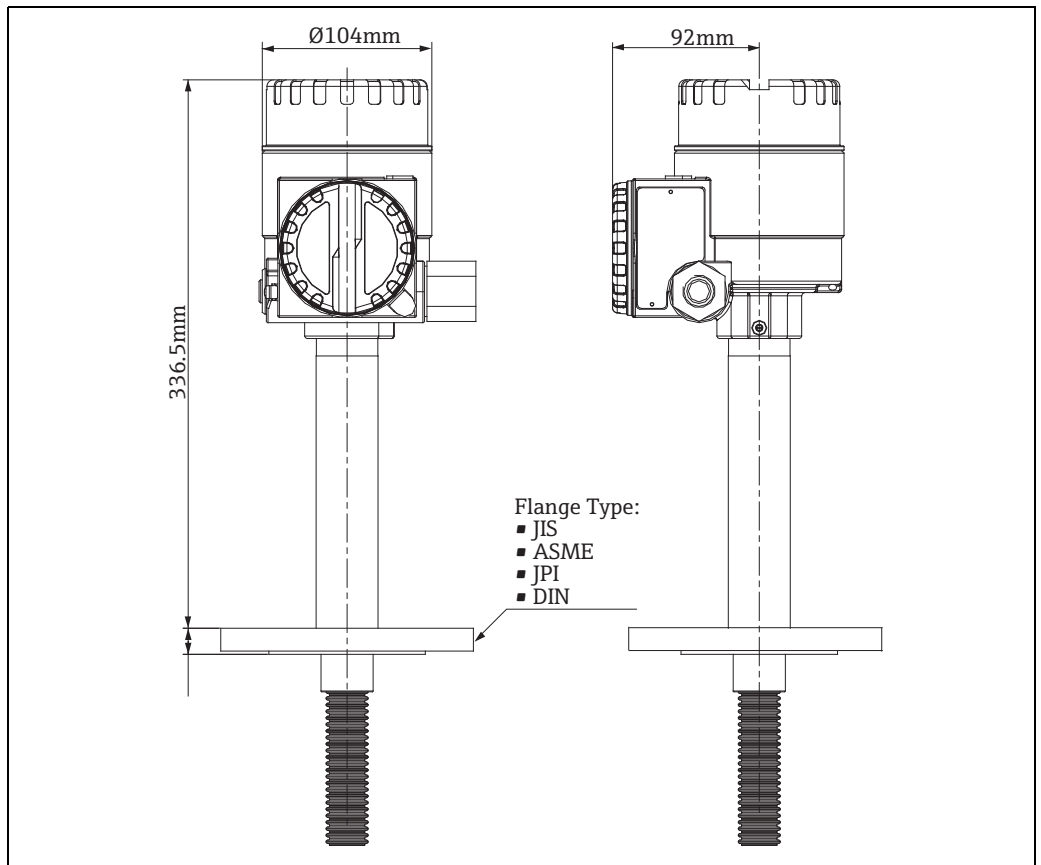


Figure 33: Welding Flange

Because flange is completely welded, the waterproof is improved. However the position of the flange can not be adjusted after welding. The waterproof is only for TIIS.

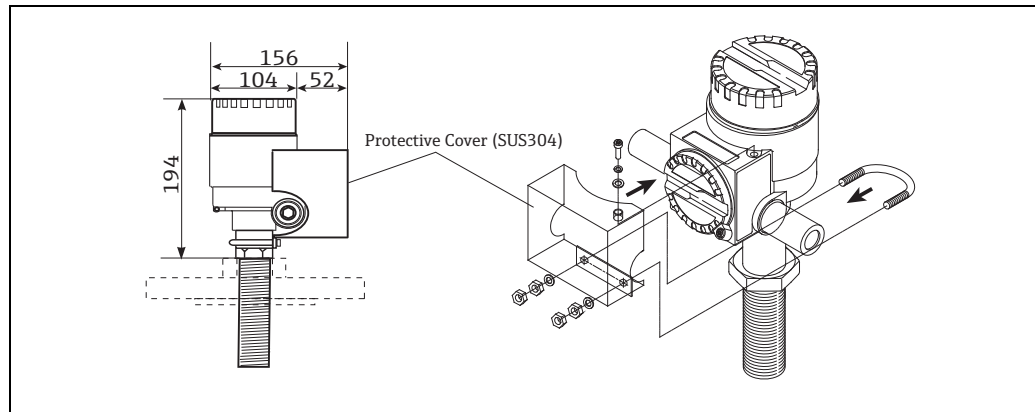
**Protective Cover for TIIS Exd  
[ia]**

Figure 34: Protective Cover

The cover is only for TIIS Ex d [ia] specification.

