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Technical Information
iTHERM ModuLine TM131

Industrial modular thermometer



Metric RTD/TC thermometer with welded thermowell for a wide range of industrial applications

Application

- For universal use
- Measuring range: −200 to +1 100 °C (−328 to +2 012 °F)
- Pressure range up to 100 bar (1 450 psi)
- Vibration-resistant sensor elements up to 60g
- Improved ease of maintenance (sensor replacement without process shutdown), easy and safe recalibration of the measuring point

Your benefits

- Dual Seal technology: Second process seal with failure indication offers valuable device health status information
- iTHERM QuickSens: fastest response times of 1.5 s for optimum process control
- iTHERM StrongSens: unsurpassed vibration resistance (> 60g) for ultimate plant safety
- iTHERM QuickNeck – cost and time savings thanks to simple, tool-free recalibration
- Bluetooth® connectivity (optional)
- International certifications: explosion protection according to ATEX, IECEx, CSA and NEPSI

Endress+Hauser
People for Process Automation

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About this document

Symbols

Electrical symbols

⎓	Direct current	~	Alternating current	≂	Direct and alternating current
⏚	Ground connection	⏚	Protective earth (PE)		

Symbols for certain types of information

Symbol	Meaning
✓	**Permitted** Procedures, processes or actions that are permitted.
✓✓	**Preferred** Procedures, processes or actions that are preferred.
✗	**Forbidden** Procedures, processes or actions that are forbidden.
i	**Tip** Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Visual inspection

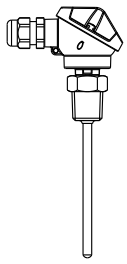
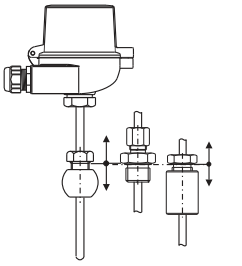
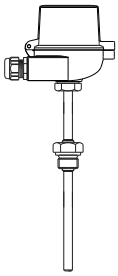
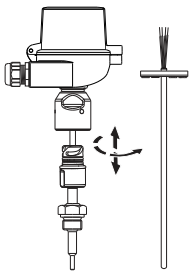
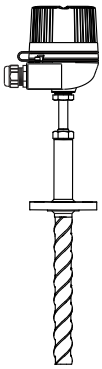
Symbols in graphics

Symbol	Meaning	Symbol	Meaning
1, 2, 3,...	Item numbers	1., 2., 3...	Series of steps
A, B, C, ...	Views	A-A, B-B, C-C, ...	Sections
EX	Hazardous area	EX	Safe area (non-hazardous area)

Function and system design

iTHERM ModuLine This thermometer is part of the product line of modular thermometers for industrial applications.

Differentiating factors when selecting a suitable thermometer:

Thermowell	**Direct contact - without thermowell**		**Thermowell, welded**		**Thermowell from barstock material**
Device type	Metric				
Thermometer	TM101  A0039102	TM111  A0038281	TM121  A0038194	TM131  A0038195	TM151  A0052360
FLEX segment	**F**	**E**	**F**	**E**	**E**
Properties	Excellent price-performance ratio	iTHERM StrongSens and QuickSens inserts	Excellent price-performance ratio with thermowell	▪ iTHERM StrongSens and QuickSens inserts ▪ iTHERM QuickNeck ▪ Fast response times ▪ Dual Seal technology ▪ Dual compartment housing	▪ iTHERM StrongSens and iTHERM QuickSens inserts ▪ iTHERM QuickNeck ▪ iTHERM TwistWell ▪ Fast response times ▪ Dual Seal technology ▪ Dual compartment housing
Hazardous area	-	EX	-	EX	EX

Measuring principle

Resistance thermometers (RTD)

These resistance thermometers use a Pt100 temperature sensor according to IEC 60751. The temperature sensor is a temperature-sensitive platinum resistor with a resistance of 100 Ω at 0 °C (32 °F) and a temperature coefficient $\alpha = 0.003851\ °C^{-1}$.

There are generally two different kinds of platinum resistance thermometers:

- **Wire-wound (WW):WW** In these thermometers, a double coil of fine, high-purity platinum wire is accommodated in a ceramic support. This support is then sealed top and bottom with a ceramic protective layer. Such resistance thermometers not only facilitate very reproducible measurements but also offer good long-term stability of the resistance/temperature characteristic within temperature ranges up to 600 °C (1 112 °F). This type of sensor is relatively large in size and is comparatively sensitive to vibrations.
- **Thin-film platinum resistance thermometers(TF):** A very thin, ultrapure platinum layer, approx. 1 µm thick, is vaporized in a vacuum on a ceramic substrate and then structured photolithographically. The platinum conductor paths formed in this way create the measuring resistance. Additional covering and passivation layers are applied and reliably protect the thin platinum layer from contamination and oxidation, even at high temperatures.

The primary advantages of thin-film temperature sensors over wire wound versions are their smaller sizes and better vibration resistance. It should be noted that, due to the operating principle of TF sensors, they frequently exhibit a relatively slight deviation in their resistance/temperature characteristic from the standard characteristic defined in IEC 60751 at higher temperatures. As a result, the tight limit values of tolerance class A as per IEC 60751 can only be observed with TF sensors at temperatures up to approx. 300 °C (572 °F).

Thermocouples (TC)

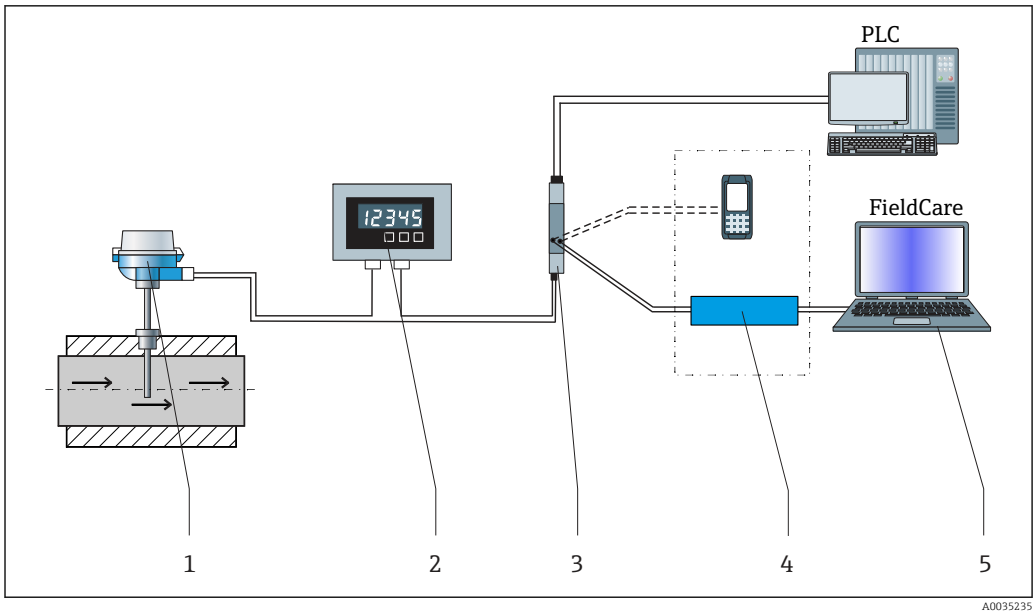
Thermocouples are comparatively simple, robust temperature sensors which use the Seebeck effect for temperature measurement: if two electrical conductors made of different materials are connected at a point, a weak electrical voltage can be measured between the two open conductor ends if the conductors are subjected to a thermal gradient. This voltage is called thermoelectric voltage or electromotive force (emf). Its magnitude depends on the type of conducting materials and the temperature difference between the "measuring point" (the junction of the two conductors) and the "cold junction" (the open conductor ends). Accordingly, thermocouples primarily only measure differences in temperature. The absolute temperature at the measuring point can be determined from these if the associated temperature at the cold junction is known or is measured separately and compensated for. The material combinations and associated thermoelectric voltage/temperature characteristics of the most common types of thermocouple are standardized in the IEC 60584 and ASTM E230/ANSI MC96.1 standards.

Measuring system

Endress+Hauser offers a complete portfolio of optimized components for the temperature measuring point – everything needed for the seamless integration of the measuring point into the overall facility. These include:

- Power supply unit/barrier
- Display units
- Overvoltage protection

For more information, see the brochure "System Components - Solutions for a Complete Measuring Point" (FA00016K)

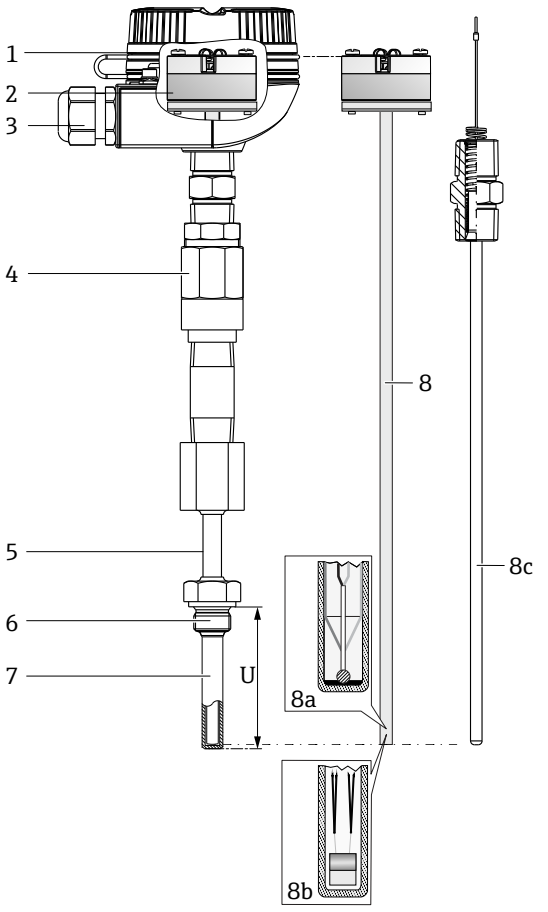


1 Example of application, measuring point layout with additional Endress+Hauser components

1 *Installed iTHERM thermometer with HART® communication protocol*
2 *Process indicator from the RIA product family. The process indicator is integrated into the current loop and displays the measuring signal or HART® process variables in digital form. The process indicator does not require an external power supply. It is powered directly from the current loop.*
3 *RN Series active barrier - The active barrier (17.5 V_{DC}, 20 mA) has a galvanically isolated output for supplying voltage to loop-powered transmitters. The universal power supply works with an input supply voltage of 24 to 230 V AC/DC, 0/50/60 Hz, which means that it can be used in all international power grids.*
4 *Communication examples: HART® Communicator (handheld terminal), FieldXpert, Commubox FXA195 for intrinsically safe HART® communication with FieldCare via USB interface*
5 *FieldCare is a FDT-based plant asset management tool from Endress+Hauser, for details see section "accessories".*

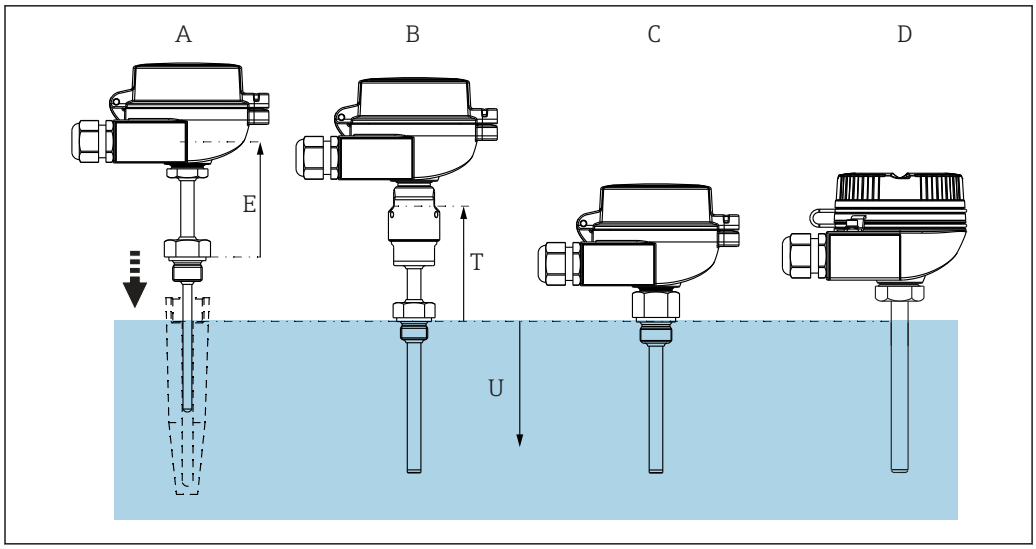
Modular design

Design		Options

	1: Terminal head	Variety of terminal heads made of aluminum, polyamide or stainless steel
		Your benefits:
		▪ Optimum terminal access thanks to low housing edge of bottom section:
		  ▪ Easier to use
		  ▪ Lower installation and maintenance costs
		▪ Optional display: local process indicator for added reliability

	2: Wiring, electrical connection, output signal	▪ Ceramic terminal block ▪ Flying leads ▪ Head transmitter: (4 to 20 mA, HART®, Ethernet-APL, PROFIBUS® PA, FOUNDATION™ Fieldbus), IO-Link® (one-channel or two-channel) ▪ Plug-in display
	3: Plug or cable gland	▪ Polyamide or brass cable glands ▪ M12 plug, 4-pin/8-pin: PROFIBUS® PA, Ethernet-APL, IO-Link® ▪ 7/8" plug: PROFIBUS® PA, FOUNDATION™ Fieldbus
	4: Removable extension neck	Different extension neck options are available ▪ Without extension neck according to DIN 43772 Form 2 ▪ Thermowell lagging according to Form 2 F/G, 3G/G removable extension neck according to DIN 43772 ▪ iTHERM QuickNeck ▪ Extension neck with second process seal ▪ Nipple, Nipple-Union, or Nipple-Union-Nipple **Your benefits:** **iTHERM QuickNeck:** tool-free removal of the insert: Saves time/costs on frequently calibrated measuring points and avoids wiring errors
	5: Lagging	The thermowell lagging ensures the required distance between the thermometer connection and the process connection
	6: Process connection	Variety of process connections including threads, flanges according to EN or ASME standard, compression fittings
	7: Thermowell	Versions with and without thermowell (insert in direct contact with process). Various diameters, materials and tip shapes (reduced, straight or tapered) **Your benefits:** Quick-response thermowell, compared to traditional design, reduces the t_{90} response time of the temperature measurement by a factor of 4

	8: Insert with:
	8a: iTHERM QuickSens
	8b: iTHERM StrongSens
	8c: Central-spring-loaded insert
		Sensor models: RTD - wire wound (WW), thin film sensor (TF) or thermocouples type K, J or N. Insert diameter Ø3 mm (0.12 in) or Ø6 mm (0.24 in), depending on thermowell tip or selected thermometer
		Your benefits:
		▪ **iTHERM QuickSens** - insert with the world's fastest response time:
		  ▪ Fast, highly accurate measurements, delivering maximum process safety and control
		  ▪ Quality and cost optimization
		▪ **iTHERM StrongSens** - insert with unbeatable durability:
		  ▪ Vibration resistance ≤ 60g: lower life cycle costs thanks to longer operating life and high plant availability
		  ▪ Automated, traceable production: top quality and maximum process safety



2 *Different thermowell versions available*

A Thermometer for installation in a separate thermowell
B Thermometer with thermowell, continuous, similar to DIN 43772 Form 2 G/F, 3 G/F
C Thermometer with thermowell, hexagonal, similar to DIN 43772 Form 5, 8
D Thermometer with thermowell, without lagging similar to DIN 43772 Form 2

E Length of removable extension neck - can be replaced (DIN extension neck, second process seal, nipple, etc.)
T Length of thermowell lagging - lagging or extension neck, integral part of the thermowell
U Immersion length - length of the lower thermometer section in the process medium, usually from the process connection

Input

Measured variable

Temperature (temperature-linear transmission behavior)

Measuring range

Depends on the type of sensor used

Sensor type	Measuring range
Pt100 thin film (TF), basic	−50 to +200 °C (−58 to +392 °F)
Pt100 thin film (TF), iTHERM QuickSens	−50 to +200 °C (−58 to +392 °F)
Pt100 thin film (TF), standard	−50 to +400 °C (−58 to +752 °F)
Pt100 thin film (TF), iTHERM StrongSens, vibration-resistant > 60 g	−50 to +500 °C (−58 to +932 °F)
Pt100 wire wound (WW), extended measuring range	−200 to +600 °C (−328 to +1 112 °F)
Thermocouple TC, type J	−40 to +750 °C (−40 to +1 382 °F)
Thermocouple TC, type K	−40 to +1 100 °C (−40 to +2 012 °F)
Thermocouple TC, type N	

Output

Output signal

The measured values can be transmitted in two ways:

- Via directly-wired sensors: sensor measured values are forwarded without an iTEMP transmitter.
- By selecting the appropriate iTEMP transmitter via all common protocols.

All iTEMP transmitters are mounted directly in the terminal head and wired with the sensory mechanism.

Family of temperature transmitters

Thermometers fitted with iTEMP transmitters are an installation-ready complete solution to improve temperature measurement by significantly increasing measurement accuracy and reliability, when compared to direct wired sensors, as well as reducing both wiring and maintenance costs.

4 to 20 mA head transmitters
They offer a high degree of flexibility, thereby supporting universal application with low inventory storage. The iTEMP transmitters can be configured quickly and easily at a PC. Endress+Hauser offers free configuration software which can be downloaded from the Endress+Hauser Website.

HART® head transmitters
The iTEMP transmitter is a 2-wire device with one or two measuring inputs and one analog output. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using HART® communication. Swift and easy operation, visualization and maintenance using universal configuration software like FieldCare, DeviceCare or FieldCommunicator 375/475. Integrated Bluetooth® interface for the wireless display of measured values and configuration via Endress +Hauser SmartBlue (app), optional.

PROFIBUS® PA head transmitters
Universally programmable iTEMP transmitter with PROFIBUS® PA communication. Conversion of various input signals into digital output signals. High measurement accuracy over the complete ambient temperature range. PROFIBUS PA functions and device-specific parameters are configured via fieldbus communication.

FOUNDATION Fieldbus™ head transmitter
Universally programmable iTEMP transmitter with FOUNDATION Fieldbus™ communication. Conversion of various input signals into digital output signals. High measurement accuracy over the complete ambient temperature range. All iTEMP are approved for use in all the main process control systems. The integration tests are performed in Endress+Hauser's 'System World'.

Head transmitter with PROFINET® and Ethernet-APL™
The iTEMP transmitter is a 2-wire device with two measuring inputs. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using the PROFINET® protocol. Power is supplied via the 2-wire Ethernet connection according to IEEE 802.3cg 10Base-T1. The iTEMP can be installed as an intrinsically safe electrical apparatus in Zone 1 hazardous areas. The device can be used for instrumentation purposes in the terminal head form B (flat face) according to DIN EN 50446.

Head transmitter with IO-Link®
The iTEMP transmitter is an IO-Link® device with a measurement input and an IO-Link® interface. It offers a configurable, simple and cost-effective solution thanks to digital communication via IO-Link®. The device is mounted in a terminal head form B (flat face) as per DIN EN 5044.

Advantages of the iTEMP transmitters:
- Double or single sensor input (optionally for certain transmitters)
- Attachable display (optionally for certain transmitters)
- Unsurpassed reliability, accuracy and long-term stability in critical processes
- Mathematical functions
- Monitoring of the thermometer drift, sensor backup functionality, sensor diagnostic functions
- Sensor-transmitter-matching based on the Callendar van Dusen coefficients (CvD).

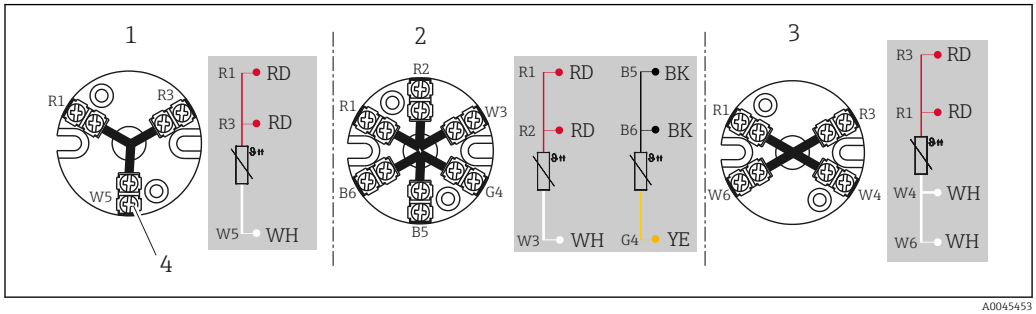
Field transmitter
Field transmitter with HART®, FOUNDATION Fieldbus™ or PROFIBUS® PA communication and backlighting. Can be read easily from a distance, in sunlight and at night. Large measurement value format, bar graphs and faults are displayed. The benefits are: dual sensor input, highest reliability in harsh industrial environments, mathematical functions, thermometer drift monitoring and sensor back-up functionality, corrosion detection.

Power supply

The sensor connection wires are equipped with terminal lugs. The nominal diameter of the lug is 1.3 mm (0.05 in).