**Weight**

Approx. 13kg  
Condition:  
16 elements  
Temp. probe: 10m  
WB probe: 1m  
NPS 2" Cl.150 RF, 316 flange ASME B16.5

**Material**

Elements: Class A Pt100, IEC60751/DIN EN 60751/JIS C1604  
Housing: Aluminum die cast  
Temp. probe: SUS316, SUS316L (refer to drawing on 26 page)  
WB sensor: SUS316 (center rod SUS 304 & PFA protected)

## Human Interface

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### **Operation Using FieldCare**

NMT539 can also be operated via FieldCare Package. These programs support commissioning, securing of data, signal analysis and documentation of the instruments.

FieldCare Packages support the following functions:

- Online configuration of transmitters
- Loading and saving of instrument data (Upload/Download)
- Confirmation of measuring points

## Certificates and Approvals

### CE Mark

By attaching the CE mark, Endress+Hauser confirms that the instruments pass the required tests.

### Ex Approvals

Ex Approval	Class
ATEX	II 1/2 G Ex ia IIB T2 to T6 Ga/Gb (converter with temperature and/or WB) II 2G Ex ia IIB T2 to T6 Gb (converter only)
IECEX	Ex ia IIB T2 to T6 Ga/Gb (converter with temperature and /or WB) Ex ia IIB T2 to T6 Ga/Gb (converter only)
FM	IS Class I, Div. 1, Gp. C, D, T6, T4, T3, T2 Class I, Zone 0, AEx ia IIB, T6, T4, T3, T2
CSA	Ex ia Class I, Div.1, Gp. C, D, T6 to T2 Ex ia IIB T6 to T2
TIIS	Ex ia IIB T4
	Ex ia IIB T2
	Ex d [ia] IIB T4
NEPSI	Ex ia IIB T2 to T6 (converter with temperature and /or WB) Ex ia IIB T2 to T6 (converter only)

### PTB W&M Approval

PTB 14.70 08.01 (Germany)

### External Standards and Guidelines

IEC 61326 Appendix: A, Immunity according to table A-1

#### EN 60529

Protection class of housing (IP-code)

#### EN 61326

Emissions (equipment class B), compatibility (appendix A - industrial area) EN61000-4-2  
Immunity to electrostatic discharge

## Order Information

<b>010</b>	<b>Approval:</b>	0	Weather proof, IP65 NEMA4X
		7	FM IS Cl.I Div.1 Gr.C-D
		8	CSA IS Cl.I Div.1 Gr.C-D
		B	ATEX Ex (ia) IIB T2-T6
		C	TIIS Ex ia IIB T2
		A	TIIS Ex ia IIB T4
		E	TIIS Ex d (ia) IIB T4
		F	IEC Ex ia IIB T2-T6 Ga
		G	NEPSI Ex ia IIB T2-T6
		9	Special version, TSP-no. to be spec.
<b>020</b>	<b>Application:</b>	0	Converter
		1	Temperature, Converter
		3	Temperature, Water Bottom, Converter
		4	Temperature, Converter (PTB type approval)
		5	Temperature, Converter, Water Bottom (PTB type approval)
		9	Special version, TSP-no. to be spec.
<b>030</b>	<b>Temperature Measuring Range:</b>	0	Not selected
		5	-20 ...+100 °C
		1	-40 ...+100 °C
		6	-20 ...+235 °C
		2	-55 ...+235 °C
		3	-170 ...+60 °C
		4	-20 ...+120 °C (PTB type approval only)
		9	Special version, TSP-no. to be spec.
<b>040</b>	<b>Water Bottom Measuring Range:</b>	0	Not selected
		1	1m/3.3 ft.
		2	2m/6.6 ft.
		9	Special version, TSP-no. to be spec.
<b>050</b>	<b>Cable Entry:</b>	A	Thread G1/2
		B	Thread NPT1/2
		D	Thread M20
		Y	Special version, TSP-no. to be spec.
<b>060</b>	<b>Process Connection:</b>	0	10K 50A RF, 316, flange JIS B2220
		1	NPS 2" Cl.150 RF, 316 flange ASME B16.5
		2	DN50 PN10 B1, 316, flange EN1092-1 (DIN2527 B)
		3	50A 150lbs RF, 316, flange JPI 7S-15
		4	Universal coupling, G3/4, (Converter only)
		5	Thread M20 (converter only)
		9	Special version, TSP-no. to be spec.
<b>NMT539-</b>	<b>Product designation (Continued on next page)</b>		