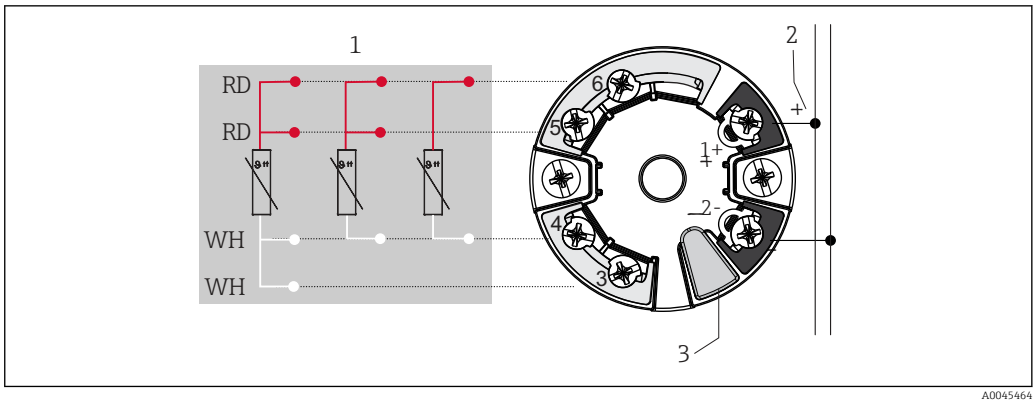
Terminal assignment

RTD sensor connection type



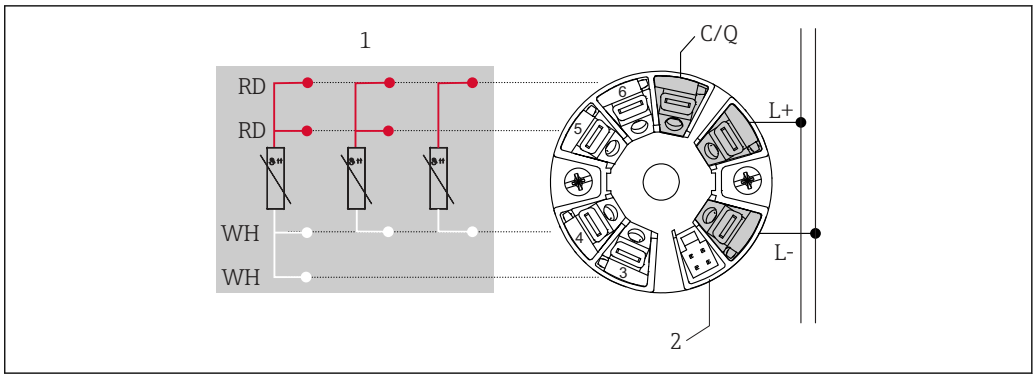
3 Mounted ceramic terminal block

1 3-wire
2 2x3-wire
3 4-wire
4 Outside screw



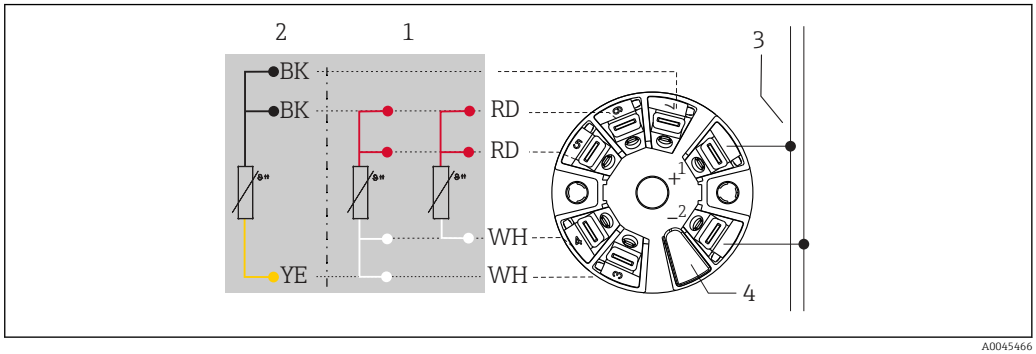
4 *Head-mounted iTEMP TMT7x transmitter or iTEMP TMT31 (single sensor input)*

1 Sensor input, RTD, 4-, 3- and 2-wire
2 Power supply/bus connection
3 Display connection/CDI interface



5 *Head-mounted iTEMP TMT36 transmitter (single sensor input)*

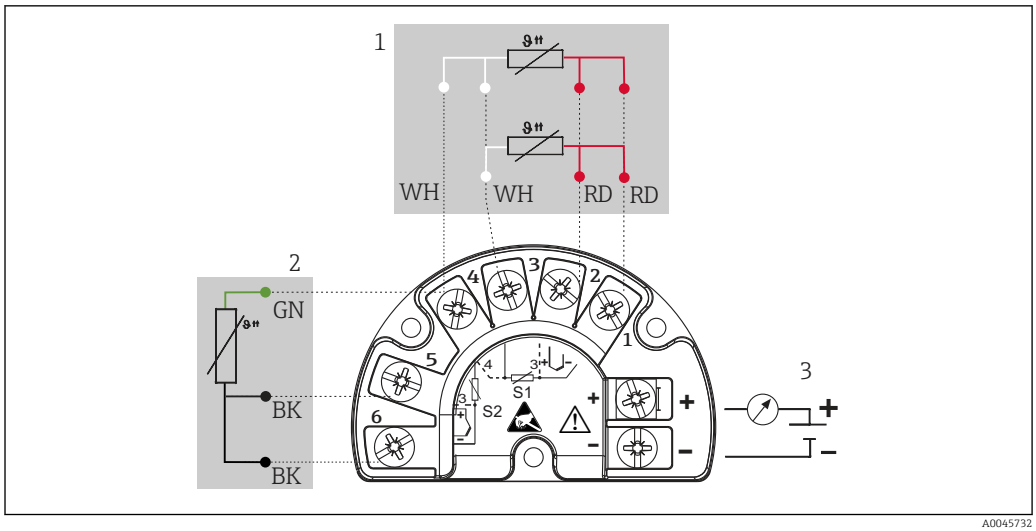
1 RTD sensor input: 4-, 3- and 2-wire
2 Display connection
L+ 18 to 30 V_{DC} power supply
L- 0 V_{DC} power supply
C/Q IO-Link or switch output



6 *Head-mounted iTEMP TMT8x transmitter (dual sensor input)*

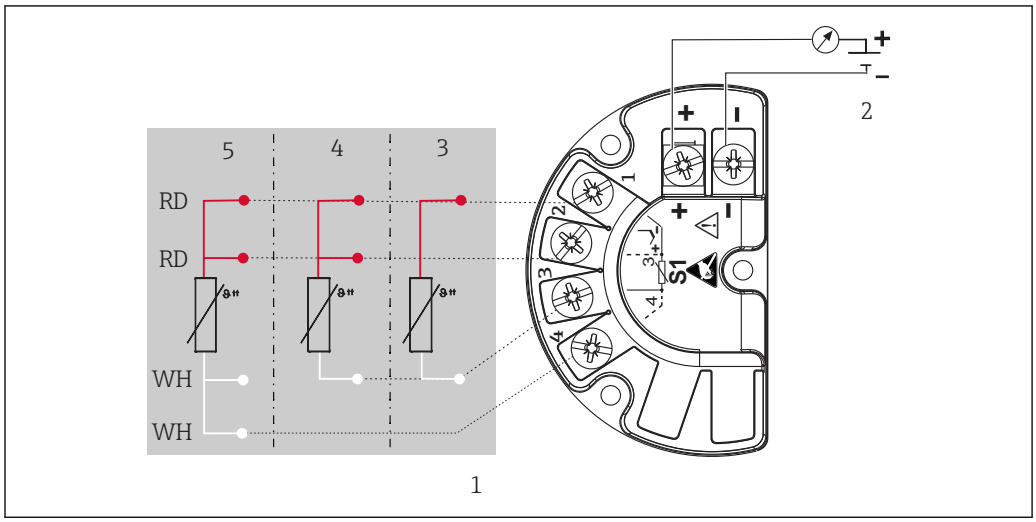
1 Sensor input 1, RTD, 4- and 3-wire
2 Sensor input 2, RTD, 3-wire
3 Fieldbus connection and power supply
4 Display connection

Mounted field transmitter: Fitted with screw terminals



7 iTEMP TMT162 (dual input)

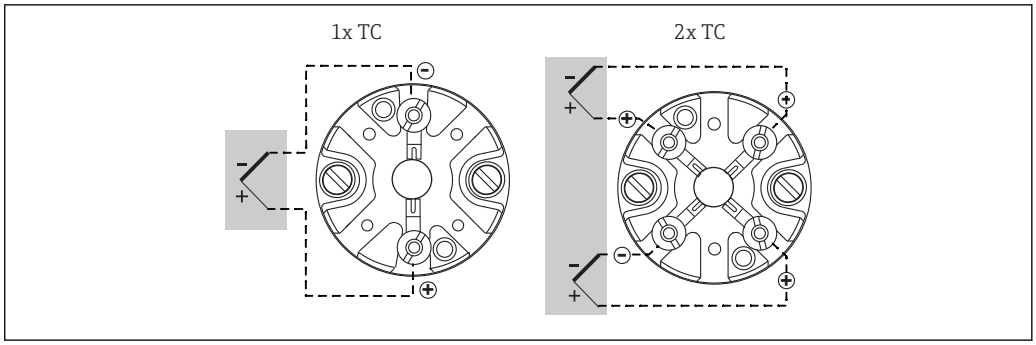
1 Sensor input 1, RTD: 3- and 4-wire
2 Sensor input 2, RTD: 3-wire
3 Power supply field transmitter and analog output 4 to 20 mA or fieldbus connection



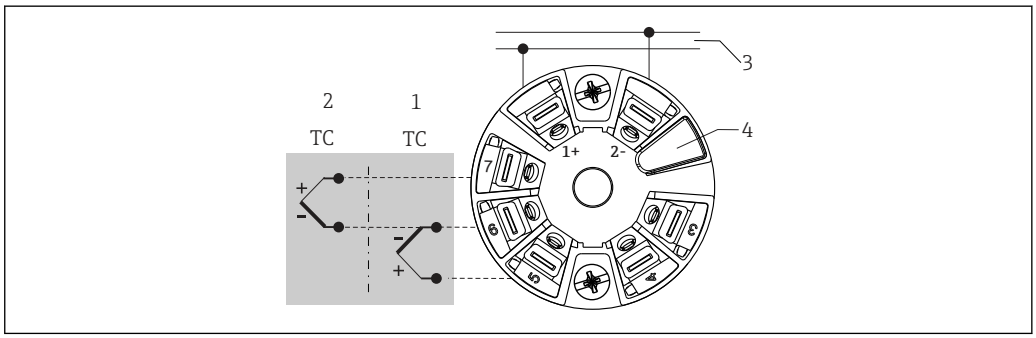
8 iTEMP TMT142B (single input)

1 Sensor input RTD
2 Power supply field transmitter and analog output 4 to 20 mA, HART® signal
3 2-wire
4 3-wire
5 4-wire

Thermocouple (TC) sensor connection type

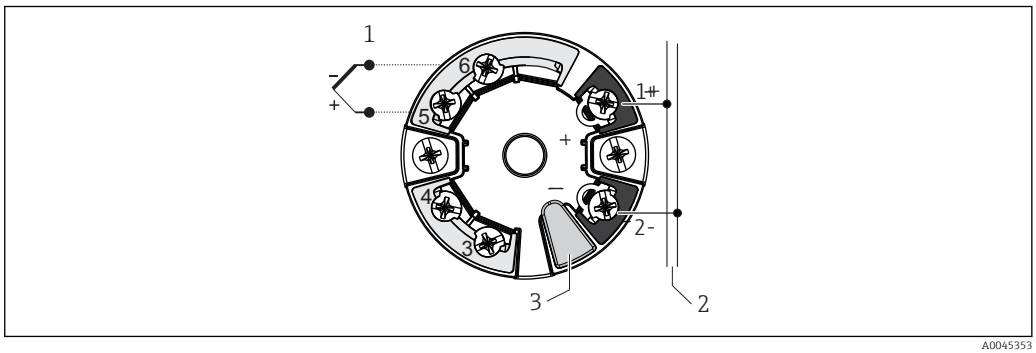


9 *Installed ceramic terminal block for thermocouples.*



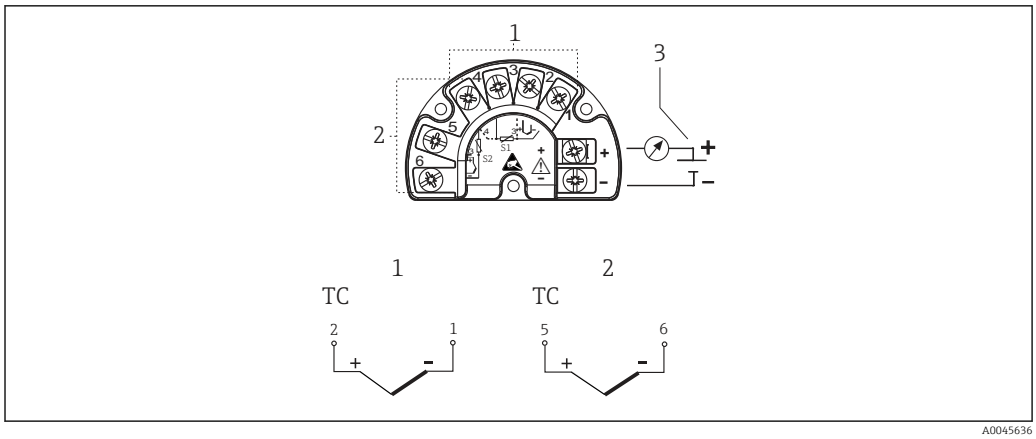
10 *Head-mounted iTEMP TMT8x transmitter (dual sensor input)*

1 *Sensor input 1*
2 *Sensor input 2*
3 *Fieldbus connection and power supply*
4 *Display connection*



11 *Head-mounted iTEMP TMT7x transmitter or iTEMP TMT31 (single sensor input)*

1 *Sensor input*
2 *Power supply and bus connection*
3 *Display connection and CDI interface*



12 Mounted field transmitter iTEMP TMT162 or TMT142B iTEMP

1 Sensor input 1
2 Sensor input 2 (not iTEMP TMT142B)
3 Supply voltage for field transmitter and analog output 4 to 20 mA or fieldbus communication

Thermocouple wire colors

As per IEC 60584	As per ASTM E230
▪ Type J: black (+), white (-) ▪ Type K: green (+), white (-) ▪ Type N: pink (+), white (-)	▪ Type J: white (+), red (-) ▪ Type K: yellow (+), red (-) ▪ Type N: orange (+), red (-)

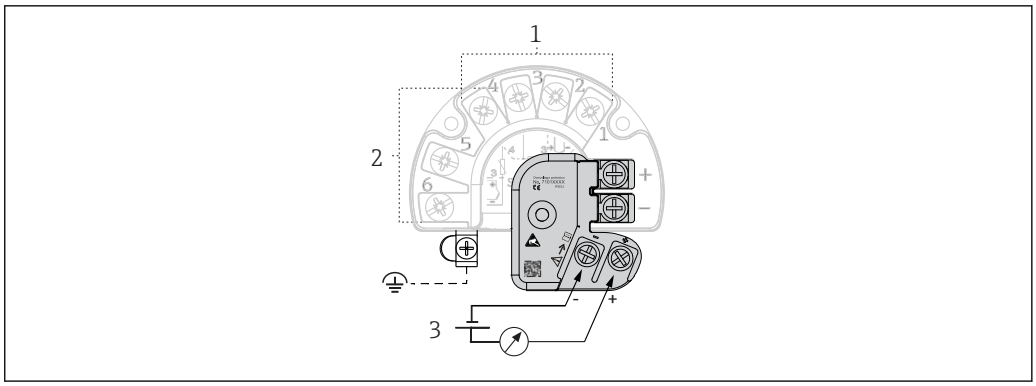
Integrated overvoltage protection

Overvoltage protection is optionally available [1]. The module protects the electronics from damage from overvoltage. Overvoltage occurring in signal cables (e.g. 4 to 20 mA, communication lines (fieldbus systems) and power supply is diverted to ground. The functionality of the transmitter is not affected as no problematic voltage drop occurs.

Connection data:

Maximum continuous voltage (rated voltage)	U_C = 36 V_{DC}
Nominal current	I = 0.5 A at $T_{amb.}$ = 80 °C (176 °F)
Surge current resistance ▪ Lightning surge current D1 (10/350 µs) ▪ Nominal discharge current C1/C2 (8/20 µs)	 ▪ I_{imp} = 1 kA (per wire) ▪ I_n = 5 kA (per wire) I_n = 10 kA (total)
Temperature range	–40 to +80 °C (–40 to +176 °F)
Series resistance per wire	1.8 Ω, tolerance ±5 %

1) Available for the field transmitters with HART® 7 communication



13 Electrical connection of overvoltage protection

1 Sensor connection 1
2 Sensor connection 2
3 Bus connection and power supply

The device must be connected to the potential equalization via the external ground clamp. The connection between the housing and the local ground must have a minimum cross-section of 4 mm² (13 AWG). All ground connections must be secured tightly.

Terminals

iTEMP head transmitters fitted with push-in terminals unless screw terminals are explicitly selected, the second process seal is chosen or a double sensor is installed.

Terminal design	Cable design	Cable cross-section
Screw terminals	Rigid or flexible	≤ 1.5 mm² (16 AWG)
Push-in terminals (cable version, stripping length = min. 10 mm (0.39 in)	Rigid or flexible	0.2 to 1.5 mm² (24 to 16 AWG)
	Flexible with ferrules (with or without plastic ferrule)	0.25 to 1.5 mm² (24 to 16 AWG)

Ferrules must be used with push-in terminals and when using flexible cables with a cable cross-section of ≤ 0.3 mm². Otherwise, the use of ferrules when connecting flexible cables to push-in terminals is not recommended.

Cable entries

The cable entries must be selected during configuration of the device. Different terminal heads offer different options in terms of the thread and number of available cable entries.

Device plug

The manufacturer offers a wide variety of device plugs for the simple and fast integration of the thermometer into a process control system. The following tables show the PIN assignments of the various plug connector combinations.

The manufacturer advises against connecting thermocouples directly to connectors. The direct connection to the pins of the plug might generate a new "thermocouple" which influences the accuracy of the measurement. The thermocouples are connected in combination with a iTEMP transmitter.

Abbreviations

#1	Order: first transmitter/insert	#2	Order: second transmitter/insert
i	Insulated. Wires marked 'i' are not connected and are insulated with heat shrink tubes.	YE	Yellow
GND	Grounded. Wires marked 'GND' are connected to the internal grounding screw in the terminal head.	RD	Red
BN	Brown	WH	White
GNYE	Green-yellow	PK	Pink

BU	Blue	GN	Green
GY	Gray	BK	Black

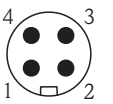
Terminal head with a cable entry [1)]

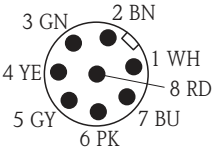
Plug	**1x PROFIBUS® PA**								**1x FOUNDATION™ Fieldbus (FF)**				**1x PROFINET® and Ethernet-APL™**			
Plug thread	M12				7/8"				7/8"				M12			
PIN number	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Electrical connection (terminal head)																
Flying leads and TC	Not connected (not insulated)															
3-wire terminal block (1x Pt100)	RD	RD	WH		RD	RD	WH		RD	RD	WH		RD	RD	WH	
4-wire terminal block (1x Pt100)			WH	WH			WH	WH			WH	WH			WH	WH
6-wire terminal block (2x Pt100)	RD (#1) [2)]	RD (#1)	WH (#1)		RD (#1)	RD (#1)	WH (#1)		RD (#1)	RD (#1)	WH (#1)				WH (#1)	
1x TMT 4 to 20 mA or HART®	+	i	-	i	+	i	-	i	+	i	-	i	Cannot be combined			
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover	+(#1)	+(#2)	-(#1)	-(#2)	+(#1)	+(#2)	-(#1)	-(#2)	+(#1)	+(#2)	-(#1)	-(#2)	Cannot be combined			
1x TMT PROFIBUS® PA	+	i	-	GND [3)]	+	i	-	GND [3)]	Cannot be combined							
2x TMT PROFIBUS® PA	+(#1)		-(#1)		+		-									
1x TMT FF	Cannot be combined				Cannot be combined				-	+	GND	i	Cannot be combined			
2x TMT FF									-(#1)	+(#1)						
1x TMT PROFINET®									Cannot be combined				Ethernet-APL signal -	Ethernet-APL signal +	GND	-
2x TMT PROFINET®													Ethernet-APL signal - (#1)	Ethernet-APL signal + (#1)		
PIN position and color code	4 3 1 2 1 BN 2 GNYE 3 BU 4 GY A0018929				1 3 2 4 1 BN 2 GNYE 3 BU 4 GY A0018930				1 3 2 4 1 BU 2 BN 3 GY 4 GNYE A0018931				4 3 1 2 1 RD 2 GN A0052119			

1) Options depend on product and configuration
2) Second Pt100 is not connected
3) If a head is used without grounding screw, e.g. plastic housing TA30S or TA30P, insulated 'i' instead of grounded GND

Terminal head with a cable entry [1)]

Plug	**4-pin/8-pin**							
Plug thread	M12							
PIN number	1	2	3	4	5	6	7	8

<table>
<tr><th>Plug</th><th colspan="8">4-pin/8-pin</th></tr>
<tr><td colspan="9"></td></tr>
<tr><td colspan="9">Electrical connection (terminal head)</td></tr>
<tr><td>Flying leads and TC</td><td colspan="8">Not connected (not insulated)</td></tr>
<tr><td>3-wire terminal block (1x Pt100)</td><td rowspan="3">RD</td><td rowspan="3">RD</td><td colspan="2">WH</td><td colspan="4" rowspan="2">i</td></tr>
<tr><td>4-wire terminal block (1x Pt100)</td><td>WH</td><td>WH</td></tr>
<tr><td>6-wire terminal block (2x Pt100)</td><td colspan="2">WH</td><td>BK</td><td>BK</td><td colspan="2">YE</td></tr>
<tr><td>1x TMT 4 to 20 mA or HART®</td><td rowspan="2">+(#1)</td><td rowspan="2">i</td><td rowspan="2">-(#1)</td><td rowspan="2">i</td><td colspan="4">i</td></tr>
<tr><td>2x TMT 4 to 20 mA or HART® in the terminal head with a high cover</td><td>+(#2)</td><td>i</td><td>-(#2)</td><td>i</td></tr>
<tr><td>1x TMT PROFIBUS® PA</td><td colspan="8" rowspan="2">Cannot be combined</td></tr>
<tr><td>2x TMT PROFIBUS® PA</td></tr>
<tr><td>1x TMT FF</td><td colspan="8" rowspan="2">Cannot be combined</td></tr>
<tr><td>2x TMT FF</td></tr>
<tr><td>1x TMT PROFINET®</td><td colspan="8">Cannot be combined</td></tr>
<tr><td>2x TMT PROFINET®</td><td colspan="8">Cannot be combined</td></tr>
<tr><td>PIN position and color code</td><td colspan="4">

1 BN
2 GNYE
3 BU
4 GY
A0018929</td><td colspan="4">

A0018927</td></tr>
</table>

1) Options depend on product and configuration

Terminal head with one cable entry

Plug	1x IO-Link®, 4-pin			
Plug thread	M12			
PIN number	1	2	3	4
Electrical connection (terminal head)				
Flying leads	Not connected (not insulated)			
3-wire terminal block (1x Pt100)	RD	i	RD	WH
4-wire terminal block (1x Pt100)	Cannot be combined			
6-wire terminal block (2x Pt100)				
1x TMT 4 to 20 mA or HART®	Cannot be combined			
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover				
1x TMT PROFIBUS® PA	Cannot be combined			
2x TMT PROFIBUS® PA				
1x TMT FF	Cannot be combined			
2x TMT FF				
1x TMT PROFINET®	Cannot be combined			
2x TMT PROFINET®				
1x TMT IO-Link®	L+	-	L-	C/Q

Plug	1x IO-Link®, 4-pin			
2x TMT IO-Link®	L+ (#1)	-	L- (#1)	C/Q
PIN position and color code	 1 BN 3 BU 4 BK A0055383			

Terminal head with two cable entries [1)]

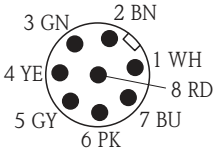
Plug	2x PROFIBUS® PA								2x FOUNDATION™ Fieldbus (FF)				2x PROFINET® and Ethernet-APL™			
Plug thread  A0021706	M12(#1) / M12(#2)				7/8"(#1)/7/8"(#2)				7/8"(#1)/7/8"(#2)				M12 (#1)/M12 (#2)			
PIN number	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Electrical connection (terminal head)																
Flying leads and TC	Not connected (not insulated)															
3-wire terminal block (1x Pt100)	RD/i	RD/i	WH/i		RD/i	RD/i	WH/i		RD/i	RD/i	WH/i		RD/i	RD/i	WH/i	
4-wire terminal block (1x Pt100)			WH/i	WH/i			WH/i	WH/i			WH/i	WH/i			WH/i	WH/i
6-wire terminal block (2x Pt100)	RD/BK	RD/BK	WH/YE		RD/BK	RD/BK	WH/YE		RD/BK	RD/BK	WH/YE		RD/BK	RD/BK	WH/YE	
1x TMT 4 to 20 mA or HART®	+/i	i/i	-/i	i/i	+/i	i/i	-/i	i/i	+/i	i/i	-/i	i/i	+/i	i/i	-/i	i/i
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover	+ (#1)/ + (#2)		- (#1)/ -(#2)		+ (#1)/ + (#2)		- (#1)/ -(#2)		+ (#1)/ + (#2)		- (#1)/ -(#2)		+ (#1)/ +(#2)		- (#1)/ -(#2)	
1x TMT PROFIBUS® PA	+/i		-/i	GND/ GND	+/i		-/i	GND/ GND	Cannot be combined							
2x TMT PROFIBUS® PA	+ (#1)/ + (#2)		- (#1)/ -(#2)		+ (#1)/ + (#2)		- (#1)/ -(#2)									
1x TMT FF	Cannot be combined				Cannot be combined				-/i	+/i	i/i	GND/ GND	Cannot be combined			
2x TMT FF									- (#1)/ -(#2)	+ (#1)/ + (#2)						
1x TMT PROFINET®	Cannot be combined				Cannot be combined				Cannot be combined				Ethernet-APL signal -	Ethernet-APL signal +	GND	i

Plug	2x PROFIBUS® PA		2x FOUNDATION™ Fieldbus (FF)	2x PROFINET® and Ethernet-APL™			
2x TMT PROFINET®	Cannot be combined	Cannot be combined	Cannot be combined	Ethernet-APL signal - (#1) and (#2)	Ethernet-APL signal + (#1) and (#2)		
PIN position and color code	 1 BN 2 GNYE 3 BU 4 GY A0018929	 1 BN 2 GNYE 3 BU 4 GY A0018930	 1 BU 2 BN 3 GY 4 GNYE A0018931	 1 RD 2 GN A0052119			

1) Options depend on product and configuration

Terminal head with two cable entries [1)]

Plug	4-pin/8-pin							
Plug thread  A0021706	M12 (#1)/M12 (#2)							
PIN number	1	2	3	4	5	6	7	8

Electrical connection (terminal head)					
Flying leads and TC	Not connected (not insulated)				
3-wire terminal block (1x Pt100)	RD/i	RD/i	WH/i		i/i
4-wire terminal block (1x Pt100)			WH/i	WH/i	
6-wire terminal block (2x Pt100)	RD/BK	RD/BK	WH/YE		
1x TMT 4 to 20 mA or HART®	+/i	i/i	-/i	i/i	
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover	+(#1)/ +(#2)		-(#1)/-(#2)		
1x TMT PROFIBUS® PA	Cannot be combined				
2x TMT PROFIBUS® PA					
1x TMT FF	Cannot be combined				
2x TMT FF					
1x TMT PROFINET®	Cannot be combined				
2x TMT PROFINET®	Cannot be combined				
PIN position and color code	 1 BN 2 GNYE 3 BU 4 GY A0018929				 A0018927

1) Options depend on product and configuration

Terminal head with two cable entries

Plug	2x IO-Link®, 4-pin			
Plug thread	M12(#1)/M12 (#2)			
PIN number	1	2	3	4
Electrical connection (terminal head)				
Flying leads	Not connected (not insulated)			
3-wire terminal block (1x Pt100)	RD	i	RD	WH
4-wire terminal block (1x Pt100)	Cannot be combined			
6-wire terminal block (2x Pt100)	RD/BK	i	RD/BK	WH/YE
1x TMT 4 to 20 mA or HART®	Cannot be combined			
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover				
1x TMT PROFIBUS® PA	Cannot be combined			
2x TMT PROFIBUS® PA				
1x TMT FF	Cannot be combined			
2x TMT FF				
1x TMT PROFINET®	Cannot be combined			
2x TMT PROFINET®				
1x TMT IO-Link®	L+	-	L-	C/Q
2x TMT IO-Link®	L+ (#1) and (#2)	-	L- (#1) and (#2)	C/Q
PIN position and color code	 1 BN 3 BU 4 BK A0055383			

Connection combination: insert - transmitter [1)]

Insert	Transmitter connection [2)]			
	iTEMP TMT31/iTEMP TMT7x		iTEMP TMT8x	
	1x 1-channel	2x 1-channel	1x 2-channel	2x 2-channel
1x sensor (Pt100 or TC), flying leads	Sensor (#1) : transmitter (#1)	Sensor (#1) : transmitter (#1) (Transmitter (#2) not connected)	Sensor (#1) : transmitter (#1)	Sensor (#1) : transmitter (#1) Transmitter (#2) not connected
2x sensor (2x Pt100 or 2x TC), flying leads	Sensor (#1) : transmitter (#1) Sensor (#2) insulated	Sensor (#1) : transmitter (#1) Sensor (#2): transmitter (#2)	Sensor (#1) : transmitter (#1) Sensor (#2): transmitter (#1)	Sensor (#1) : transmitter (#1) Sensor (#2): transmitter (#1) (Transmitter (#2) not connected)
1x sensor (Pt100 or TC),with terminal block [3)]	Sensor (#1) : transmitter in cover	Cannot be combined	Sensor (#1) : transmitter in cover	Cannot be combined

Insert	Transmitter connection [2]			
	iTEMP TMT31/iTEMP TMT7x		iTEMP TMT8x	
	1x 1-channel	2x 1-channel	1x 2-channel	2x 2-channel
2x sensor (2x Pt100 or 2x TC) with terminal block	Sensor (#1) : transmitter in cover Sensor (#2) not connected		Sensor (#1) : transmitter in cover Sensor (#2): transmitter in cover	
2x sensors (2x Pt100 or 2x TC) in conjunction with feature 600, option MG [4]	Cannot be combined	Sensor (#1) : transmitter (#1) Sensor (#2): transmitter (#2)	Cannot be combined	Sensor (#1): transmitter (#1) - channel 1 Sensor (#2): transmitter (#2) - channel 1

1) Options depend on product and configuration
2) If 2 transmitters are selected in a terminal head, transmitter (#1) is installed directly on the insert. Transmitter (#2) is installed in the high cover. A TAG cannot be ordered for the second transmitter as standard. The bus address is set to the default value and, if necessary, must be changed manually before commissioning.
3) Only in the terminal head with a high cover, only 1 transmitter possible. A ceramic terminal block is automatically fitted on the insert.
4) Individual sensors each connected to channel 1 of a transmitter

Overvoltage protection

To protect against overvoltages in the supply and signal/communication lines for the thermometer electronics, Endress+Hauser offers surge arresters from the HAW product family.

For further information, see the technical information for the respective surge arrester.

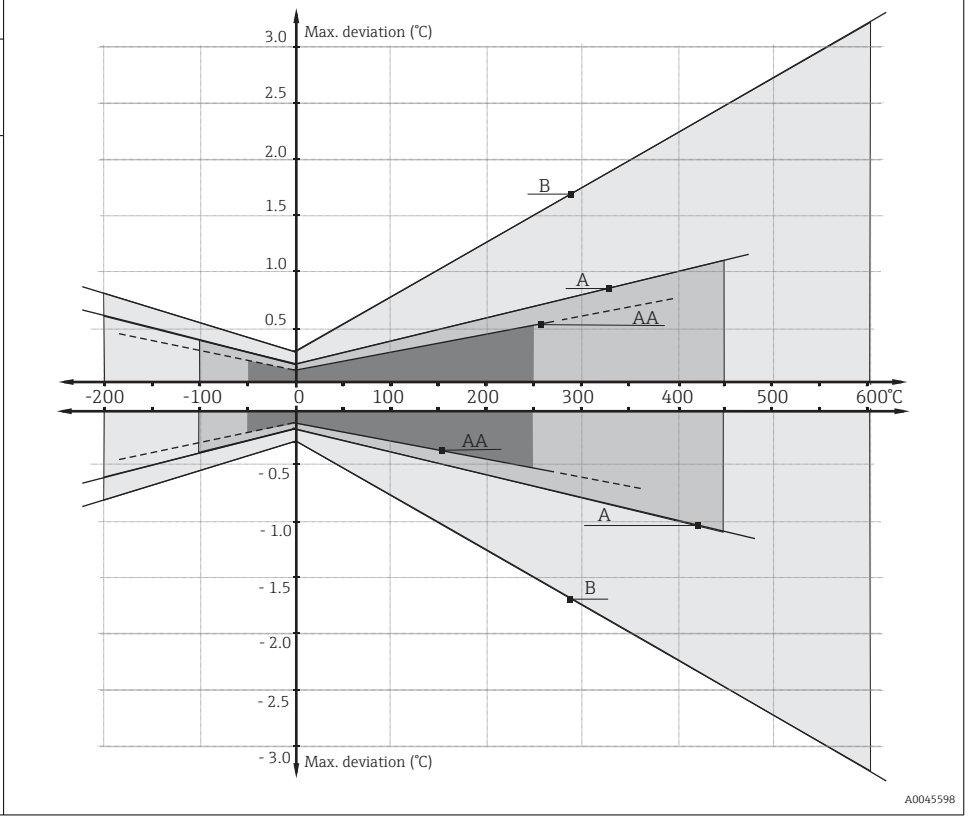
Performance characteristics

Reference operating conditions

This data is relevant for determining the measurement accuracy of the iTEMP transmitters used. See technical documentation of the specific iTEMP transmitter.

Maximum measurement error

RTD resistance thermometer corresponding to IEC 60751

Class	Max. tolerances (°C)	Characteristics
RTD maximum sensor error		
Cl. A	± (0.15 + 0.002 · |t| [1])	
Cl. AA, previously 1/3 Cl. B	± (0.1 + 0.0017 · |t|) [1]	
Cl. B	± (0.3 + 0.005 · |t| [1])	

1) |t| = Temperature absolute value in °C

To get the maximum tolerances in °F, multiply the results in °C by a factor of 1.8.

Temperature ranges

Sensor type [1]	Operating temperature range	Class B	Class A	Class AA
Pt100 (WW)	−200 to +600 °C (−328 to +1 112 °F)	−200 to +600 °C (−328 to +1 112 °F)	−100 to +450 °C (−148 to +842 °F)	−50 to +250 °C (−58 to +482 °F)
Pt100 (TF) Basic	−50 to +200 °C (−58 to +392 °F)	−50 to +200 °C (−58 to +392 °F)	−30 to +200 °C (−22 to +392 °F)	-
Pt100 (TF) Standard	−50 to +400 °C (−58 to +752 °F)	−50 to +400 °C (−58 to +752 °F)	−30 to +250 °C (−22 to +482 °F)	0 to +150 °C (+32 to +302 °F)
Pt100 (TF) iTHERM QuickSens	−50 to +200 °C (−58 to +392 °F)	−50 to +200 °C (−58 to +392 °F)	−30 to +200 °C (−22 to +392 °F)	0 to +150 °C (+32 to +302 °F)
Pt100 (TF) iTHERM StrongSens	−50 to +500 °C (−58 to +932 °F)	−50 to +500 °C (−58 to +932 °F)	−30 to +300 °C (−22 to +572 °F)	0 to +150 °C (+32 to +302 °F)

1) Options depend on product and configuration

Permissible deviation limits of thermoelectric voltages from the standard characteristic for thermocouples as per IEC 60584 or ASTM E230/ANSI MC96.1:

Standard	Type	Standard tolerance		Special tolerance	
IEC 60584		Class	Deviation	Class	Deviation
	J (Fe-CuNi)	2	±2.5 °C (−40 to +333 °C) ±0.0075 |t| [1] (333 to 750 °C)	1	±1.5 °C (−40 to +375 °C) ±0.004 |t| [1] (375 to 750 °C)
	K (NiCr-NiAl) N (NiCrSi-NiSi)	2	±0.0075 |t| [1] (333 to 1 200 °C) ±2.5 °C (−40 to +333 °C) ±0.0075 |t| [1] (333 to 1 200 °C)	1	±1.5 °C (−40 to +375 °C) ±0.004 |t| [1] (375 to 1 000 °C)

1) |t| = absolute value in °C

Thermocouples made of base metals are generally supplied so that they comply with the manufacturing tolerances specified in the tables for temperatures > −40 °C (−40 °F). These materials are generally not suitable for temperatures < −40 °C (−40 °F). The tolerances of Class 3 cannot be met. A separate material must be selected for this temperature range. This cannot be handled via the standard product.

Standard	Type	Tolerance class: Standard	Tolerance class: Special
ASTM E230/ANSI MC96.1		Deviation; the larger value applies in each case	
	J (Fe-CuNi)	±2.2 K or ±0.0075 |t| [1] (0 to 760 °C)	±1.1 K or ±0.004 |t| [1] (0 to 760 °C)
	K (NiCr-NiAl) N (NiCrSi-NiSi)	±2.2 K or ±0.02 |t| [1] (−200 to 0 °C) ±2.2 K or ±0.0075 |t| [1] (0 to 1 260 °C)	±1.1 K or ±0.004 |t| [1] (0 to 1 260 °C)

1) |t| = absolute value in °C

The materials for thermocouples are generally supplied in such a way that they comply with the tolerances specified in the table for temperatures > 0 °C (32 °F). These materials are generally not suitable for temperatures < 0 °C (32 °F). The specified tolerances cannot be satisfied. A separate material must be selected for this temperature range. This cannot be handled via the standard product.

Ambient temperature effect

Depends on the head transmitter used. For details, see the respective Technical Information.

Self-heating

RTD elements are passive resistors that are measured using an external current. This measurement current causes a self-heating effect in the RTD element itself, which in turn creates an additional measurement error. In addition to the measurement current, the size of the measurement error is also affected by the temperature conductivity and flow velocity of the process. This self-heating error is negligible when an Endress+Hauser iTEMP transmitter (very small measurement current) is used.

Response time

Tests have been performed in water at 0.4 m/s (according to IEC 60751) and with a 10 K temperature change.

Response time without heat transfer paste, in water. Typical values in seconds (s) [1]

Thermowell diameter	Type of tip	Standard Pt100 (TF)		iTHERM QuickSens		iTHERM StrongSens		Wire-wound sensor (WW)		Thermocouple					
										Type J		Type K		Type N	
		t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}
9x1.25 mm (0.35x0.04 in)	Straight	21	59	11	46	21	62	23	62	20	59	20	60	20	59
	Reduced	8	20	2	7	-	-	8	20	6	18	7	20	-	-
	Tapered	15	42	4	17	-	-	14	41	12	38	13	40	-	-
11x2 mm (0.43x0.08 in)	Straight	32	97	15	71	29	92	39	120	32	90	28	86	27	79
	Reduced	7	19	2	6	-	-	10	20	8	20	8	20	-	-

Thermowell diameter	Type of tip	Standard Pt100 (TF)		iTHERM QuickSens		iTHERM StrongSens		Wire-wound sensor (WW)		Thermocouple					
										Type J		Type K		Type N	
	Fast response	7	15	3	9	11	20	6	13	7	16	9	19	7	15
12x2.5 mm (0.47x0.10 in)	Straight	41	95	11	58	31	96	33	96	31	77	26	63	25	53
	Tapered	22	68	8	38	20	65	24	73	23	58	22	58	19	62
	Straight (fast response)	8	16	3	11	12	22	7	14	8	16	10	20	8	17
	Tapered (fast response)	7	16	3	11	11	21	8	17	8	16	10	20	8	17
14x2 mm (0.55x0.08 in)	Straight	74	253	13	105	55	211	78	259	61	223	46	165	52	187
16x3.5 mm (0.63x0.14 in)	Straight	69	220	21	99	38	156	77	245	59	200	47	156	51	175
¼" SCH80 (13.7x3 mm)	Straight	50	166	14	79	36	121	50	158	51	173	38	131	43	145
½" SCH80 (21.3x3.7 mm)	Straight	-	250	-	230	-	250	-	365	-	335	-	335	-	335
½" SCH40 (21.3x2.8 mm)	Straight	-	350	-	390	-	570	-	450	-	450	-	450	-	450

1) If using a thermowell.

Calibration

Calibration of thermometers

Calibration refers to the comparison between the display of a piece of measuring equipment and the true value of a variable provided by the calibration standard under defined conditions. The aim is to determine the deviation or measurement errors of the UUT from the true value of the measured variable. For thermometers, calibration is usually only performed on the inserts. This checks only the deviation of the sensor element caused by the insert design. However, in most applications, the deviations caused by the design of the measuring point, integration into the process, the influence of ambient conditions, and other factors are significantly greater than the deviations related to the insert. Calibration of inserts is generally carried out using two methods:

- Calibration at fixed points, e.g. at the freezing point of water at 0 °C,
- Calibration compared against a precise reference thermometer.

The thermometer to be calibrated must display either the fixed point temperature or the temperature of the reference thermometer as accurately as possible. Temperature-controlled calibration baths with very homogeneous thermal values, or special calibration furnaces are typically used for thermometer calibrations. The measurement uncertainty may increase due to heat conduction errors and short immersion lengths. The existing measurement uncertainty is recorded on the individual calibration certificate. For accredited calibrations in accordance with ISO 17025, a measurement uncertainty that is twice as high as the accredited measurement uncertainty is not permitted. If this limit is exceeded, only a factory calibration is possible.

Sensor-transmitter-matching

The resistance/temperature curve of platinum resistance thermometers is standardized but in practice it is rarely possible to keep to the values precisely over the entire operating temperature range. For this reason, platinum resistance sensors are divided into tolerance classes, such as Class A, AA or B as per IEC 60751. These tolerance classes describe the maximum permissible deviation of the specific sensor characteristic curve from the standard curve, i.e. the maximum temperature-dependent characteristic error that is permitted. The conversion of measured sensor resistance values to temperatures in temperature transmitters or other meter electronics is often susceptible to considerable errors as the conversion is generally based on the standard characteristic curve.

When Endress+Hauser iTEMP temperature transmitters are used, this conversion error can be reduced significantly by sensor-transmitter-matching:
- Calibration at three temperatures at least and determination of the actual temperature sensor characteristic curve,
- Adjustment of the sensor-specific polynomial function using Calendar-van Dusen (CvD) coefficients
- Configuration of the temperature transmitter with the sensor-specific CvD coefficients for resistance/temperature conversion, and
- another calibration of the reconfigured temperature transmitter with connected resistance thermometer.

Endress+Hauser offers its customers this kind of sensor-transmitter matching as a separate service. Furthermore, the sensor-specific polynomial coefficients of platinum resistance thermometers are always provided on every Endress+Hauser calibration certificate where possible, e.g. at least three calibration points, so that users themselves can also appropriately configure suitable temperature transmitters.

For the device, Endress+Hauser offers standard calibrations at a reference temperature of −80 to +600 °C (−112 to +1 112 °F) based on the ITS90 (International Temperature Scale). Calibrations in other temperature ranges are available from an Endress+Hauser sales center on request. Calibrations are traceable to national and international standards. The calibration certificate is referenced to the serial number of the device. Only the insert is calibrated.

Minimum immersion length (IL) for inserts required to perform a correct calibration

Due to the limitations of furnace geometries, the minimum immersion lengths must be observed at high temperatures to enable a calibration to be performed with an acceptable degree of measurement uncertainty. The same applies when using a head transmitter. Due to heat conduction, minimum lengths must be observed in order to guarantee the functionality of the transmitter −40 to +85 °C (−40 to +185 °F).

Calibration temperature	Minimum immersion length IL in mm without head transmitter
−196 °C (−320.8 °F)	120 mm (4.72 in) [1]
−80 to +250 °C (−112 to +482 °F)	No minimum immersion length required [2]
+251 to +550 °C (+483.8 to +1 022 °F)	300 mm (11.81 in)
+551 to +600 °C (+1 023.8 to +1 112 °F)	400 mm (15.75 in)

1) With iTEMP head transmitter min. 150 mm (5.91 in) is required
2) at a temperature of +80 to +250 °C (+176 to +482 °F), the iTEMP head transmitter requires min. 50 mm (1.97 in)

Insulation resistance

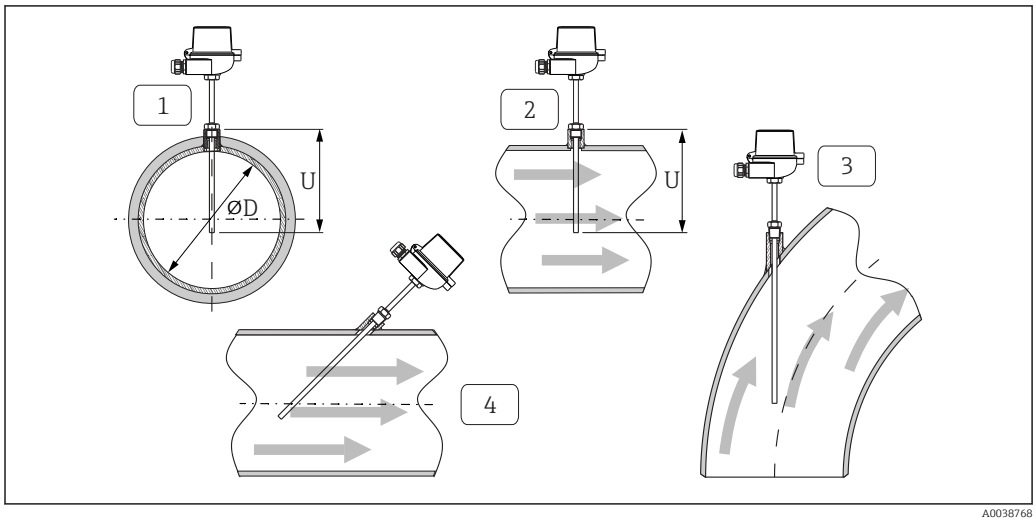
- RTD:
  Insulation resistance between the terminals and the extension neck, as per IEC 60751 > 100 MΩ at +25 °C, measured with a minimum testing voltage of 100 V_{DC}.
- TC:
  Insulation resistance as per IEC 61515 between terminals and sheath material for a test voltage of 500 V_{DC}:
  - > 1 GΩ at +20 °C
  - > 5 MΩ at +500 °C

Installation

Orientation

No restrictions. However, self-draining in the process should be guaranteed depending on the application.

Installation instructions



14 Installation examples

1 - 2 In pipes with a small cross-section, the sensor tip should reach or extend slightly past the center axis of the pipe (=U).
3 - 4 Slanted orientation.

The immersion length of the thermometer influences the measurement accuracy. If the immersion length is too small, measurement errors are caused by heat conduction via the process connection and the container wall. If installing into a pipe then the immersion length should be at least half of the pipe diameter. Installation at an angle (see item 3 and 4) could be another solution. When determining the immersion length, all the parameters of the thermometer and of the process to be measured must be taken into account (e.g. flow velocity, process pressure).

The counterparts for process connections and seals are not supplied with the thermometer and must be ordered separately if needed.

Environment

Ambient temperature range

Terminal head	Temperature in °C (°F)
Without mounted head transmitter	Depends on the terminal head used and the cable gland or fieldbus connector; see "Terminal heads" section.
With mounted iTEMP head transmitter	−40 to +85 °C (−40 to +185 °F)
With mounted iTEMP head transmitter and display	−30 to +85 °C (−22 to 185 °F)

Extension neck	Temperature in °C (°F)
Quick-fastening iTHERM QuickNeck	−50 to +140 °C (−58 to +284 °F)

Storage temperature

−40 to +85 °C (−40 to +185 °F).

Humidity

Depends on the iTEMP transmitter used. When using iTEMP head transmitters:
- Condensation permitted as per IEC 60068-2-33
- Max. relative humidity: 95% in accordance with IEC 60068-2-30

Climate class

As per EN 60654-1, Class C

Degree of protection

Max. IP 66 (NEMA Type 4x encl.)	Depending on the design (terminal head, connector, etc.)
Partly IP 68	Tested in 1.83 m (6 ft) over 24 h

Shock and vibration resistance

The Endress+Hauser inserts exceed the requirements of IEC 60751 with regard to shock and vibration resistance of 3g in a range of 10 to 500 Hz. The vibration resistance of the measuring point depends on sensor type and design:

Sensor type [1]	Vibration resistance for the sensor tip
Pt100 (WW)	≤ 30 m/s² (≤ 3g)
Pt100 (TF) Basic	
Pt100 (TF) Standard	≤ 40 m/s² (≤ 4g)
Pt100 (TF) iTHERM StrongSens	600 m/s² (60g)
Pt100 (TF) iTHERM QuickSens, version: ø6 mm (0.24 in)	600 m/s² (60g)
Pt100 (TF) iTHERM QuickSens, version: ø3 mm (0.12 in)	≤ 30 m/s² (≤ 3g)
Thermocouple TC, type J, K, N	≤ 30 m/s² (≤ 3g)

1) Options depend on product and configuration

Electromagnetic compatibility (EMC)

Electromagnetic compatibility in accordance with all the relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE21). For details refer to the EU Declaration of Conformity.

Maximum measurement error < 1% of the measuring range.

Interference immunity as per IEC/EN 61326 series, industrial requirements

Interference emission as per IEC/EN 61326 series, Class B equipment

Process

Process temperature range

Depends on the type of sensor and the thermowell material used, max. −200 to +1 100 °C (−328 to +2 012 °F)..

For fast-responding thermowell, −200 to +400 °C (−328 to +752 °F) max.

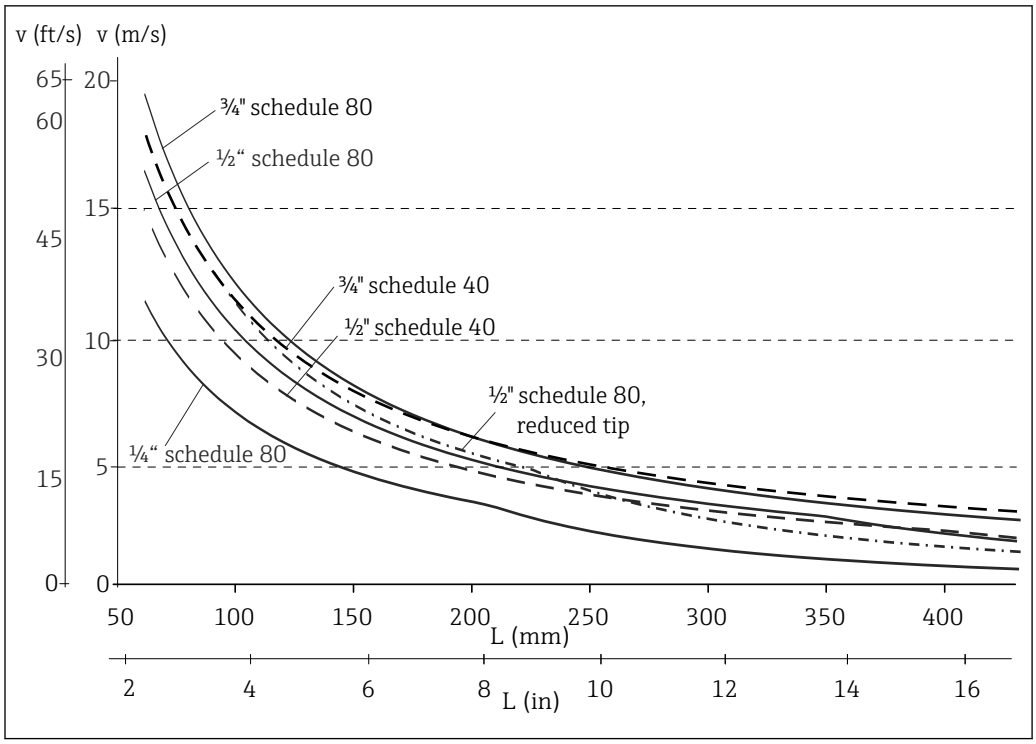
Process pressure range

The maximum possible process pressure depends on various influencing factors, such as the design, process connection and process temperature. For information on the maximum possible process pressures for the individual process connections, see the "Process connection" section.