## Accessories

### Anchor Weight (High Profile, D120)

#### Mounting Attachment Option: B

This high profile anchor type is designed for converter + temperature probe versions.

**⚠ CAUTION**

Installation of the anchor weight will cause the lowest temperature measurement position to be raised approximately 400mm (16") 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.

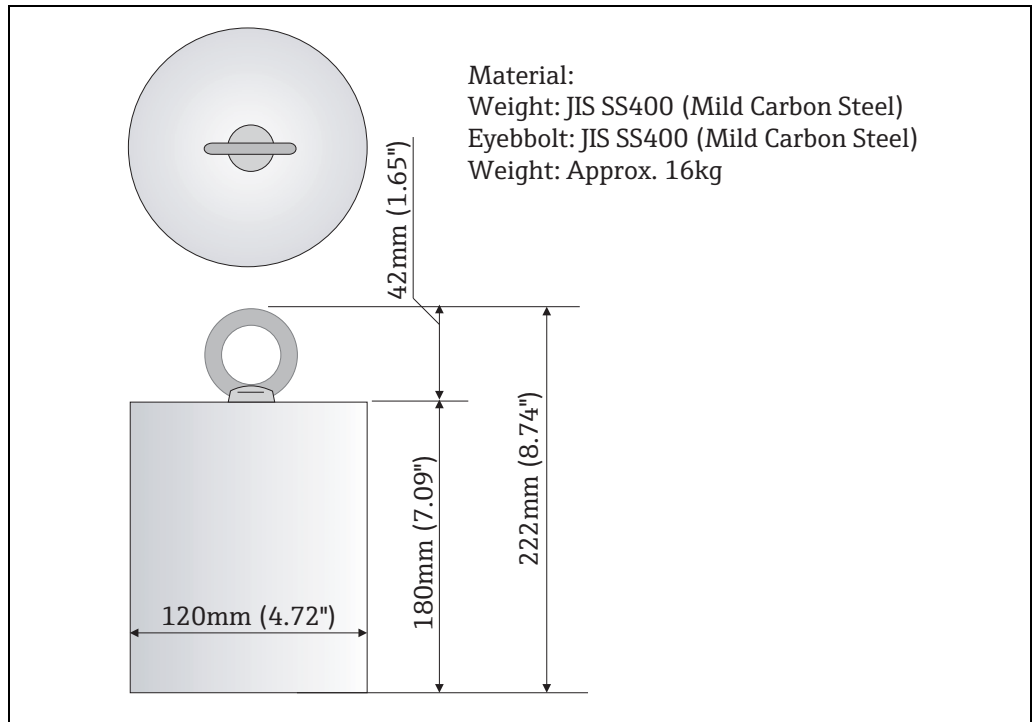


Figure 35: Anchor Weight for High Profile

Different dimensions, weight and material for the anchor weight are also available.

### Anchor Weight (Low Profile, Hexagon H41)

#### Mounting Attachment Option: C

The low profile anchor weight is mainly designed to fix WB 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 version.