It is possible to check the mechanical loading capacity as a function of the installation and process conditions online using the Sizing Thermowell calculation tool in the Endress+Hauser Applicator software. https://portal.endress.com/webapp/applicator

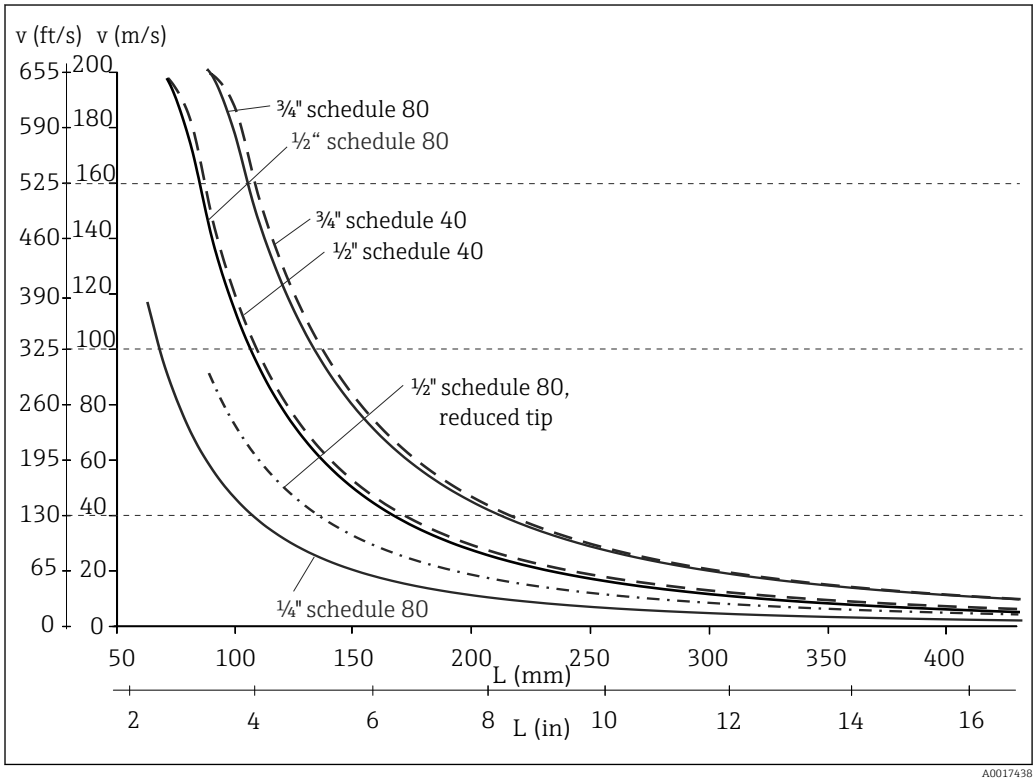
Permitted flow velocity depending on the immersion length

The highest flow velocity tolerated by the thermometer diminishes with increasing sensor immersion length exposed to the flowing fluid. In addition it is dependent on the diameter of both the thermometer tip and thermowell, on the type of measuring medium, the process temperature and the process pressure. The following figures exemplify the maximum permitted flow velocities in water and superheated steam at a process pressure of 50 bar (725.2 psi).



15 Permitted flow velocities with different thermometer diameters in the process medium water at T = 50 °C (122 °F)

L Unsupported immersion length of the thermowell, material 1.4401 (316)
v Flow velocity

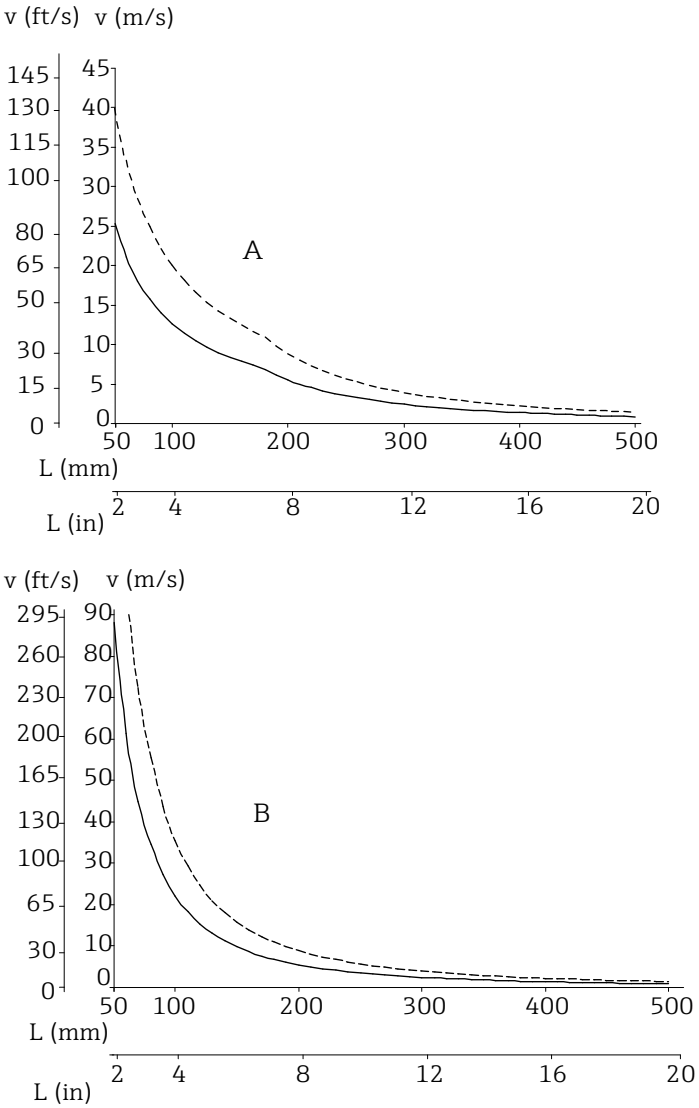


16 Permitted flow velocities with different thermometer diameters in the process medium superheated steam at T = 400 °C (752 °F)

L Unsupported immersion length of the thermowell, material 1.4401 (316)
v Flow velocity

Permitted flow velocity depending on the immersion length and process medium

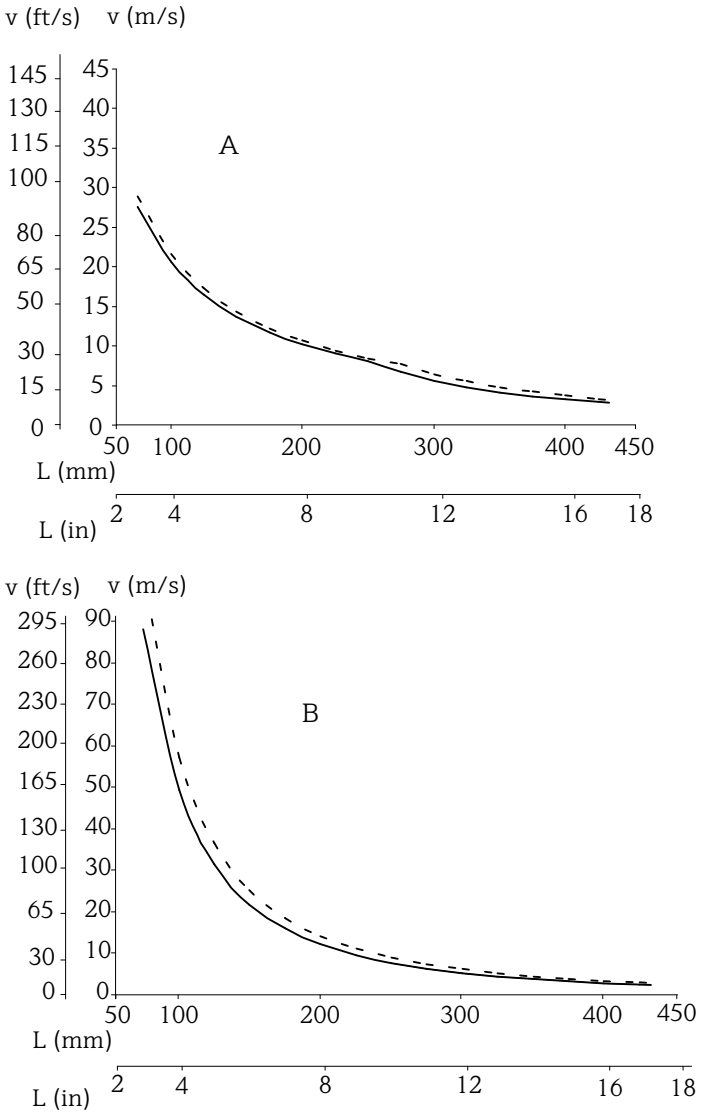
The maximum allowable flow velocity to which the thermometer can be exposed decreases as the immersion length of the insert in the flowing medium increases. In addition, it is dependent on the diameter of the thermometer tip, the medium type, the process temperature and the process pressure. The following figures exemplify the maximum permitted flow velocities in water and superheated steam at a process pressure of 50 bar (725 psi).



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17 *Maximum flow velocity with thermowell diameter 9 mm (0.35 in)(————) or 12 mm (0.47 in) (-----)*

A Medium: water at T = 50 °C (122 °F)
B Medium: superheated steam at T = 400 °C (752 °F)
L Immersion length
v Flow velocity



A0017169

18 Maximum flow velocity with thermowell diameter 14 mm (0.55 in)(————) or 15 mm (0.6 in) (-----)

A Medium: water at T = 50 °C (122 °F)
B Medium: superheated steam at T = 400 °C (752 °F)
L Immersion length
v Flow velocity

Mechanical construction

Design, dimensions

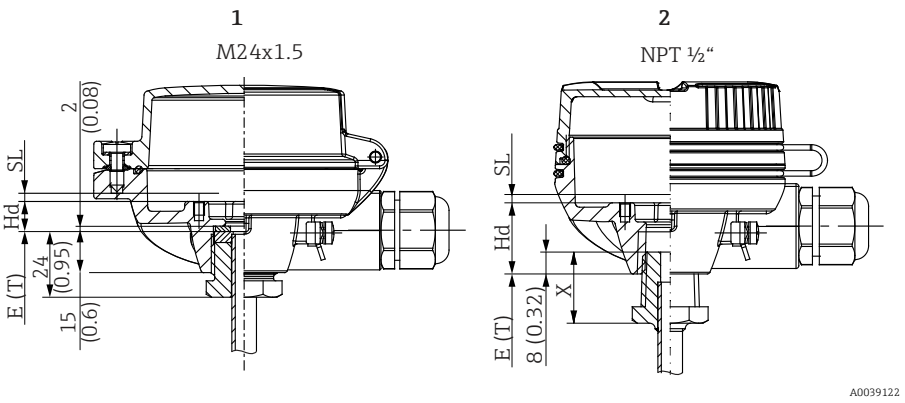
All dimensions in mm (in). The design of the thermometer depends on the general design version used:

- Thermometer for installation in a separate thermowell
- Thermometer with thermowell, continuous, similar to DIN 43772 Form 2 G/F, 3 G/F
- Thermometer with thermowell, hexagonal, similar to DIN 43772 Form 5, 8
- Thermometer with thermowell, without lagging - similar to DIN 43772 Form 2

Various dimensions, such as the immersion length U, the lagging length T and the extension neck length E, for example, are variable values and are therefore indicated as items in the following dimensional drawings.

Variable dimensions:

Item	Description
E	Extension neck length, variable depending on the configuration or pre-defined for the version with iTHERM QuickNeck
IL	Insertion length of insert
L	Thermowell length (U+T)
B	Thermowell bottom thickness: pre-defined, depends on thermowell version (see also the individual table data)
T	Length of lagging: variable or pre-defined, depends on thermowell version (see also the individual table data)
U	Immersion length: variable, depending on the configuration
Hd, SL	Variable for calculating the insertion length of the insert, depending on different screw-in lengths in terminal head thread M24x1.5 or ½" NPT, see insert length calculation (IL).
ØID	Thermowell diameter, see the following table



19 Different screw-in lengths in terminal head thread for M24x1.5 and ½" NPT

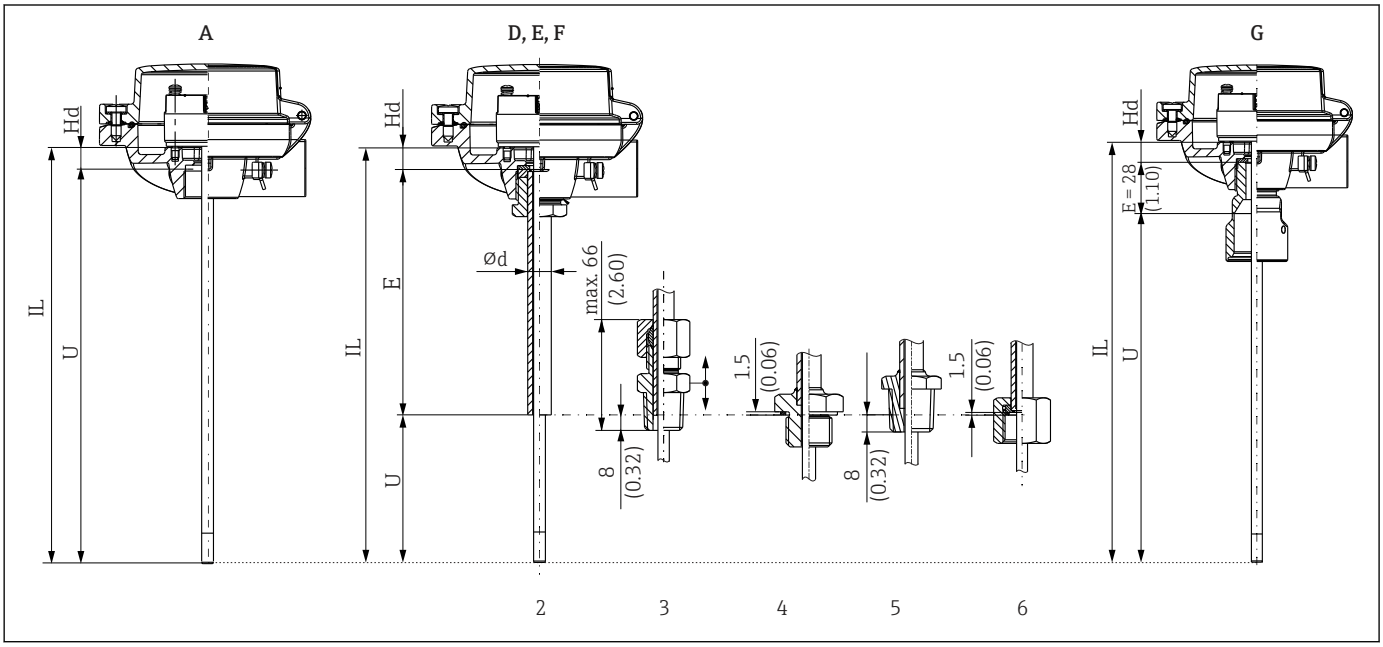
1 Metric thread M24x1.5
2 Conical thread NPT ½"
Hd Distance in terminal head
SL Spring travel

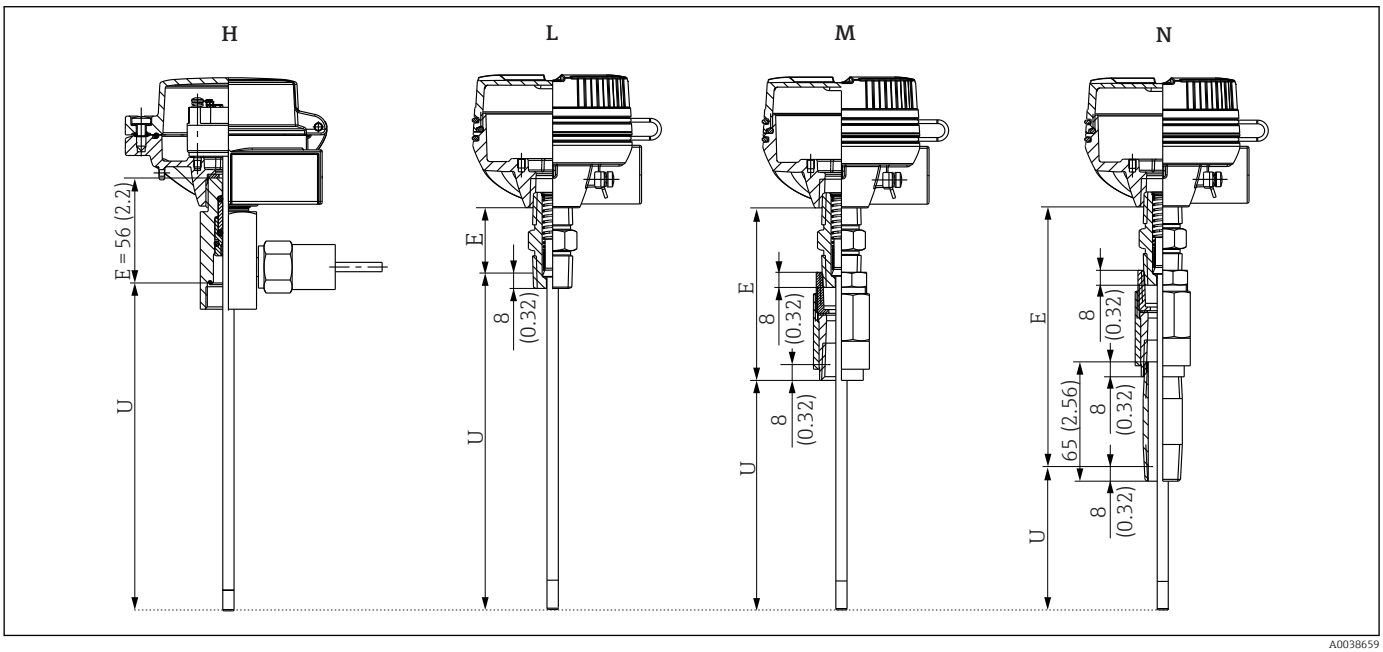
Thermometer for installation in a separate thermowell

The thermometer is supplied without a thermowell but is designed for use with a thermowell.

This version cannot be used for direct immersion in the process medium!

The thermometer can be configured as follows





- Option A: without neck (female thread M24, M20x1.5 or NPT ½") [1]
- Option D, E, F: removable extension neck; thread for connection to thermowell must be selected; available versions:
  - Without process connection (2)
  - Compression fitting (3)
  - Metric thread (4)
  - Tapered thread (5)
  - Cap nut (6)
- Option G: iTHERM QuickNeck upper part
- Option H: neck with second process seal (thread M24x1.5 female fitting to thermowell)
- Options L, M, N: NPT ½" nipple, nipple-union or nipple-union-nipple connection

1) Configuration feature 30: thermometer version

Calculation of insert length IL

Option A: without neck	IL = U + Hd
Option A for use with NAMUR thermowell	Thermowell TT151 type NF1: U_{TM131} = 304 mm (11.97 in); IL = 315 mm (12.4 in) Thermowell TT151 type NF2: U_{TM131} = 364 mm (14.33 in); IL = 375 mm (14.8 in) Thermowell TT151 type NF3: U_{TM131} = 424 mm (16.7 in); IL = 435 mm (17.13 in)

Options D, E, F: removable extension neck	Version 2: IL = U + E + Hd Version 3: IL = U + E + Hd Version 4: IL = U + E + Hd+GC Version 5: IL = U + E + Hd Version 6: IL = U + E + Hd+GC
Option G: iTHERM QuickNeck upper part	IL = U + E + Hd
Option H: second process seal	IL = U + E + Hd+GC Length E = 56 mm (2.2 in) for M24x1.5 to terminal head Length E = 48 mm (1.9 in) for NPT ½" to terminal head
Options L, M, N: nipple connection	IL = U + E + Hd E and Hd depend on the type of nipple: ▪ Standard: ▪ E = 35 mm (1.38 in) ▪ Hd = −17 mm (−0.67 in) ▪ Nipple for flameproof enclosure: ▪ E = 47 mm (1.85 in) ▪ Hd = 10 mm (0.39 in) SL = spring pre-load = 6 mm (0.24 in)
Hd for head thread M24x1.5 (TA30A, TA30D, TA30P, TA30R, TA20AB) = 11 mm (0.43 in) Hd for head thread NPT ½" (TA30EB) = 26 mm (1.02 in) Hd for head thread NPT ½" (TA30H) = 41 mm (1.61 in) GC seal compensation = 2 mm (0.08 in)	

Calculation of immersion length U for existing thermowells

Option A	A = Total length of thermowell S = Bore depth of thermowell M24 thread: U = S + 3 mm (0.12 in) NPT thread: U = A [1] - B - 8 mm (0.31 in) + 3 mm (0.12 in)
Option D, E, F	U = S + 3 mm (0.12 in) (version 3 configurable)
Option G	U = S + 3 mm (0.12 in)
Option H	U = S + 3 mm (0.12 in)
Option L, N	U = S + 6 mm (0.24 in)
Option M	U = S - 8 mm (0.31 in) + 6 mm (0.24 in)

1) A = Total length of thermowell.

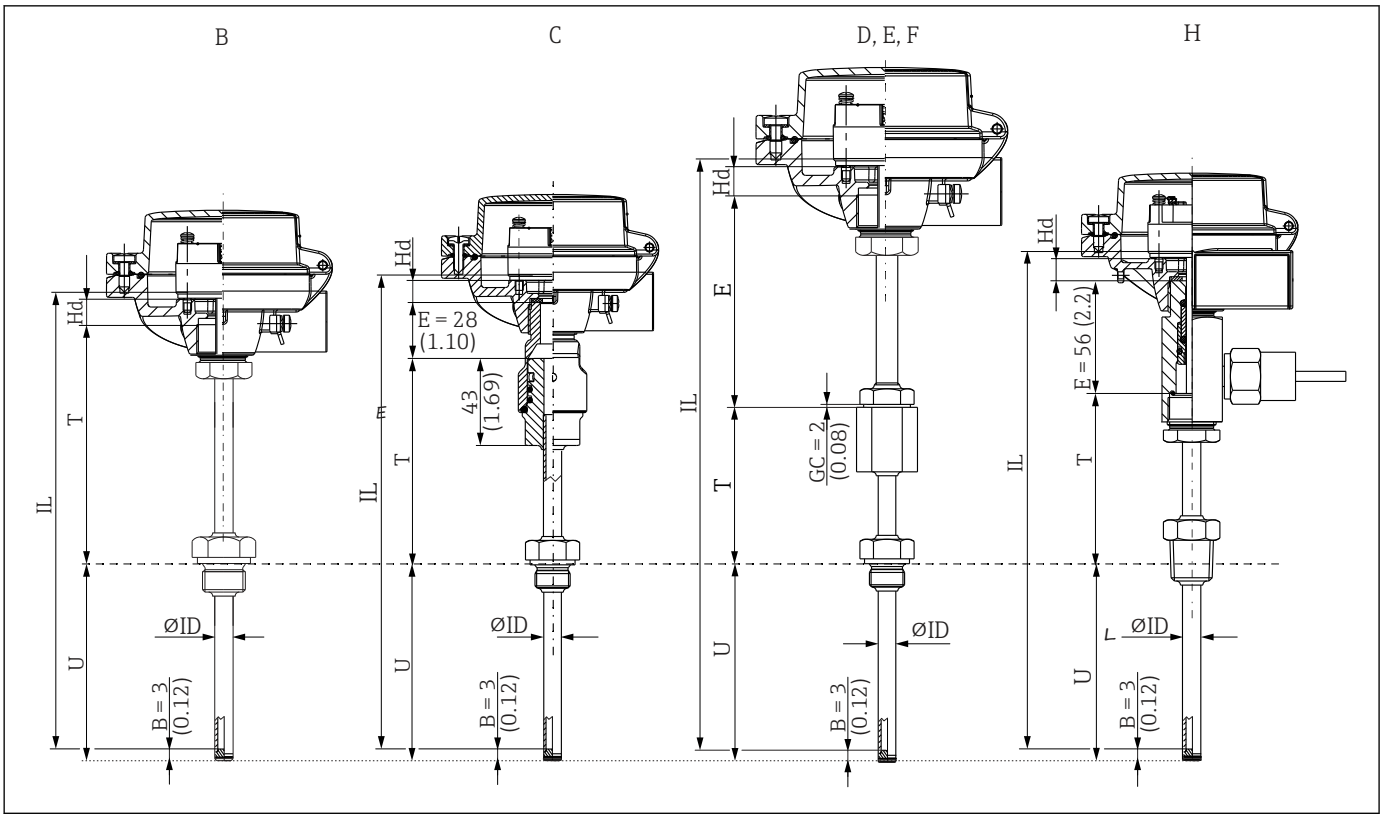
Thermometer with thermowell, continuous

The thermometer always has a thermowell.

Thermowell, continuous: above the process connection, a part of the original thermowell is kept as thermowell lagging T. The thermowell is based on thermowells DIN 43772 Forms 2G, 2F or 3G and 3F. Form 2 describes a straight thermowell tip, Form 3 a tapered one. [2] The letter G describes a thread, and F describes a flange, as the process connection.

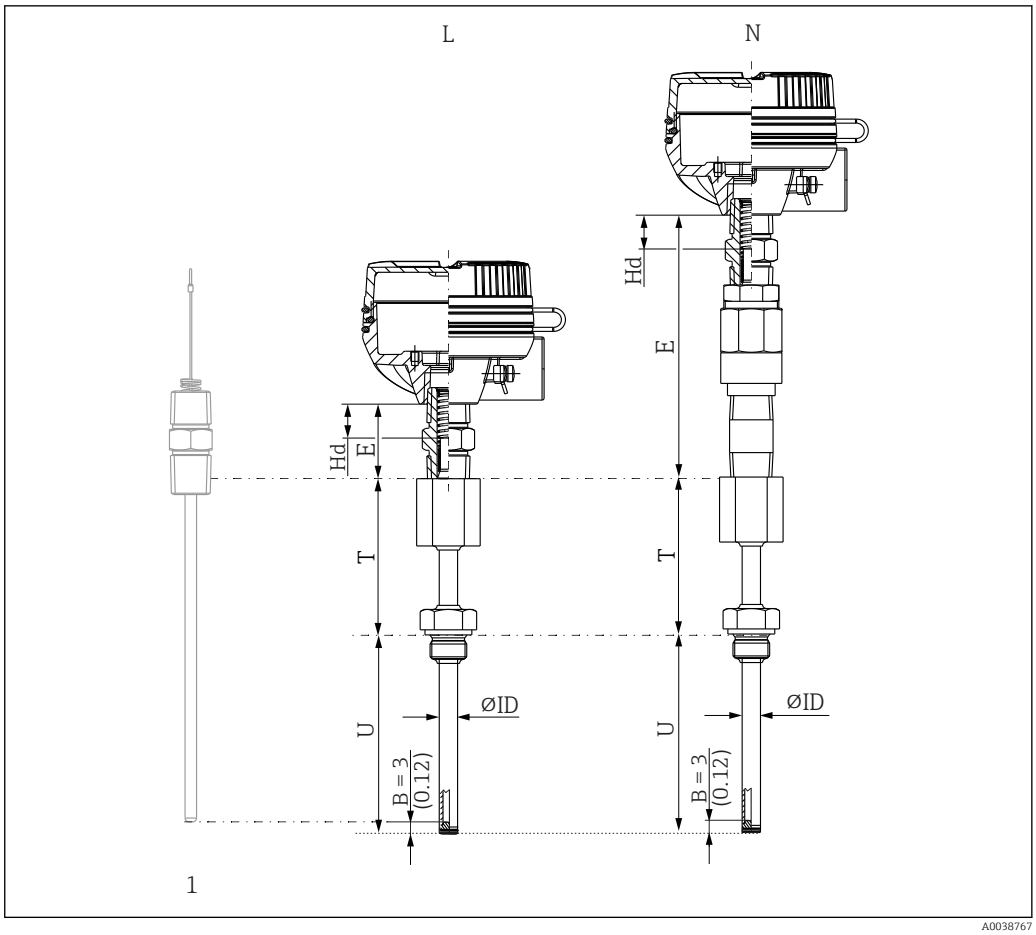
The thermometer can be configured as follows [3]

2) See also configuration feature 070: Shape of tip
3) See also configuration feature 030: Thermometer design



20 These thermometer versions use the insert TS111 with a washer.

- Option B: Lagging, DIN 43772 Form 2G, 3F, 3G, 3F
- Option C: iTHERM QuickNeck for fast tool-free calibration
- Option D, E, F: With additional removable extension neck; diameter 11 mm (0.43 in) or 12 mm (0.47 in); thread to thermowell G ½" (optional M20)
- Option H: Extension neck with second process seal



21 These versions use the central-spring-loaded insert TS211.

- 1: Insert
- Option L: Thermowell with nipple connection
- Option N: Thermowell with nipple-union-nipple connection

Calculation of insert length IL

Version B	IL = U + T + Hd - B + SL SL = spring pre-load = 2 mm (0.08 in)
Version C	IL = U + T + E + Hd - B + SL E = 28 mm (1.10 in) for head thread: M24x1.5 E = 21 mm (0.83 in) for head thread: NPT ½" SL = spring pre-load = 2 mm (0.08 in)
Versions D, E, F	IL = U + T + E + Hd - B + SL + GC SL = spring pre-load = 2 mm (0.08 in) GC = gasket compensation only for metric threads = 2 mm (0.08 in)
Version H	IL = U + T + E + Hd - B + SL E = 56 mm (2.2 in) for head thread: M24x1.5 E = 48 mm (1.9 in) for head thread: NPT ½" SL = spring pre-load = 2 mm (0.08 in)
Hd for head thread M24x1.5 (TA30A, TA30D, TA30P, TA30R, TA20AB) = 11 mm (0.43 in) Hd for head thread NPT ½" (TA30EB) = 26 mm (1.02 in) Hd for head thread NPT ½" (TA30H) = 41 mm (1.61 in)	

Versions L and N	IL = U + T+ E + Hd - B + SL
	
	E and Hd depend on the type of nipple:
	▪ Standard:
	  ▪ E = 35 mm (1.38 in)
	  ▪ Hd = –17 mm (–0.67 in)
	▪ Nipple for flameproof enclosure:
	  ▪ E = 47 mm (1.85 in)
	  ▪ Hd = 10 mm (0.39 in)
	
	SL = spring pre-load = 6 mm (0.24 in)

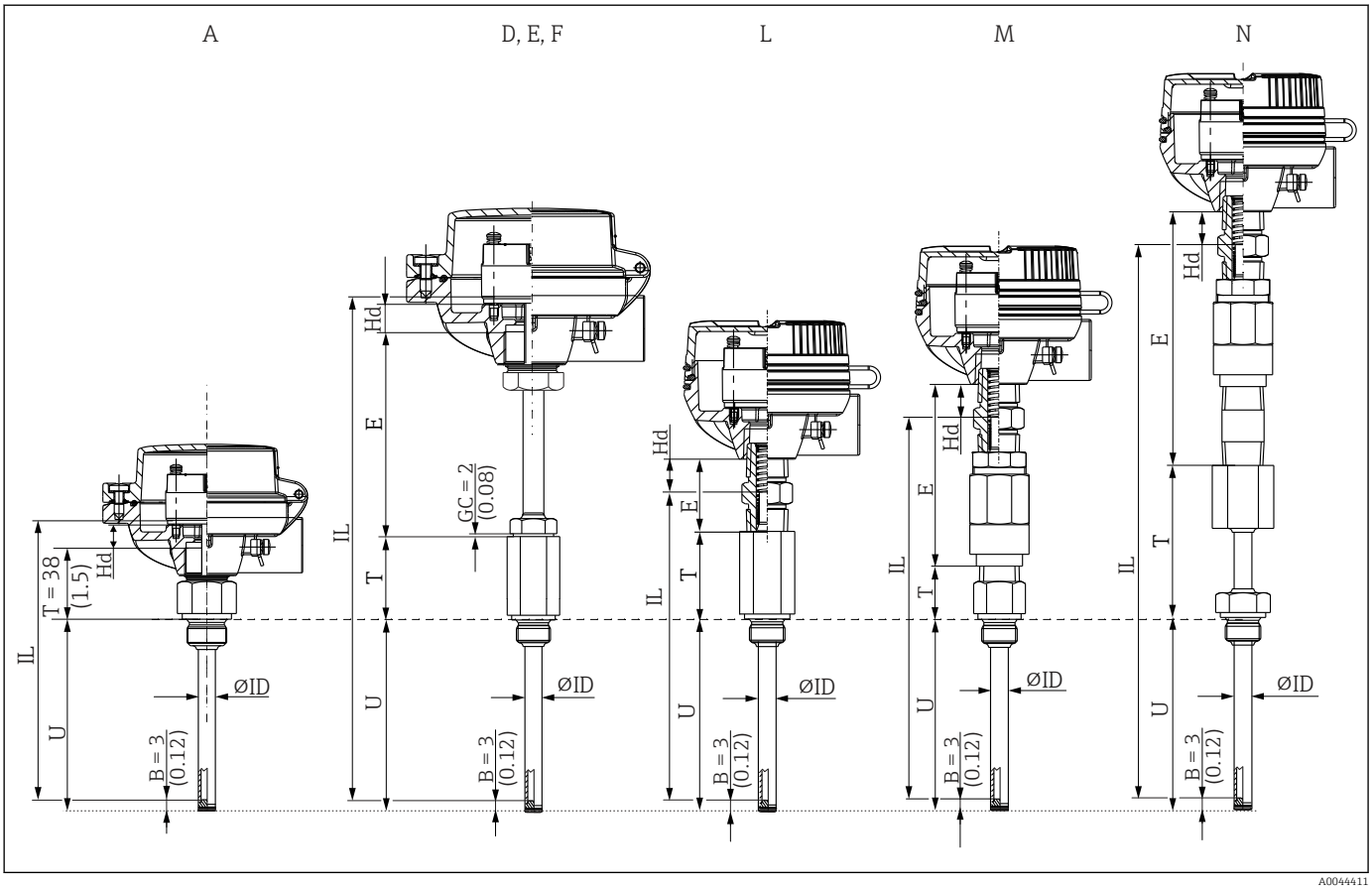
B = bottom thickness: ▪ 3 mm (0.12 in) ▪ 4 mm (0.16 in) for inch pipe diameter ▪ 5 mm (0.2 in) for pipe diameter 12x9 mm with tapered tip	

Thermometer with thermowell and hexagonal extension

The thermometer always has a thermowell.

Thermowell, hexagonal extension: above the process connection, the thermowell lagging T is hexagonal. Form 5 describes a female thread as the thermometer connection, Form 8 a male thread.

The thermometer can be configured as follows [3)]



A0044411

- Option A: Without extension neck, similar to DIN 43772 Forms 2, 5, 8
- Option D, E, F: With additional removable extension neck, similar to DIN 43772 ; diameter 11 mm (0.43 in) or 12 mm (0.47 in); thread to thermowell G ½" (optional M20)
- Option L: With nipple connection, NPT ½"
- Option M: With nipple-union connection, NPT ½"
- Option N: With nipple-union-nipple connection, NPT ½"

Calculation of insert length IL

Version A	IL = U + T + Hd - B + SL T = 38 mm (1.5 in) Hd for head thread M24x1.5 (TA30A, TA30D, TA30P, TA30R, TA20AB) = 11 mm (0.43 in) Hd for head thread NPT ½" (TA30EB) = 26 mm (1.02 in) Hd for head thread NPT ½" (TA30H) = 41 mm (1.61 in) SL = spring pre-load = 2 mm (0.08 in)
Versions D, E, F	IL = U + T + E + Hd - B + SL + GC Hd for head thread M24x1.5 (TA30A, TA30D, TA30P, TA30R, TA20AB) = 11 mm (0.43 in) Hd for head thread NPT ½" (TA30EB) = 26 mm (1.02 in) Hd for head thread NPT ½" (TA30H) = 41 mm (1.61 in) SL = spring pre-load = 2 mm (0.08 in) GC = gasket compensation only for metric threads = 2 mm (0.08 in)

Version L	IL = U + T + E + Hd - B + SL
	E and Hd depend on the type of nipple:
	▪ Standard:
	  ▪ E = 35 mm (1.38 in)
	  ▪ Hd = –17 mm (–0.67 in)
	▪ Nipple for flameproof enclosure:
	  ▪ E = 47 mm (1.85 in)
	  ▪ Hd = 10 mm (0.39 in)
	SL = spring pre-load = 6 mm (0.24 in)

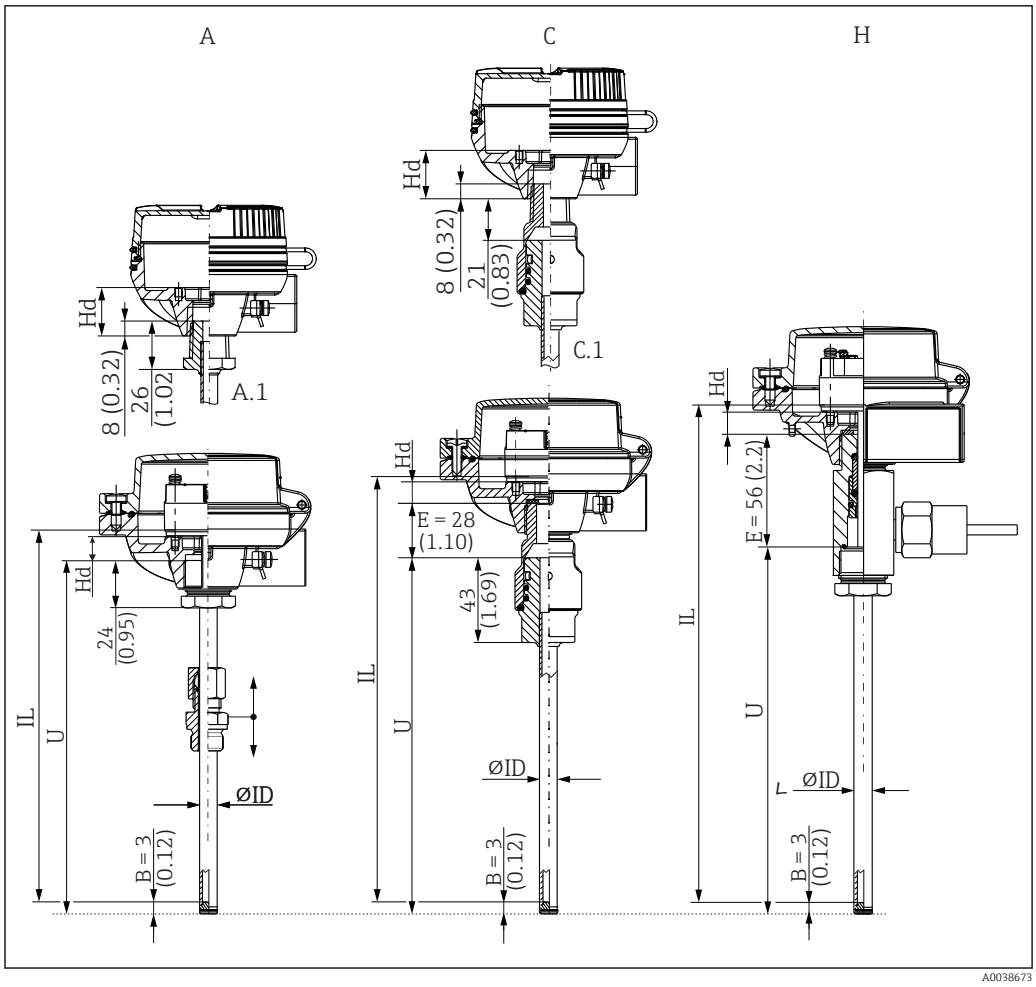
Version M	
Version N	
B = bottom thickness: ▪ 3 mm (0.12 in) ▪ 4 mm (0.16 in) for inch pipe diameter ▪ 5 mm (0.2 in) for pipe diameter 12x9 mm with tapered tip	

Thermometer with thermowell without lagging

The thermometer always has a thermowell.

Thermowell, without lagging (T = 0): The thermowell is available without a process connection or with an adjustable process connection, e.g. compression fitting. In this case, the immersion length U and the lagging length T are not pre-defined when an adjustable process connection is used.

The thermometer can be configured as follows [3)]



- Option A: Without extension neck, similar to DIN 43772 Forms 2, 5, 8 (with compression fitting)
  A.1: Related terminal head with NPT ½"
- Option C: iTHERM QuickNeck - for fast, tool-free re-calibration
  C.1: Related terminal head with NPT ½"
- Option H: With extension neck with second process seal

Note the following when replacing an Endress+Hauser TR12 thermometer with the TM131 thermometer:

Immersion length $U_{(TM131)}$ = immersion length $L_{(TR12)}$ + 24 mm (0.95 in)

Calculation of insert length IL

Version A	IL = U + Hd - B + SL SL = spring pre-load = 2 mm (0.08 in)
Version C	IL = U + E + Hd - B + SL E = 21 mm (0.83 in) for terminal heads TA30H E = 28 mm (1.1 in) for terminal heads TA30A and TA30D SL = spring pre-load = 2 mm (0.08 in)
Version H	IL = U + E + Hd - B + SL E = 48 mm (1.89 in) for terminal heads TA30H and TA30EB E = 56 mm (2.2 in) for other terminal heads SL = spring pre-load = 2 mm (0.08 in)
Hd for head thread M24x1.5 (TA30A, TA30D, TA30P, TA30R, TA20AB) = 11 mm (0.43 in) Hd for head thread NPT ½" (TA30EB) = 26 mm (1.02 in) Hd for head thread NPT ½" (TA30H) = 41 mm (1.61 in) B = bottom thickness: ▪ 3 mm (0.12 in) ▪ 4 mm (0.16 in) for inch pipe diameter ▪ 5 mm (0.2 in) for pipe diameter 12x9 mm with tapered tip	

Possible combinations of the thermowell versions with the available process connections

Process connection and size	Thermowell diameter							
	9 x 1.25 mm	11 x 2 mm	12 x 2.5 mm	14 x 2 mm 316Ti	16 x 3.5 mm 316L	¼" 316	½" 316	½" 446
Diameter tolerances								
Lower tolerance limit (mm)	0,0	0,0	0,0	0,0	0,0	-0,79	-0,79	-0,79
Upper tolerance limit (mm)	+0,1	+0,1	+0,1	+0,1	+0,1	+0,4	+0,4	+0,4
Thread								
M18 x 1.5, 316L/316Ti	316L or 316Ti	316L or 316Ti	-	-	-	-	-	-
M20 x 1.5, 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	-	-	-	-
M27 x 2, 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	-	-	-
M33 x 2, 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	-	-	-
NPT ½", 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	-	316	-	-
NPT ¾", 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	316	316	446
NPT 1", 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	316	316	446
G 3/8, 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	-	-	-	-	-
G ½", 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	-	-	-	-
G ¾", 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	-	-	-
G 1", 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	-	-	-
R ½", 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	-	-	-	-
R ¾", 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	-	-	-
M20 x 1.55, 321	-	-	321	-	-	-	-	-
M27 x 2, 321	-	-	321	-	-	-	-	-
M33 x 2, 321	-	-	321	-	-	-	-	-
NPT ½", 321	-	-	321	-	-	-	-	-
G ½", 321	-	-	321	-	-	-	-	-
M20 x 1.5, AlloyC276	AlloyC276	AlloyC276	-	-	-	-	-	-
NPT ½", AlloyC276	AlloyC276	AlloyC276	-	-	-	-	-	-
G ½", AlloyC276	AlloyC276	AlloyC276	-	-	-	-	-	-
M20 x 1.5, AlloyC600	Alloy600	Alloy600	-	-	-	-	-	-
NPT ½", AlloyC600	Alloy600	Alloy600	-	-	-	-	-	-
G ½", AlloyC600	Alloy600	Alloy600	-	-	-	-	-	-
Weld-in adapter								

Process connection and size	Thermowell diameter							
	9 x 1.25 mm	11 x 2 mm	12 x 2.5 mm	14 x 2 mm 316Ti	16 x 3.5 mm 316L	¼" 316	½" 316	½" 446
Cylindrical, D = 30 mm (1.18 in), 316L	316L, 316Ti, Alloy600, AlloyC276	-	-	-	-	-	-	-
Compression fitting								
NPT ½", 316L	316L, 316Ti, Alloy600, AlloyC276	316L or 316Ti	316Ti	316Ti	-	-	-	-
G ½", 316L	316L, 316Ti, Alloy600, AlloyC276	316L or 316Ti	316Ti	316Ti	-	-	-	-
G 1‴, 316L	316L, 316Ti, Alloy600, AlloyC276	316L or 316Ti	316Ti	316Ti	-	-	-	-
Flanged	316L	316L	316Ti	316Ti	316L	316	316	446
ANSI 1" 150 RF B16.5, 316L	316L	316L	316Ti	316Ti	316L	316	316	446
ANSI 1 ½" 150 RF B16.5, 316L	316L	316L	316Ti	316Ti	316L	316	316	446
ANSI 2" 150 RF B16.5, 316L	316L	316L	316Ti	316Ti	316L	316	316	446
ANSI 2" 300 RF B16.5, 316L	316L	316L	316Ti	316Ti	316L	316	316	446
DN15 PN40 B1 EN1092-1, 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	316	-	-
DN15 PN40 C EN1092-1, 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	316	-	-
DN25 PN20 B1 ISO7005-1, 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	316	316	446
DN25 PN40 B1 EN1092-1, 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	316	316	446
DN25 PN40 C EN1092-1, 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	316	316	446
DN25 PN100 B2 EN1092-1, 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	316	316	446
DN40 PN40 B1 EN1092-1, 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	316	316	446
DN50 PN40 B1 EN1092-1, 316L/316Ti	316L or 316Ti	316L or 316Ti	316Ti	316Ti	316L	316	316	446
DN25 PN40 B1 EN1092-1, AlloyC276 > 316L	AlloyC279	AlloyC280	-	-	-	-	-	-
DN50 PN40 B1 EN1092-1, AlloyC276 > 316L	AlloyC280	AlloyC281	-	-	-	-	-	-
DN25 PN40 B1 EN1092-1, AlloyC600 > 316L	Alloy600	Alloy600	-	-	-	-	-	-
DN50 PN40 B1 EN1092-1, AlloyC600 > 316L	Alloy600	Alloy600	-	-	-	-	-	-
DN25 PN40 B1 EN1092-1, tantalum > 316Ti	-	316Ti + 13 mm	316Ti + 13 mm	-	-	-	-	-
DN50 PN40 B1 EN1092-1, tantalum > 316Ti	-	316Ti + 13 mm	316Ti + 13 mm	-	-	-	-	-

Process connection and size	Thermowell diameter							
	9 x 1.25 mm	11 x 2 mm	12 x 2.5 mm	14 x 2 mm 316Ti	16 x 3.5 mm 316L	¼" 316	½" 316	½" 446
DN25 PN40 B1 EN1092-1, PTFE > 316Ti	-	316Ti + 15 mm	-	-	-	-	-	-
DN50 PN40 B1 EN1092-1, PTFE > 316Ti	-	316Ti + 15 mm	-	-	-	-	-	-

Weight

1 to 10 kg (2 to 22 lbs) for standard versions

Material

Lagging and thermowell, insert, process connection.

The temperatures for continuous operation specified in the following table are only intended as reference values for use of the various materials in air and without any significant mechanical load. The maximum operating temperatures can be reduced considerably in cases where abnormal conditions such as high mechanical load occur or in aggressive media.

Please note that the maximum temperature also always depends on the temperature sensor used!