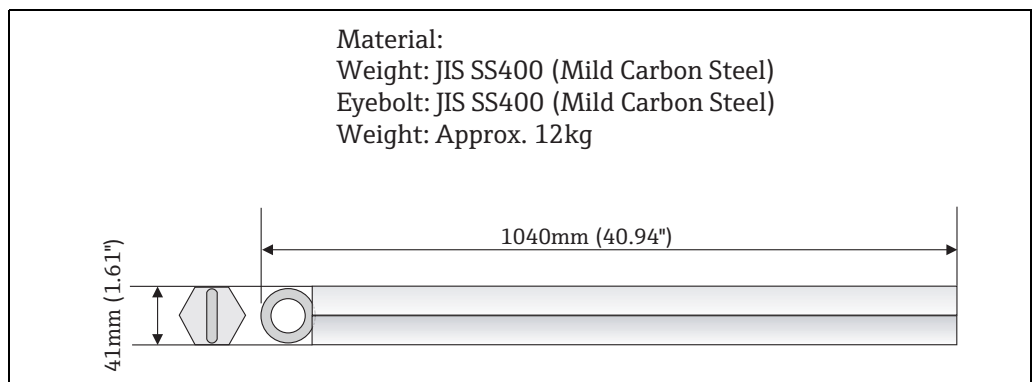


Figure 36: Anchor Weight for Low Profile

## Wire Hook, Top Anchor

## Mounting Attachment Option: D, F

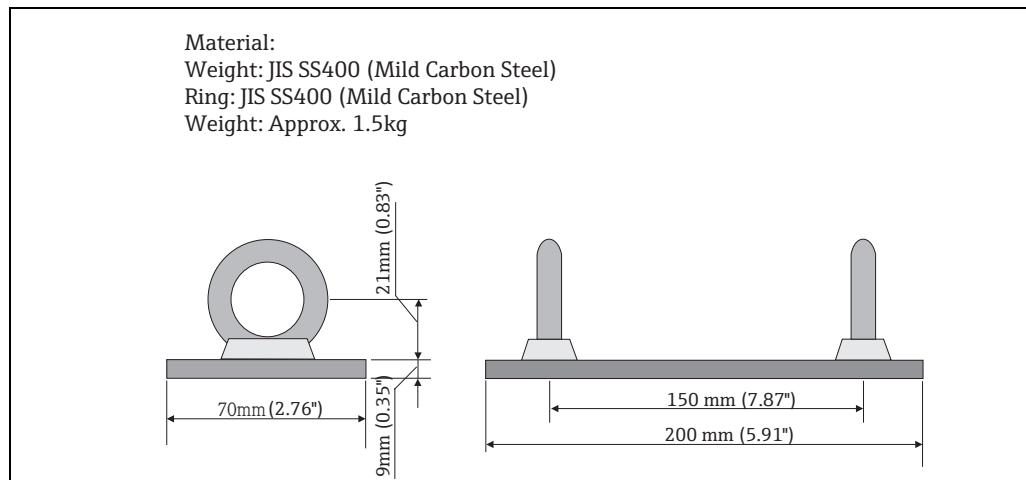


Figure 37: Wier Hook

Actual tension can be performed between wire hook and top anchor with using a tension wire (SUS316, stranded, 3mm diameter).