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316/1.4401	X5CrNiMo 17-12-2	650 °C (1 202 °F) [1]	▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion-resistance in chlorinated and acidic, non-oxidizing atmospheres by adding molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with low concentration)
AISI 316L/1.4404 1.4435	X2CrNiMo17-12-2 X2CrNiMo18-14-3	650 °C (1 202 °F) [1]	▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion-resistance in chlorinated and acidic, non-oxidizing atmospheres by adding molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with low concentration) ▪ Increased resistance to intergranular corrosion and pitting ▪ Compared to 1.4404, 1.4435 has even higher corrosion resistance and a lower delta ferrite content
AISI 316Ti/1.4571	X6CrNiMoTi17-12-2	700 °C (1 292 °F) [1]	▪ Properties comparable with AISI316L ▪ Addition of titanium means increased resistance to intergranular corrosion even after welding ▪ Broad range of uses in the chemical, petrochemical and oil industries as well as in coal chemistry ▪ Can only be polished to a limited extent, titanium streaks can form
Alloy600/2.4816	NiCr15Fe	1 100 °C (2 012 °F)	▪ A nickel/chromium alloy with very good resistance to aggressive, oxidizing and reducing atmospheres, even at high temperatures ▪ Resistance to corrosion caused by chlorine gases and chlorinated media as well as many oxidizing mineral and organic acids, sea water etc. ▪ Corrosion from ultrapure water ▪ Not to be used in sulfur-containing atmospheres

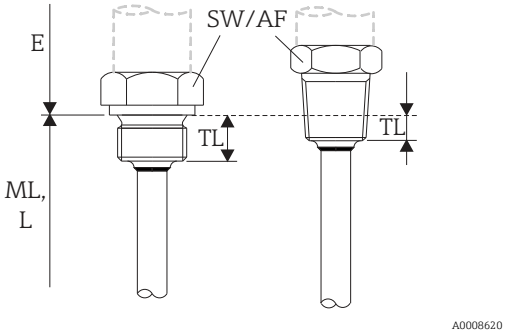
Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AlloyC276/2.4819	NiMo16Cr15W	1 100 °C (2 012 °F)	▪ A nickel-based alloy with good resistance to oxidizing and reducing atmospheres, even at high temperatures ▪ Particularly resistant to chlorine gas and chloride as well as to many oxidizing mineral and organic acids
AISI 321/1.4541	X6CrNiTi18-10	815 °C (1 499 °F)	▪ Austenitic, stainless steel ▪ High resistance to intergranular corrosion even after welding ▪ Good welding characteristics, suitable to all standard welding methods ▪ It is used in many sectors of the chemical industry, petrochemical, and pressurized vessels
AISI 446/~1.4762/ ~1.4749	X10CrAl24 X18CrNi24	1 100 °C (2 012 °F)	▪ A ferritic, heat resistant, high-chromium stainless steel ▪ Very high resistance to reducing sulphurous gases and salts with low content of oxygen ▪ Very good resistance to constant as well as cyclical thermal stress, to incineration ashcorrosion and to melts of copper, lead and tin ▪ Poorly resistant to gases containing nitrogen
Jacket			
PTFE (Teflon)	Polytetrafluorethylene	200 °C (392 °F)	▪ Resistant to almost all chemicals ▪ High temperature-resistance
Tantalum	-	250 °C (482 °F)	▪ With the exception of hydrofluoric acid, fluorine and fluorides, tantalum exhibits excellent resistance to most mineral acids and saline solutions ▪ Prone to oxidation and embrittlement at higher temperatures in air

1) Can be used to a limited extent up to 800 °C (1472 °F) for low mechanical loads and in non-corrosive media. Please contact your Endress+Hauser sales team for further information.

Process connections

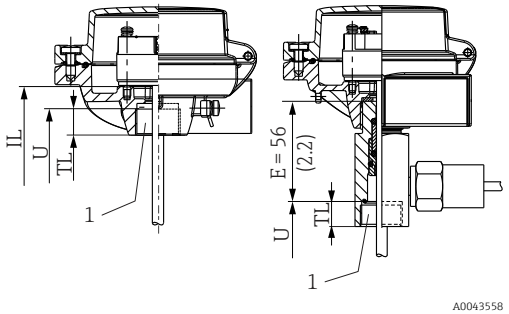
Thread

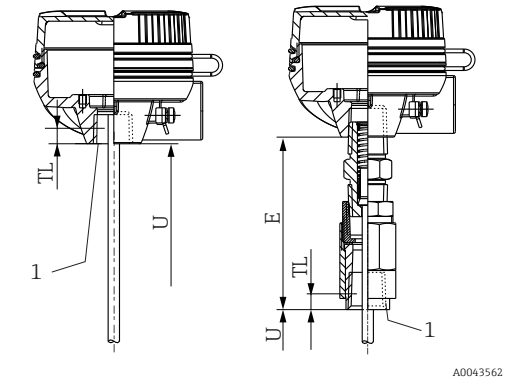
Process connections with a cylindrical male thread are supplied with copper seals according to DIN 7603 Form A with a thickness of 1.5 mm.

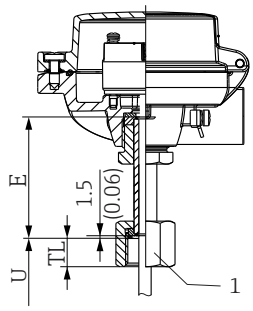
Threaded process connection Male thread	Version		Thread length TL	Width across flats	Max. process pressure
 22 *Cylindrical (left side) and conical (right side) version*	M	M14x1.5	12 mm (0.47 in)	22 mm (0.87 in)	Maximum static process pressure for threaded process connection: [1] 400 bar (5 802 psi) at +400 °C (+752 °F)
		M20x1.5	14 mm (0.55 in)	27 mm (1.06 in)	
		M18x1.5	12 mm (0.47 in)	24 mm (0.95 in)	
		M27x2	16 mm (0.63 in)	32 mm (1.26 in)	
		M33x2	18 mm (0.71 in)	41 mm (1.61 in)	
	G [2]	G ½" DIN / BSP	15 mm (0.6 in)	27 mm (1.06 in)	
		G 1" DIN / BSP	18 mm (0.71 in)	41 mm (1.61 in)	
		G ¾" BSP	15 mm (0.6 in)	32 mm (1.26 in)	
		G 3/8"	12 mm (0.47 in)	24 mm (0.95 in)	

Threaded process connection Male thread	Version		Thread length TL	Width across flats	Max. process pressure
	NPT	NPT ½"	8 mm (0.32 in)	22 mm (0.87 in)	
		NPT ¾"	8.5 mm (0.33 in)	27 mm (1.06 in)	
		NPT 1"	10.2 mm (0.4 in)	41 mm (1.61 in)	
	R	R ¾"	8 mm (0.32 in)	27 mm (1.06 in)	
		R ½"		22 mm (0.87 in)	

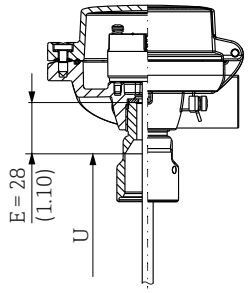
1) Maximum pressure specifications only for the thread. The failure of the thread is calculated, taking the static pressure into consideration. The calculation is based on a fully tightened thread (TL = thread length)
2) DIN ISO 228 BSPP

Connection thread Metric female thread	Version		Thread length TL	Width across flats	
 *1 Female thread*	M	M24x1.5 M20x1.5	14 mm (0.55 in) 20 mm (0.8 in)	27 mm (1.06 in)	The metric female thread is not designed as a process connection. This connection is only available for thermometers without a thermowell.

Connection thread Conical female thread	Version		Thread length TL	Width across flats	
 *1 Female thread*	NPT	NPT ½"	8 mm (0.32 in)	22 mm (0.87 in)	The conical female thread is not designed as a process connection. This connection is only available for thermometers without a thermowell.

Connection thread Cap nut [1]	Version	Thread length TL	Width across flats	
 *1 Cap nut thread*	M20x1.5	15.5 mm (0.61 in)	27 mm (1.06 in)	The cap nuts are not designed as process connections. This connection is only available for thermometers without a thermowell.
	G½"	15.5 mm (0.61 in)	27 mm (1.06 in)	
	G¾"	19.5 mm (0.77 in)	32 mm (1.26 in)	

1) For selection without thermowell. Only available for installation in an existing thermowell

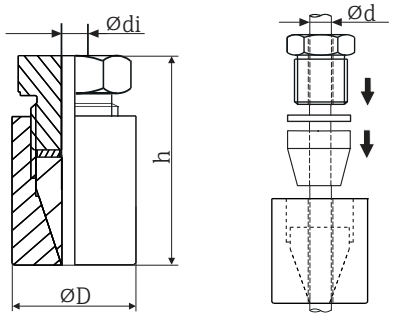
iTHERM QuickNeck (upper half) [1]	
	iTHERM QuickNeck (upper half) is used for connection to an existing thermowell with iTHERM QuickNeck (lower part). This connection is only available for thermometers without a thermowell.

1) For installation in an existing thermowell

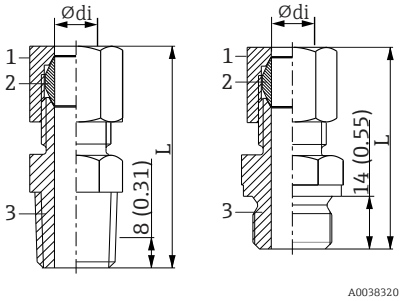
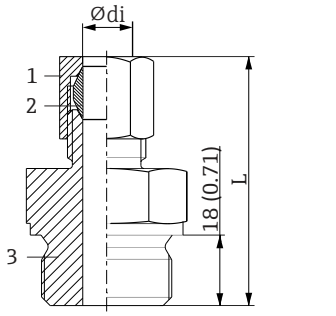
The 316L compression fittings can only be used once due to deformation. This applies to all the components of the compression fittings! A replacement compression fitting must be secured at another point (grooves in thermowell). PEEK compression fittings must never be used at a temperature that is lower than the temperature present when the compression fitting is secured. This is because the fitting would no longer be leak-tight as a result of heat contraction of the PEEK material.

SWAGELOCK or similar fittings are strongly recommended for higher requirements.

Weld-in adapter

Type TK40	Version	Dimensions			Technical properties
	Cylindrical	Ødi	ØD	h	
Weld-in adapter 	Ferrule material Elastosil Thread G½"	9.2 mm (0.36 in)	30 mm (1.18 in)	57 mm (2.24 in)	$P_{max.}$ = 10 bar (145 psi), $T_{max.}$ = +200 °C (+392 °F) for ELASTOSIL ferrule, tightening torque = 5 Nm

Compression fitting

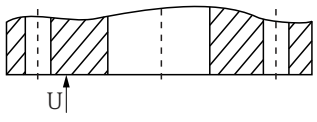
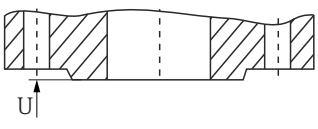
Type TK40	Version	Dimensions			Technical properties
		Ød_i	L	Width across flats	
 *1 Nut* *2 Ferrule* *3 Process connection*	NPT ½", ferrule material 316L G ½", ferrule material 316L	9 mm (0.35 in), minimum torque = 70 Nm 11 mm (0.43 in), minimum torque = 70 Nm 12 mm (0.47 in), minimum torque = 90 Nm 14 mm (0.55 in), minimum torque = 110 Nm	G½": 56 mm (2.2 in) ½" NPT: 60 mm (2.36 in)	G½": 27 mm (1.06 in) ½" NPT: 24 mm (0.95 in)	▪ $P_{max.}$ = 40 bar (104 psi) at T = +200 °C (+392 °F) for 316L material ▪ $P_{max.}$ = 25 bar (77 psi) at T = +400 °C (+752 °F) for 316L material
 *1 Nut* *2 Ferrule* *3 Process connection*	G 1", ferrule material 316L	9 mm (0.35 in), minimum torque = 70 Nm 11 mm (0.43 in), minimum torque = 70 Nm 12 mm (0.47 in), minimum torque = 90 Nm 14 mm (0.55 in), minimum torque = 110 Nm	64 mm (2.52 in)	41 mm (1.61 in)	▪ $P_{max.}$ = 40 bar (104 psi) at T = +200 °C (+392 °F) for 316L material ▪ $P_{max.}$ = 25 bar (77 psi) at T = +400 °C (+752 °F) for 316L material

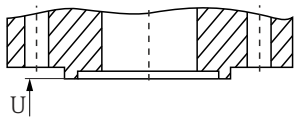
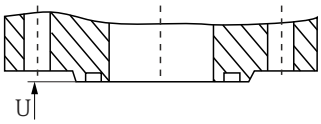
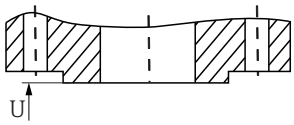
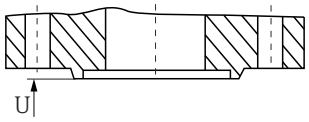
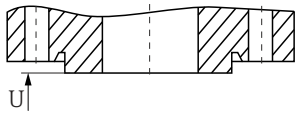
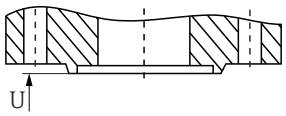
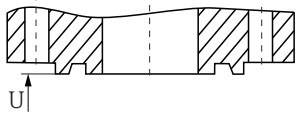
Flanges

The different materials are categorized according to their strength-temperature properties in DIN EN 1092-1 Tab.18 under 13E0 and in JIS B2220:2004 Tab. 5 under 023b. The ASME flanges are grouped together under Tab. 2-2.2 in ASME B16.5-2013. Inches are converted into metric units (in - mm) using the factor 25.4. In the ASME standard, the metric data is rounded to 0 or 5.

Versions
ASME flanges: American Society of Mechanical Engineers ASME B16.5-2013

Geometry of sealing surfaces

Flanges	Sealing surface	DIN 2526 [1]		DIN EN 1092-1			ASME B16.5	
		Form	Rz (µm)	Form	Rz (µm)	Ra (µm)	Form	Ra (µm)
without raised face		A B	- 40 to 160	A [2]	12.5 to 50	3.2 to 12.5	Flat face (FF)	3.2 to 6.3 (AARH 125 to 250 µin)
with raised face		C D E	40 to 160 40 16	B1 [3] B2	12.5 to 50 3.2 to 12.5	3.2 to 12.5 0.8 to 3.2	Raised face (RF)	

Flanges	Sealing surface	DIN 2526 [1]		DIN EN 1092-1			ASME B16.5	
		Form	Rz (µm)	Form	Rz (µm)	Ra (µm)	Form	Ra (µm)
Spring	 A0043517	F	-	C	3.2 to 12.5	0.8 to 3.2	Tongue (T)	3.2
Groove	 A0043518	N		D			Groove (G)	
Projection	 A0043519	V 13	-	E	12.5 to 50	3.2 to 12.5	Male (M)	3.2
Recess	 A0043520	R 13		F			Female (F)	
Projection	 A0043521	V 14	for O-rings	H	3.2 to 12.5	3.2 to 12.5	-	-
Recess	 A0043522	R 14		G			-	-
With ring groove	 A0052680	-	-	-	-	-	Ring-type joint (RTJ)	1.6

1) Contained in DIN 2527
2) Typically PN2.5 to PN40
3) Typically from PN63

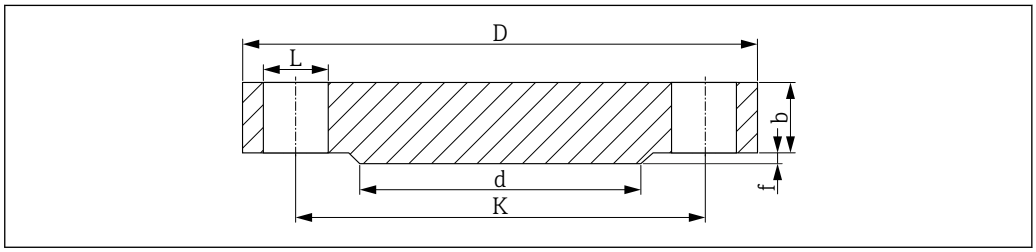
Height of raised face [1]

Standard	Flanges	Height of raised face f	Tolerance
DIN EN 1092-1:2002-06	all types	2 (0.08)	0 −1 (−0.04)
DIN EN 1092-1:2007	≤ DN 32		
	> DN 32 to DN 250	3 (0.12)	0 −2 (−0.08)
	> DN 250 to DN 500	4 (0.16)	0 −3 (−0.12)
	> DN 500	5 (0.19)	0 −4 (−0.16)
ASME B16.5 - 2013	≤ Class 300	1.6 (0.06)	±0.75 (±0.03)
	≥ Class 600	6.4 (0.25)	0.5 (0.02)
JIS B2220:2004	< DN 20	1.5 (0.06) 0	-

Standard	Flanges	Height of raised face f	Tolerance
	> DN 20 to DN 50	2 (0.08) 0	
	> DN 50	3 (0.12) 0	

1) Dimensions in mm (in)

ASME flanges (ASME B16.5-2013)



23 *Raised face RF*

L Bore diameter
d Diameter of raised face
K Diameter of pitch circle
D Flange diameter
b Total flange thickness
f Height of raised face, Class 150/300: 1.6 mm (0.06 in) or from Class 600: 6.4 mm (0.25 in)

Surface quality of sealing surface Ra ≤ 3.2 to 6.3 µm (126 to 248 µin).

Class 150 [1)]

DN	D	b	K	d	L	approx. kg (lbs)
1"	108.0 (4.25)	14.2 (0.56)	79.2 (3.12)	50.8 (2.00)	4xØ15.7 (0.62)	0.86 (1.9)
1¼"	117.3 (4.62)	15.7 (0.62)	88.9 (3.50)	63.5 (2.50)	4xØ15.7 (0.62)	1.17 (2.58)
1½"	127.0 (5.00)	17.5 (0.69)	98.6 (3.88)	73.2 (2.88)	4xØ15.7 (0.62)	1.53 (3.37)
2"	152.4 (6.00)	19.1 (0.75)	120.7 (4.75)	91.9 (3.62)	4xØ19.1 (0.75)	2.42 (5.34)
2½"	177.8 (7.00)	22.4 (0.88)	139.7 (5.50)	104.6 (4.12)	4xØ19.1 (0.75)	3.94 (8.69)
3"	190.5 (7.50)	23.9 (0.94)	152.4 (6.00)	127.0 (5.00)	4xØ19.1 (0.75)	4.93 (10.87)
3½"	215.9 (8.50)	23.9 (0.94)	177.8 (7.00)	139.7 (5.50)	8xØ19.1 (0.75)	6.17 (13.60)
4"	228.6 (9.00)	23.9 (0.94)	190.5 (7.50)	157.2 (6.19)	8xØ19.1 (0.75)	7.00 (15.44)
5"	254.0 (10.0)	23.9 (0.94)	215.9 (8.50)	185.7 (7.31)	8xØ22.4 (0.88)	8.63 (19.03)
6"	279.4 (11.0)	25.4 (1.00)	241.3 (9.50)	215.9 (8.50)	8xØ22.4 (0.88)	11.3 (24.92)
8"	342.9 (13.5)	28.4 (1.12)	298.5 (11.8)	269.7 (10.6)	8xØ22.4 (0.88)	19.6 (43.22)
10"	406.4 (16.0)	30.2 (1.19)	362.0 (14.3)	323.8 (12.7)	12xØ25.4 (1.00)	28.8 (63.50)

1) The dimensions in the following tables are in mm (in), unless otherwise specified

Class 300

DN	D	b	K	d	L	approx. kg (lbs)
1"	124.0 (4.88)	17.5 (0.69)	88.9 (3.50)	50.8 (2.00)	4xØ19.1 (0.75)	1.39 (3.06)
1¼"	133.4 (5.25)	19.1 (0.75)	98.6 (3.88)	63.5 (2.50)	4xØ19.1 (0.75)	1.79 (3.95)
1½"	155.4 (6.12)	20.6 (0.81)	114.3 (4.50)	73.2 (2.88)	4xØ22.4 (0.88)	2.66 (5.87)
2"	165.1 (6.50)	22.4 (0.88)	127.0 (5.00)	91.9 (3.62)	8xØ19.1 (0.75)	3.18 (7.01)

DN	D	b	K	d	L	approx. kg (lbs)
2½"	190.5 (7.50)	25.4 (1.00)	149.4 (5.88)	104.6 (4.12)	8xØ22.4 (0.88)	4.85 (10.69)
3"	209.5 (8.25)	28.4 (1.12)	168.1 (6.62)	127.0 (5.00)	8xØ22.4 (0.88)	6.81 (15.02)
3½"	228.6 (9.00)	30.2 (1.19)	184.2 (7.25)	139.7 (5.50)	8xØ22.4 (0.88)	8.71 (19.21)
4"	254.0 (10.0)	31.8 (1.25)	200.2 (7.88)	157.2 (6.19)	8xØ22.4 (0.88)	11.5 (25.36)
5"	279.4 (11.0)	35.1 (1.38)	235.0 (9.25)	185.7 (7.31)	8xØ22.4 (0.88)	15.6 (34.4)
6"	317.5 (12.5)	36.6 (1.44)	269.7 (10.6)	215.9 (8.50)	12xØ22.4 (0.88)	20.9 (46.08)
8"	381.0 (15.0)	41.1 (1.62)	330.2 (13.0)	269.7 (10.6)	12xØ25.4 (1.00)	34.3 (75.63)
10"	444.5 (17.5)	47.8 (1.88)	387.4 (15.3)	323.8 (12.7)	16xØ28.4 (1.12)	53.3 (117.5)

Class 600

DN	D	b	K	d	L	approx. kg (lbs)
1"	124.0 (4.88)	17.5 (0.69)	88.9 (3.50)	50.8 (2.00)	4xØ19.1 (0.75)	1.60 (3.53)
1¼"	133.4 (5.25)	20.6 (0.81)	98.6 (3.88)	63.5 (2.50)	4xØ19.1 (0.75)	2.23 (4.92)
1½"	155.4 (6.12)	22.4 (0.88)	114.3 (4.50)	73.2 (2.88)	4xØ22.4 (0.88)	3.25 (7.17)
2"	165.1 (6.50)	25.4 (1.00)	127.0 (5.00)	91.9 (3.62)	8xØ19.1 (0.75)	4.15 (9.15)
2½"	190.5 (7.50)	28.4 (1.12)	149.4 (5.88)	104.6 (4.12)	8xØ22.4 (0.88)	6.13 (13.52)
3"	209.5 (8.25)	31.8 (1.25)	168.1 (6.62)	127.0 (5.00)	8xØ22.4 (0.88)	8.44 (18.61)
3½"	228.6 (9.00)	35.1 (1.38)	184.2 (7.25)	139.7 (5.50)	8xØ25.4 (1.00)	11.0 (24.26)
4"	273.1 (10.8)	38.1 (1.50)	215.9 (8.50)	157.2 (6.19)	8xØ25.4 (1.00)	17.3 (38.15)
5"	330.2 (13.0)	44.5 (1.75)	266.7 (10.5)	185.7 (7.31)	8xØ28.4 (1.12)	29.4 (64.83)
6"	355.6 (14.0)	47.8 (1.88)	292.1 (11.5)	215.9 (8.50)	12xØ28.4 (1.12)	36.1 (79.6)
8"	419.1 (16.5)	55.6 (2.19)	349.3 (13.8)	269.7 (10.6)	12xØ31.8 (1.25)	58.9 (129.9)
10"	508.0 (20.0)	63.5 (2.50)	431.8 (17.0)	323.8 (12.7)	16xØ35.1 (1.38)	97.5 (214.9)

Class 900

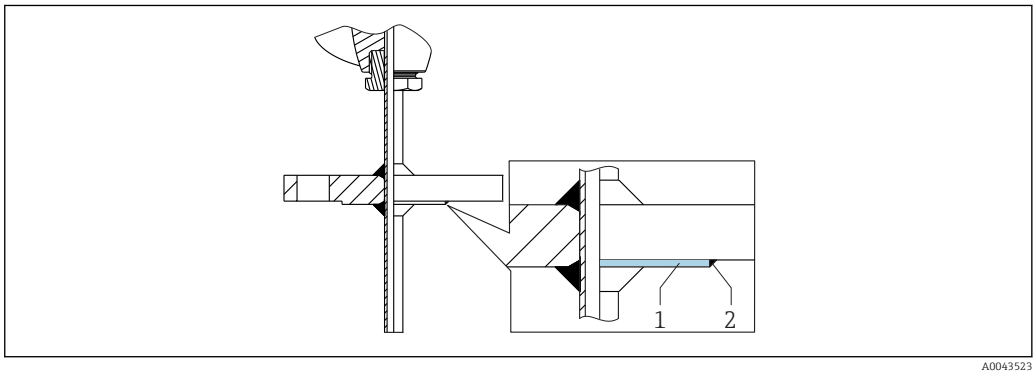
DN	D	b	K	d	L	approx. kg (lbs)
1"	149.4 (5.88)	28.4 (1.12)	101.6 (4.0)	50.8 (2.00)	4xØ25.4 (1.00)	3.57 (7.87)
1¼"	158.8 (6.25)	28.4 (1.12)	111.3 (4.38)	63.5 (2.50)	4xØ25.4 (1.00)	4.14 (9.13)
1½"	177.8 (7.0)	31.8 (1.25)	124.0 (4.88)	73.2 (2.88)	4xØ28.4 (1.12)	5.75 (12.68)
2"	215.9 (8.50)	38.1 (1.50)	165.1 (6.50)	91.9 (3.62)	8xØ25.4 (1.00)	10.1 (22.27)
2½"	244.4 (9.62)	41.1 (1.62)	190.5 (7.50)	104.6 (4.12)	8xØ28.4 (1.12)	14.0 (30.87)
3"	241.3 (9.50)	38.1 (1.50)	190.5 (7.50)	127.0 (5.00)	8xØ25.4 (1.00)	13.1 (28.89)
4"	292.1 (11.50)	44.5 (1.75)	235.0 (9.25)	157.2 (6.19)	8xØ31.8 (1.25)	26.9 (59.31)
5"	349.3 (13.8)	50.8 (2.0)	279.4 (11.0)	185.7 (7.31)	8xØ35.1 (1.38)	36.5 (80.48)
6"	381.0 (15.0)	55.6 (2.19)	317.5 (12.5)	215.9 (8.50)	12xØ31.8 (1.25)	47.4 (104.5)
8"	469.9 (18.5)	63.5 (2.50)	393.7 (15.5)	269.7 (10.6)	12xØ38.1 (1.50)	82.5 (181.9)
10"	546.1 (21.50)	69.9 (2.75)	469.0 (18.5)	323.8 (12.7)	16xØ38.1 (1.50)	122 (269.0)

Class 1500

DN	D	b	K	d	L	approx. kg (lbs)
1"	149.4 (5.88)	28.4 (1.12)	101.6 (4.0)	50.8 (2.00)	4xØ25.4 (1.00)	3.57 (7.87)
1¼"	158.8 (6.25)	28.4 (1.12)	111.3 (4.38)	63.5 (2.50)	4xØ25.4 (1.00)	4.14 (9.13)

DN	D	b	K	d	L	approx. kg (lbs)
1½"	177.8 (7.0)	31.8 (1.25)	124.0 (4.88)	73.2 (2.88)	4xØ28.4 (1.12)	5.75 (12.68)
2"	215.9 (8.50)	38.1 (1.50)	165.1 (6.50)	91.9 (3.62)	8xØ25.4 (1.00)	10.1 (22.27)
2½"	244.4 (9.62)	41.1 (1.62)	190.5 (7.50)	104.6 (4.12)	8xØ28.4 (1.12)	14.0 (30.87)
3"	266.7 (10.5)	47.8 (1.88)	203.2 (8.00)	127.0 (5.00)	8xØ31.8 (1.25)	19.1 (42.12)
4"	311.2 (12.3)	53.8 (2.12)	241.3 (9.50)	157.2 (6.19)	8xØ35.1 (1.38)	29.9 (65.93)
5"	374.7 (14.8)	73.2 (2.88)	292.1 (11.5)	185.7 (7.31)	8xØ41.1 (1.62)	58.4 (128.8)
6"	393.7 (15.50)	82.6 (3.25)	317.5 (12.5)	215.9 (8.50)	12xØ38.1 (1.50)	71.8 (158.3)
8"	482.6 (19.0)	91.9 (3.62)	393.7 (15.5)	269.7 (10.6)	12xØ44.5 (1.75)	122 (269.0)
10"	584.2 (23.0)	108.0 (4.25)	482.6 (19.0)	323.8 (12.7)	12xØ50.8 (2.00)	210 (463.0)

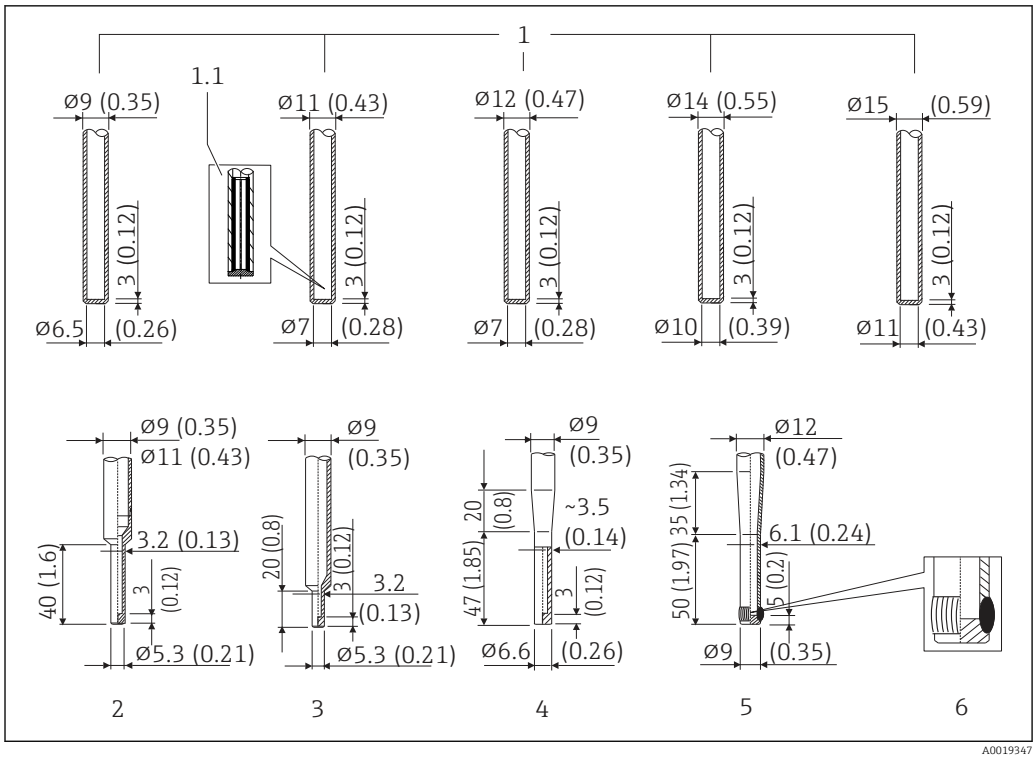
Thermowell material, nickel-based, with flange
If the thermowell materials Alloy 600 and Alloy C276 are combined with a flange process connection, only the raised face and not the complete flange is made of the alloy for cost reasons. This is welded onto a flange with the parent material 316L. Identified in the order code by the material designation Alloy 600 > 316L or Alloy C276 > 316L.



1 Raised face
2 Weld

Shape of tip

The thermal response time, the reduction of the flow cross-section and the mechanical load that occurs in the process are the criteria that matter when selecting the shape of the tip. Advantages of using reduced or tapered thermometer tips:
- A smaller tip shape has less impact on the flow characteristics of the pipe carrying the medium.
- The flow characteristics are optimized, thereby increasing the stability of the thermowell.
- Endress+Hauser offers users a range of thermowell tips to meet every requirement:
  - Reduced tip with Φ5.3 mm (0.21 in): walls of lower thickness significantly reduce the response times of the overall measuring point.
  - Tapered tip with Φ6.6 mm (0.26 in) and reduced tip with Φ9 mm (0.35 in): walls of greater thickness are particularly well suited to applications with a higher degree of mechanical load or wear (e.g. pitting, abrasion, etc.).



24 Available thermowell tips (reduced, straight or tapered). Maximum surface roughness Ra ≤ 0.76 µm (30 µin). Bottom thickness = 3 mm (0.12 in)for straight version, except bottom thickness for schedule (SCH) straight versions = 4 mm (0.16 in)

Item no.	Shape of tip	Insert diameter
1	Straight	6 mm (0.24 in)
1.1	Tip assembly detail: fast response time design is available as an option for Φ11 mm (0.43 in) and Φ 12 mm (0.47 in). The gap between the insert and thermowell is filled with a stable heat transfer material.	
2	Reduced, U ≥ 70 mm (2.76 in)	3 mm (0.12 in)
3	Reduced, U ≥ 50 mm (1.97 in) [1]	3 mm (0.12 in)
4	Tapered, U ≥ 90 mm (3.54 in) [1]	3 mm (0.12 in)
5	Tapered DIN43772-3G, U ≥ 115 mm (4.53 in) [1] [2]	6 mm (0.24 in)
6	Welded tip, weld quality according to EN ISO 5817 - quality class B	

1) Not with the following materials: Alloy C276, Alloy 600, 321, 316 and 446
2) Tip assembly detail: fast response time design is available as an option. The gap between the insert and thermowell is filled with a stable heat transfer material.

It is possible to verify the mechanical loading capacity depending on the installation and process conditions using the online TW Sizing Module for thermowells in the Endress+Hauser Applicator software. See "Accessories" section.

Inserts

Depending on the configuration, iTHERM TS111 or TS211 inserts with different RTD and TC sensors are available for the device.

Sensor type RTD [1]	Pt100 (TF), basic thin film	Pt100 (TF), standard thin film	Pt100 (TF), iTHERM StrongSens	Pt100 (TF), iTHERM QuickSens [2]	Pt100 (WW), wire-wound	
Sensor design; connection method	1x Pt100, 3- or 4-wire	1x Pt100, 3- or 4-wire, mineral-insulated	1x Pt100, 3- or 4-wire, mineral-insulated	1x Pt100, 3- or 4-wire ▪ ø6 mm (0.24 in), mineral-insulated ▪ ø3 mm (0.12 in), Teflon-insulated	1x Pt100, 3- or 4-wire, mineral-insulated	2x Pt100, 3-wire, mineral-insulated
Vibration resistance of the insert tip	≤ 3g	≤ 4g	Increased vibration resistance 60 g	▪ ø3 mm (0.12 in) ≤ 3g ▪ ø6 mm (0.24 in) ≤ 60g	≤ 3g	
Measuring range; accuracy class	−50 to +200 °C (−58 to +392 °F), Class A or AA	−50 to +400 °C (−58 to +752 °F), Class A or AA	−50 to +500 °C (−58 to +932 °F), Class A or AA	−50 to +200 °C (−58 to +392 °F), Class A or AA	−200 to +600 °C (−328 to +1 112 °F), Class A or AA	
Diameter	ø 3 mm (0.12 in) ø 6 mm (0.24 in)	ø 3 mm (0.12 in) ø 6 mm (0.24 in)	ø 6 mm (0.24 in)	ø 3 mm (0.12 in) ø 6 mm (0.24 in)		

1) Options depend on product and configuration
2) Recommended for immersion lengths U < 70 mm (2.76 in)

Sensor type TC [1]	Type K	Type J	Type N
Sensor design	Mineral-insulated, with Alloy600 sheathed cable	Mineral-insulated, stainless steel sheathed cable	
Vibration resistance of the insert tip	≤ 3g		
Measuring range	−40 to +1 100 °C (−40 to +2 012 °F)	−40 to +750 °C (−40 to +1 382 °F)	−40 to +1 100 °C (−40 to +2 012 °F)
Connection type	Grounded or ungrounded		
Temperature-sensitive length	Insert length		
Diameter	ø 3 mm (0.12 in) ø 6 mm (0.24 in)		

1) Options depend on product and configuration

For more information on the deployed insert iTHERM TS111 and TS211 with enhanced vibration resistance and fast-response sensor, see the Technical Information (TI01014T and TI01411T).

Product spare parts that are currently available can be found online at: http://www.products.endress.com/spareparts_consumables.
- Select the appropriate product root.
- Always quote the serial number of the device when ordering spare parts.

The insertion length IL is automatically calculated using the serial number.

Surface roughness

Values for wetted surfaces:

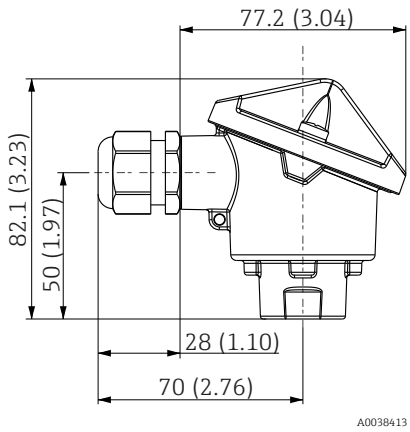
Standard surface	R_a ≤ 1.6 µm (0.06 µin)

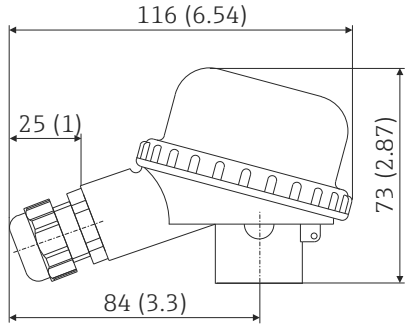
Terminal heads

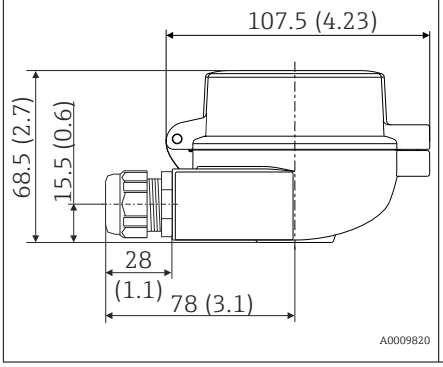
All terminal heads have an internal shape and size in accordance with DIN EN 50446, Form B (flat face) and a thermometer connection with a M24x1.5 or ½" NPT thread. All dimensions in mm (in). The sample cable glands in the diagrams correspond to M20x1.5 connections with non-Ex polyamide cable glands. Specifications without head transmitter installed. For ambient temperatures with head transmitter installed, see the "Environment" section.

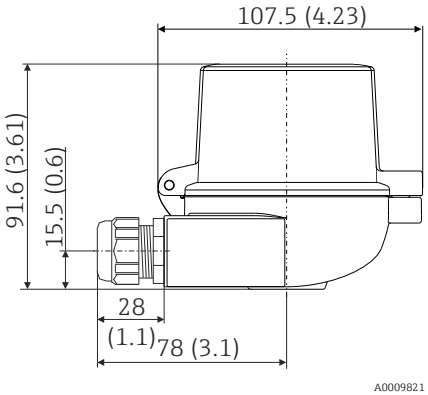
As a special feature, Endress+Hauser offers terminal heads with optimized terminal accessibility for easy installation and maintenance.

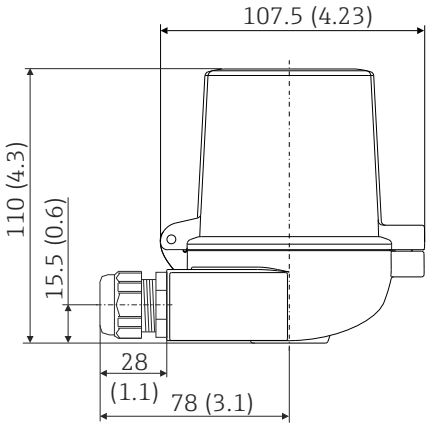
IP 68 = 1.83 m (6 ft), 24 h, with cable gland without cable (with plug), type 6P as per NEMA250-2003

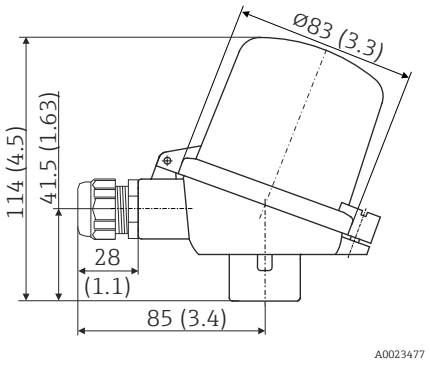
TA20AB	Specification
	▪ Protection class: IP 66/68, NEMA 4x ▪ Temperature: −40 to +100 °C (−40 to +212 °F), polyamide cable gland ▪ Material: aluminum; polyester powder coated Seals: silicone ▪ Threaded cable entry: NPT ½" and M20x1.5 ▪ Color: blue, RAL 5012 ▪ Weight: approx. 300 g (10.6 oz)

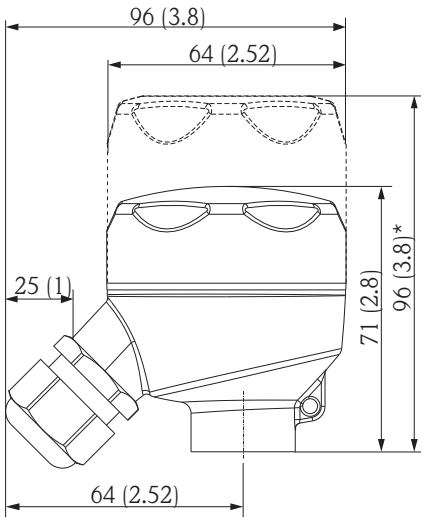
TA20B	Specification
	▪ Degree of protection: IP65 The following applies for option B2: IP55 (no sealing for cover installed) ▪ Max. temperature: −40 to +80 °C (−40 to +176 °F) without cable gland ▪ Material: polyamide (PA) ▪ Cable entry: M20x1.5 ▪ Head and cap color: black ▪ Weight: 80 g (2.82 oz) ▪ With 3-A® symbol

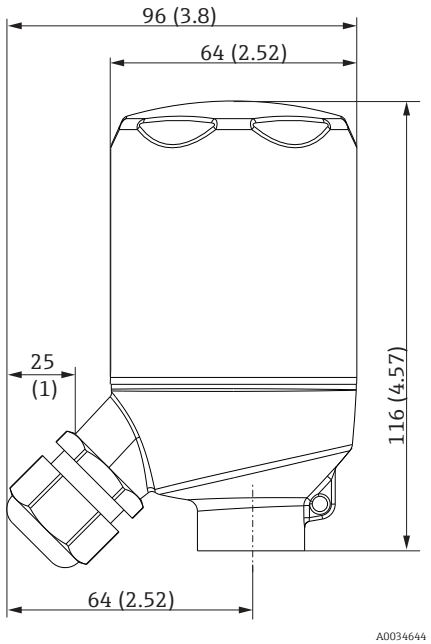
TA30A	Specification
	▪ Protection degree: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", NPT ½" and M20x1.5; ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 330 g (11.64 oz) ▪ Ground terminal, internal and external ▪ Available with sensors with 3-A® symbol

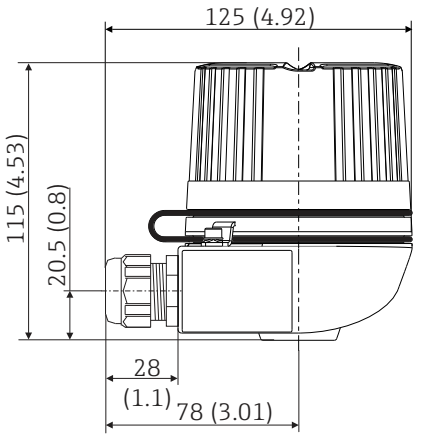
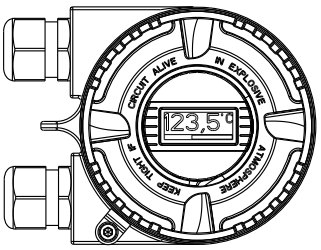
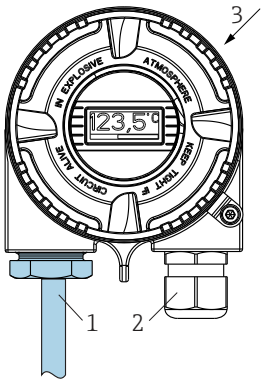
TA30A with display window in cover	Specification
	▪ Protection degree: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", NPT ½" and M20x1.5 ▪ Head color: blue, RAL 5012 Cap color: gray, RAL 7035 ▪ Weight: 420 g (14.81 oz) ▪ Display window: single-pane safety glass according to DIN 8902 ▪ Display window in cover for head transmitter with TID10 display ▪ Ground terminal, internal and external ▪ Available with sensors with 3-A® symbol

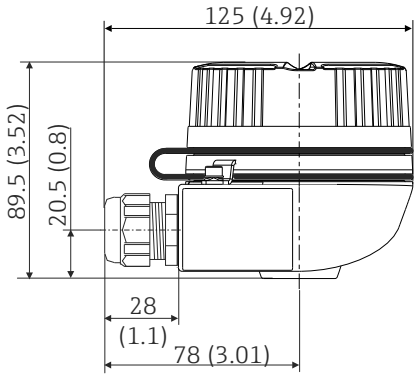
TA30D	Specification
	▪ Protection degree: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", NPT ½" and M20x1.5 ▪ Two head transmitters can be mounted. In the standard configuration one transmitter is mounted in the terminal head cover and an additional terminal block is installed directly on the insert. ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 390 g (13.75 oz) ▪ Ground terminal, internal and external ▪ Available with sensors with 3-A® symbol

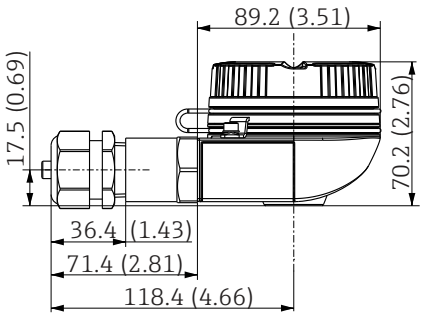
TA30P	Specification
	▪ Degree of protection: IP65 ▪ Max. temperature: −40 to +120 °C (−40 to +248 °F) ▪ Material: polyamide (PA12), antistatic Seals: silicone ▪ Threaded cable entry: M20x1.5 ▪ Two head transmitters can be mounted. In the standard version, one transmitter is mounted in the terminal head cover and an additional terminal block is installed directly on the insert. ▪ Head and cap color: black ▪ Weight: 135 g (4.8 oz) ▪ Type of protection: intrinsic safety (G Ex ia) ▪ Ground terminal: only internal via auxiliary clamp ▪ Available with sensors with 3-A® symbol

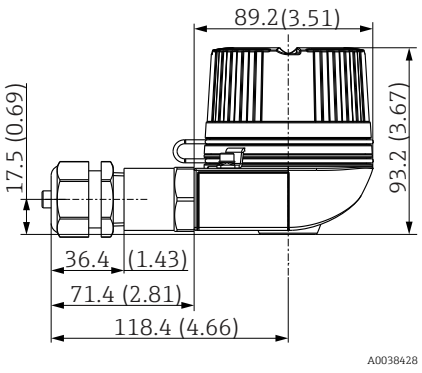
TA30R (optionally with display window in cover)	Specification
 * Dimensions of version with display window in cover	▪ Degree of protection - standard version: IP69K (NEMA Type 4x encl.) Degree of protection - version with display window: IP66/68 (NEMA Type 4x encl.) ▪ Temperature: −50 to +130 °C (−58 to +266 °F) without cable gland ▪ Material: stainless steel 316L, abrasive-blasted or polished Seals: silicone, optional EPDM for applications free from paint-wetting impairment substances Display window: polycarbonate (PC) ▪ Cable entry thread NPT ½" and M20x1.5 ▪ Weight ▪ Standard version: 360 g (12.7 oz) ▪ Version with display window: 460 g (16.23 oz) ▪ Display window in cover optionally for head transmitter with display TID10 ▪ Ground terminal: internal as standard ▪ Available with sensors with 3-A® symbol ▪ Not allowed for Class II and III applications

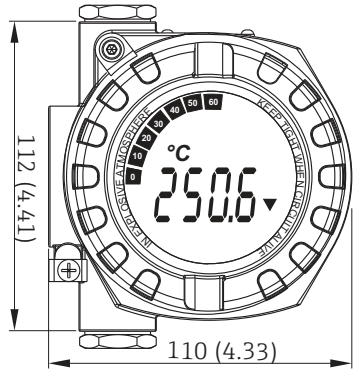
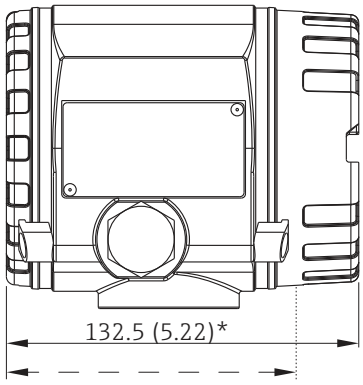
TA30R (high version for two transmitters)	Specification
	▪ Degree of protection: IP69K (NEMA Type 4x encl.) ▪ Temperature: −50 to +130 °C (−58 to +266 °F) without cable gland ▪ Material: stainless steel 316L, abrasive-blasted or polished Seals: EPDM ▪ Cable entry thread NPT ½" and M20x1.5 ▪ Weight: 460 g (16.23 oz) ▪ For two head transmitters ▪ Ground terminal: internal as standard ▪ Not allowed for Class II and III applications ▪ Available with 3-A marked sensors