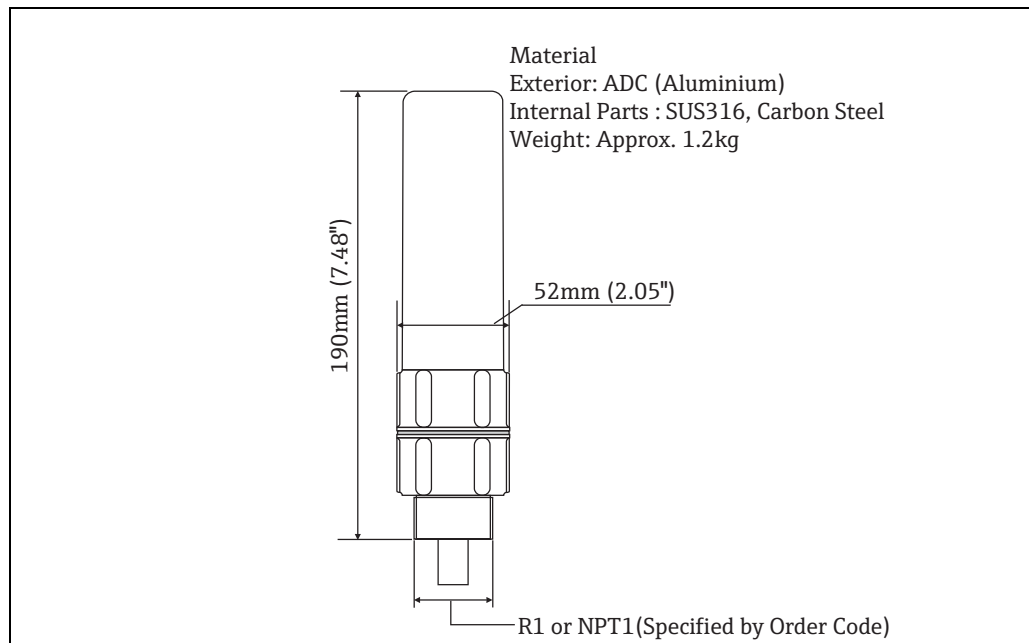


Figure 38: Top Anchor Dimension

**NOTICE**

The standard process connection of the top anchor is R1 or NPT1 threaded connection. However other sizes and materials can be used for the process connection and the flange.



## Documentation

### Technical Information

**TI00452G**  
Proservo NMS5

**TI00462G**  
Promonitor NRF560

**TI00461G**  
Servo Gauge TGM5

**TI00463G**  
Digital Transmitter TMD1

### Operating Instructions

**BA01025G**  
Prothermo NMT539 (Installation Instructions)

**BA01026G**  
Prothermo NMT539 (Operating Instructions and Description of Instrument Function)

### Certificates

NMT539	TIIS	ATEX	IEC	NEPSI	FM	CSA
Temp. Converter	Ex496-826XJ(Ex ia)	XA00585G-A	XA00583G-A	XA01259G	Ex461-851-1	Ex462-712-2
Average Temp. and/or WB Sensor (Exi)	Ex463-820XJ(Ex ia)				Ex461-850-1	Ex462-711-2
Average Temp. (High Temp.)	Ex495-823XJ(Ex ia)					
Average Temp.(Low Temp.)	Ex1061-986XJ(Ex ia)					
Average Temp. and/or WB Sensor (Ex d  ia )	Ex1016-983XJ(Ex d  ia )					

## Appendix

### Stainless Steel Conversion Table

The stainless steel material used in products of Endress + Hauser Yamanashi normally have expressions according to Japanese industrial standards, such as JIS (Japanese Industrial Standard). Each country or region may have different expressions.

The following conversion table contains the expression of equivalent stainless steel material based on chemical composition and mechanical properties.

Country	Standard	Expressions			
Japan	JIS	SUS304	SUS304L	SUS316	SUS316L
Germany	DIN 17006	X5 CrNi 18 10 X5 CrNi 18 12	X2 CrNi 18 11	X5 CrNiMo 17 12 2 / 1713 3	X2 CrNiMo 17 13 2
	W.N. 17007	1.4301 1.4303	1.4306	1.4401 / 1.4436	1.4404
France	AFNOR	Z 6 CN 18-09	Z 2CN 18-10	Z 6 CND 17-11 / 17 12	Z2 CND 17-12
Italy	UNI	X5 CrNi 1810	X2 CrNi 1911	X5 CrNiMo 1712 / 1713	X2 CrNiMo 1712
U.K.	BSI	304S15 / 304S16	304S11	316S31 / 316S33	316S11
U.S.A.	AISI	304	304 L	316	316L
E.U.	EURONORM	X6 CrNi 1810	X3 CrNi 1810	X6 CrNiMo 17 12 2 / 17 13 3	X3 CrNiMo 17 12 2
Spain	UNE	X6 CrNi 19-10	X2 CrNi 19-10	X6 CrNiMo 17-12-03	X2 CrNiMo 17-12-03
Russia	GOST	08KH18N10 06KH18N11	03KH18N11	-	03KH17N14M2
-	ISO	11	10	20	19
-	ASME	S30400	S30403	S31600	S31603

#### NOTICE

Standards may be not necessarily correspond exactly to JIS, because they are defined by mechanical and chemical criteria.

[www.addresses.endress.com](http://www.addresses.endress.com)

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