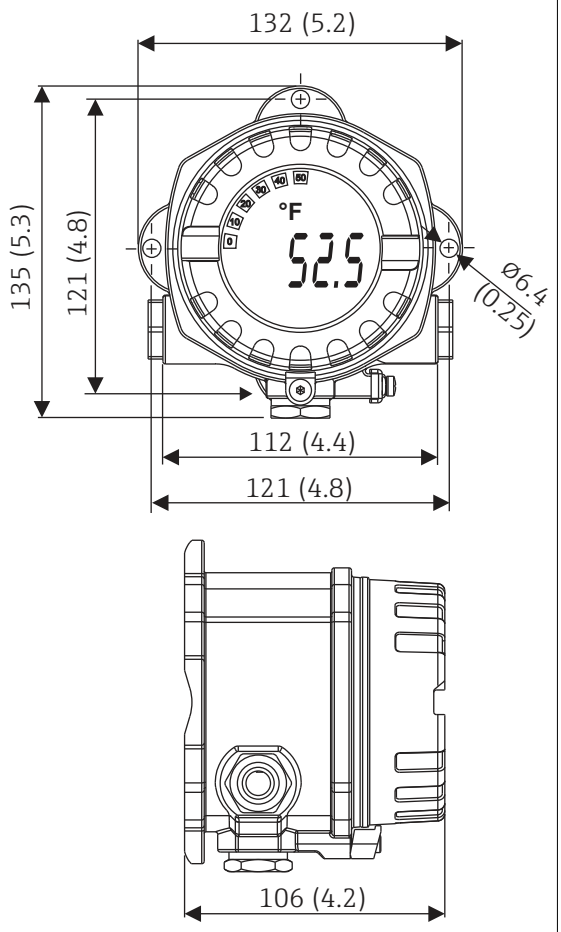
TA30H with display window in cover	Specification
  A0009831  A0044217 25 *Terminal head used as field housing with display frontal mounted* *1 One cable input serves as a sensor input channel with a measuring insert* *2 Cable entry used for wiring* *3 The bottom entry into the housing is not available for the field housing version*	▪ Flameproof (XP) version, explosion-protected, captive screw cap, available with one or two cable entries ▪ Degree of protection: IP 66/68, NEMA Type 4x Encl. Ex-version: IP 66/67 ▪ Temperature: −50 to +150 °C (−58 to +302 °F) for rubber seal without cable gland (observe max. permitted temperature of cable gland!) ▪ Material: ▪ Aluminum; polyester powder coated ▪ Stainless steel 316L without coating ▪ Dry lubricant Klüber Syntheso Glep 1 ▪ Display window: single-pane safety glass according to DIN 8902 ▪ Thread: NPT ½", NPT ¾", M20x1.5, G½" ▪ Color of aluminum head: blue, RAL 5012 ▪ Color of aluminum cap: gray, RAL 7035 ▪ Weight: ▪ Aluminium approx. 860 g (30.33 oz) ▪ Stainless steel approx. 2 900 g (102.3 oz) ▪ Head transmitter optionally available with TID10 display When the housing cover is unscrewed: Before fastening, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1)

TA30H	Specification
	▪ Flameproof (XP) version, explosion-protected, captive screw cap, available with one or two cable entries ▪ Degree of protection: IP 66/68, NEMA Type 4x Encl. Ex-version: IP 66/67 ▪ Temperature: −50 to +150 °C (−58 to +302 °F) for rubber seal without cable gland (observe max. permitted temperature of cable gland!) ▪ Material: ▪ Aluminum, with polyester powder coating ▪ Stainless steel 316L without coating ▪ Dry lubricant Klüber Syntheso Glep 1 ▪ Thread: NPT ½", NPT ¾", M20x1.5, G½" ▪ Color of aluminum head: blue, RAL 5012 ▪ Color of aluminum cap: gray, RAL 7035 ▪ Weight: ▪ Aluminum: approx. 640 g (22.6 oz) ▪ Stainless steel: approx. 2 400 g (84.7 oz) When the housing cover is unscrewed: Before fastening, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1)

TA30EB	Specification
	▪ Screw cap ▪ Degree of protection: IP 66/68, NEMA 4x ▪ Temperature: −50 to +150 °C (−58 to +302 °F) ▪ Material: aluminum; polyester powder coating; Klüber Syntheso Glep 1 dry-film lubricant ▪ Thread: M20x1.5 ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: approx. 400 g (14.11 oz) ▪ Ground terminal: internal and external When the housing cover is unscrewed: Before fastening, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1)

TA30EB with display window in cover	Specification
	▪ Screw cap ▪ Degree of protection: IP 66/68, NEMA 4x Ex-version: IP 66/68 ▪ Temperature: −50 to +150 °C (−58 to +302 °F) for rubber seal without cable gland (observe max. permitted temperature of cable gland!) ▪ Material: aluminum; polyester powder coating; Klüber Syntheso Glep 1 dry-film lubricant ▪ Display window: single-pane safety glass according to DIN 8902 ▪ Thread: NPT ½", NPT ¾", M20x1.5, G½" ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: approx. 400 g (14.11 oz) When the housing cover is unscrewed: Before fastening, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1)

Temperature field transmitter iTEMP TMT162	Specification
  A0024608 * Dimensions without display = 112 mm (4.41 in)	▪ Separate electronics compartment and connection compartment ▪ Protection class: IP66, 67, NEMA Type 4x ▪ Material: Die-cast aluminum housing AlSi10Mg with powder coating on polyester base or stainless steel 316L ▪ Display rotatable in 90° increments ▪ Cable entry: NPT ½" ▪ Bright backlit display with ease of visibility in bright sunshine or pitch darkness ▪ Gold plated terminals to avoid corrosion and additional measurement errors ▪ SIL certification as per IEC 61508:2010 (HART-protocol) ▪ Integrated overvoltage protection for the prevention of damage from overvoltage, optional The iTEMP TMT162 is installed as a terminal head in a vertical orientation, as shown in the picture opposite (thermometer facing downwards, cable connection facing upwards).

Temperature field transmitter iTEMP TMT142B	Specification
	▪ Protection class: IP66/67, NEMA type 4x ▪ Material: Die-cast aluminum housing AlSi10Mg with powder coating on polyester base or stainless steel 316L ▪ Display rotatable in 90° increments ▪ Integrated Bluetooth® interface for wireless measured value display and parameter configuration, optional ▪ Bright backlit display with ease of visibility in bright sunshine or pitch darkness ▪ Gold plated terminals to avoid corrosion and additional measurement errors ▪ Integrated overvoltage protection for the prevention of damage from overvoltage, optional The iTEMP TMT142B is installed as a terminal head in a horizontal orientation as shown in the picture opposite (thermometer facing downwards, cable connection facing upwards).

Cable glands and connectors [1)]

Type	Suitable for cable entry	Degree of protection	Temperature range	Suitable cable diameter
Cable gland, polyamide blue (indication of Ex-i circuit)	½" NPT	IP68	−30 to +95 °C (−22 to +203 °F)	7 to 12 mm (0.27 to 0.47 in)
Cable gland, polyamide	½" NPT, ¾" NPT, M20x1.5 (optionally 2x cable entry)	IP68	−40 to +100 °C (−40 to +212 °F)	5 to 9 mm (0.19 to 0.35 in)
	½" NPT, M20x1.5 (optionally 2x cable entry)	IP69K	−20 to +95 °C (−4 to +203 °F)	
Cable gland for dust ignition-proof area, polyamide	½" NPT, M20x1.5	IP68	−20 to +95 °C (−4 to +203 °F)	
Cable gland for dust ignition-proof area, nickel-plated brass	M20x1.5	IP68 (NEMA Type 4x)	−20 to +130 °C (−4 to +266 °F)	
M12 plug, 4-pin, 316 (PROFIBUS® PA, Ethernet-APL™, IO-Link®	½" NPT, M20x1.5	IP67	−40 to +105 °C (−40 to +221 °F)	-

Type	Suitable for cable entry	Degree of protection	Temperature range	Suitable cable diameter
M12 plug, 8-pin, 316	M20x1.5	IP67	−30 to +90 °C (−22 to +194 °F)	-
7/8" plug, 4-pin, 316 (FOUNDATION ™ Fieldbus, PROFIBUS® PA)	½" NPT, M20x1.5	IP67	−40 to +105 °C (−40 to +221 °F)	-

1) Depending on product and configuration

Cable glands are not available for encapsulated, flameproof thermometers.

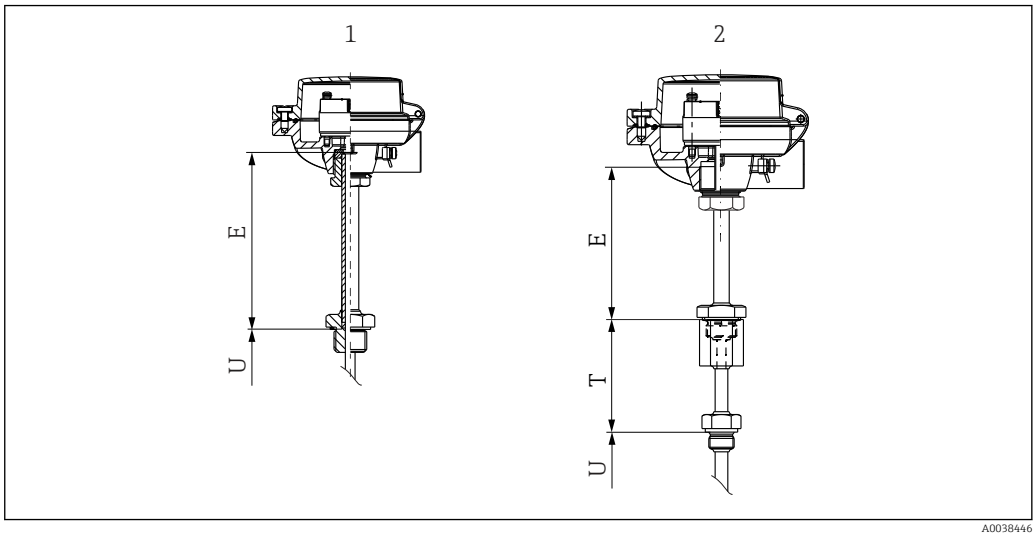
Extension neck

The extension neck is the part between the process connection and the terminal head. It may consist of two parts: thermowell lagging that is permanently attached to the thermowell and a detachable extension neck. The term E is used to describe the length of the removable extension neck.

Different versions of the removable extension neck are possible.

Removable extension neck according DIN 43772

The removable extension neck according to DIN has a threaded connection on both sides. If the thermometer has a thermowell, the standard connection is a G½" thread [4]. If the thermometer does not have a thermowell, and is intended for installation in a separate thermowell, the thread for the thermowell connection can be selected *(feature 50: process/thermowell connection)*

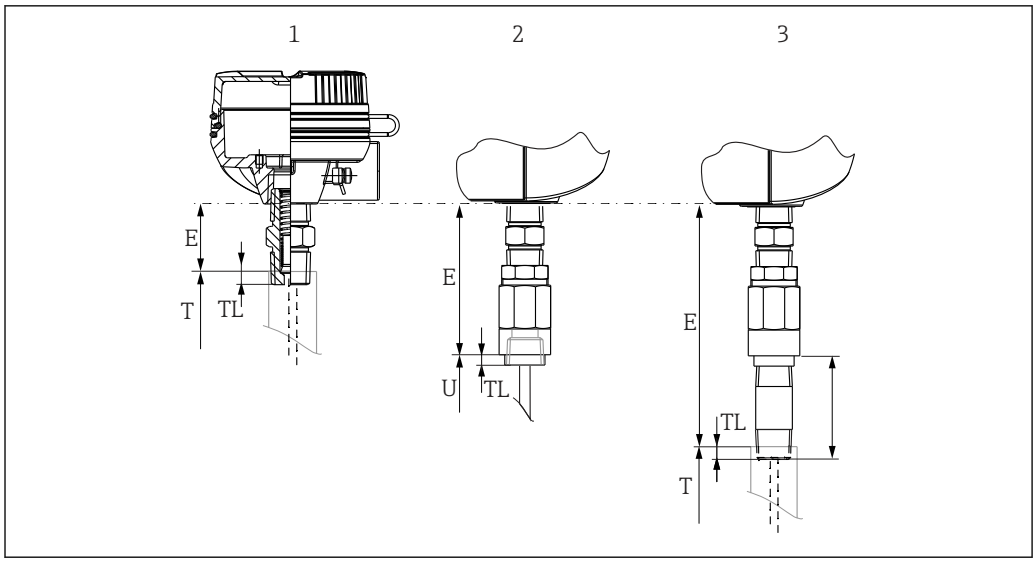


1 Removable extension neck - thermometer without thermowell
2 Removable extension neck - thermometer with thermowell

Removable extension neck as nipple connection

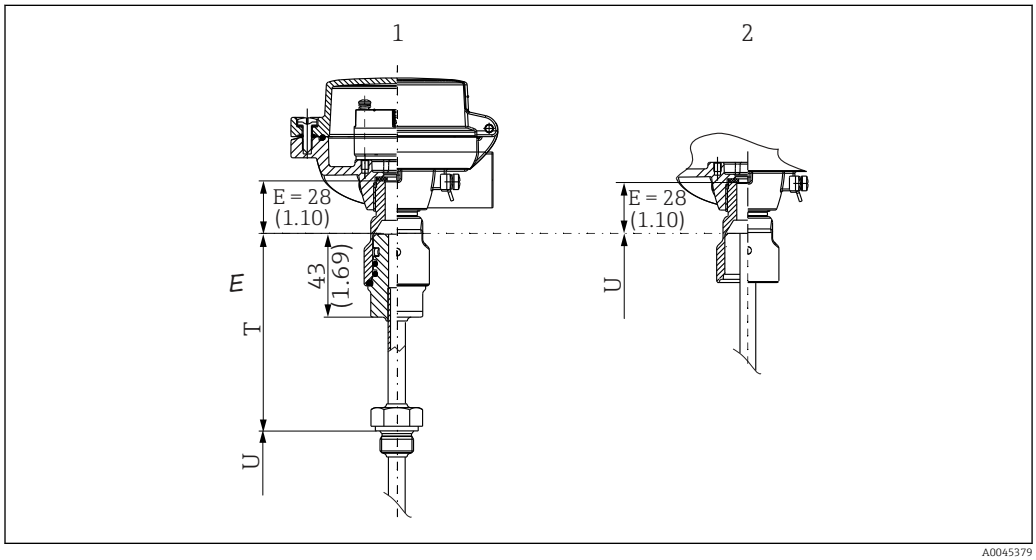
- The removable extension neck can be designed as a nipple connection. In this case, the connection is always an NPT ½" thread. The nipple directly on the terminal head is part of the TS211 insert in this case. The length of the nipple is not variable. It is 35 mm (1.38 in) as the standard version and 47 mm (1.85 in) as a lamination nipple version for Ex d applications.
- For the nipple-union connection, an NPT ½" female thread is used for the connection to the thermowell. The nipple directly on the terminal head is part of the TS211 insert in this case. The overall length is not variable. It is 93 mm (3.66 in) as the standard version and 105 mm (4.13 in) as a lamination nipple version for Ex d applications.
- In the case of the nipple-union-nipple connection, the nipple directly on the terminal head is part of the TS211 insert. The overall length is not variable. It is 142 mm (5.6 in) as the standard version and 154 mm (6.06 in) as the version for Ex d applications. In the case of this connection, the length of the second nipple can be configured if required.

4) Unless an M20x1.5 thread is specifically selected



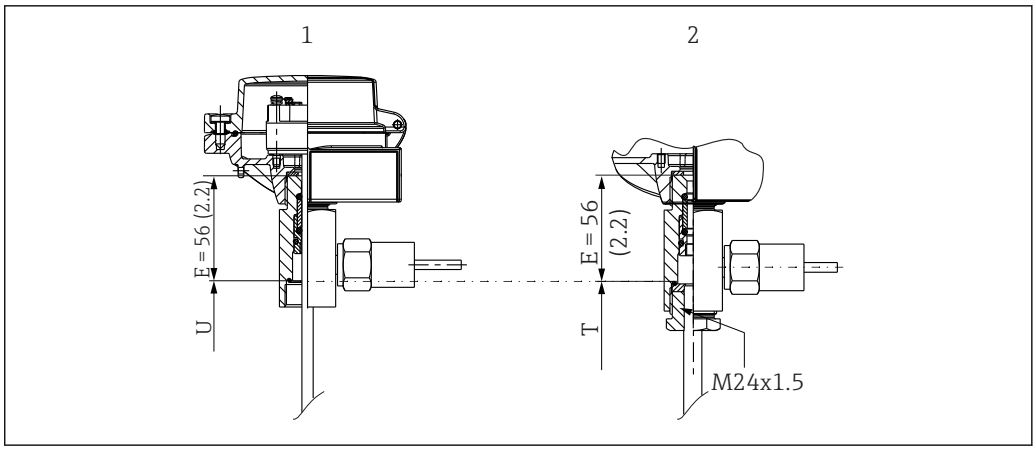
1 Extension neck type N NPT ½"
2 Extension neck type NU NPT ½" female thread
3 Extension neck type NUN (nipple-union-nipple) NPT ½", the length of the lower nipple can be configured

Removable extension neck as upper half of the iTHERM QuickNeck
In an iTHERM QuickNeck, the upper part is the removable extension neck and the lower part the lagging. If the thermometer does not have a thermowell, select the iTHERM QuickNeck (upper half) option *(feature 50: process/thermowell connection, option G1)*. The length of the removable extension neck is predetermined by the chosen design here.



1 Continuous thermowell + iTHERM QuickNeck, separable
2 iTHERM QuickNeck - upper half - to mount in an existing thermowell with iTHERM QuickNeck

Removable extension neck as 'second process seal'
The removable extension neck can be designed as a second process seal. The connections are designed with an M24x1.5 male thread on the head side and an M24x1.5 female thread on the thermowell side to allow retrofitting with standard thermometers. The length of the removable extension neck is predetermined by the chosen design here.

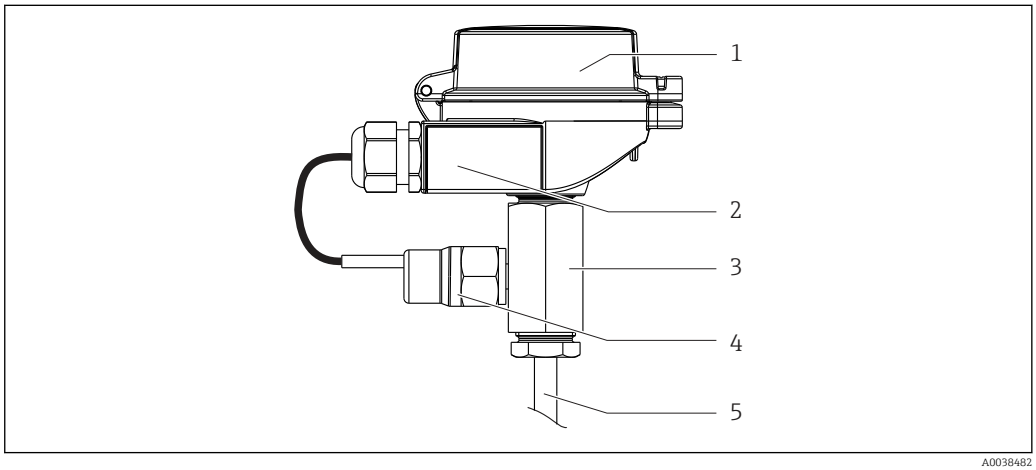


1 Extension neck with second process seal without a thermowell
2 Extension neck with second process seal with thermowell

Extension neck with second process seal

A special version of the extension neck is available with a second process seal, which can be placed as an optional component between the thermowell and the terminal head. In the event of a thermowell failure, no process medium will enter the terminal head or the wiring circuit. The process medium is enclosed within the thermowell. A pressure switch emits a signal if the pressure in the component with the second process seal increases, alerting maintenance personnel to a hazardous situation. Measurement can continue for a short transition period, depending on the pressure, temperature and process medium, until the thermowell is replaced.

Transmitter wiring scheme: An Endress+Hauser TMT82 temperature transmitter with two channels and HART® protocol is used. One channel converts the signals of the temperature sensor to a 4 to 20 mA signal. The second channel uses the sensor breakage detection function in the thermocouple configuration and transmits this failure information via the HART® protocol if the pressure switch is activated. Other configurations are possible on request.



26 Extension neck with second process seal

1 Terminal head with built-in temperature transmitter
2 Housing with dual cable entry. A suitable cable gland is installed for the cable entry of the pressure switch. The second cable entry is not assigned.
3 Second process seal
4 Installed pressure switch
5 Upper part of the thermowell

Maximum pressure	200 bar (2 900 psi)
Switch point	3.5 bar (50.8 psi)±1 bar (±14.5 psi)
Ambient temperature range	−20 to +80 °C (−4 to +176 °F)

Process temperature range	Up to +400 °C (+752 °F), minimum required length of extension neck T = 100 mm (3.94 in)
Seal material	FKM

During the design phase, pay attention to the significantly lower pressure resistance of the thermowell and process connection as well as the resistance of the seal material to the process medium!

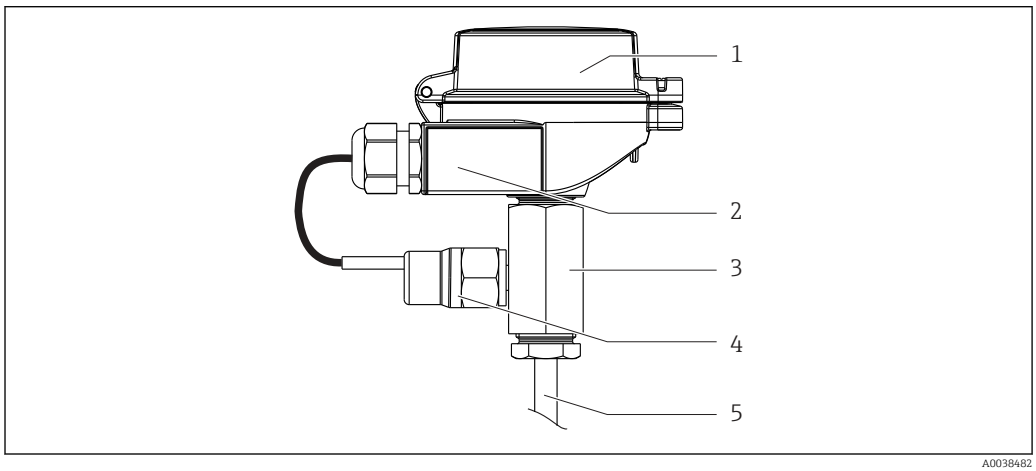
The primary thermowell, whose material can be selected from various stainless steels or nickel-based materials, represents the first process seal. The resistance of the thermowell material to the process conditions must be guaranteed. The extension neck represents the second process seal. The process here is sealed off from the environment by means of seals made of FKM. The resistance of the seal material to the process conditions must be guaranteed.

Recommendation: Due to the aging of the internal seals, we recommend replacing the components of the second process seal every five years, even if no fault has occurred in the thermowell. In the event of a leak in the thermowell, the components of the second process seal must be replaced along with the thermowell. If, as a result of the leak in the first process seal, the pressure in the extension neck rises above the switching pressure of the pressure switch, the transmitter transmits a "sensor break" error message to the control system via HART® communication.

Extension neck with Dual Seal technology

Dual Seal, a second process seal, is available as a special version of the extension neck. It is placed as an optional component between the thermowell and the terminal head. In the event of a thermowell failure, no process medium will enter the terminal head or the wiring circuit. The process medium is enclosed within the thermowell. A pressure switch emits a signal if the pressure in the component with the second process seal increases, alerting maintenance personnel to a hazardous situation. Measurement can continue for a short transition period, depending on the pressure, temperature and process medium, until the thermowell is replaced.

Transmitter wiring scheme:
- An Endress+Hauser iTEMP TMT82 temperature transmitter with two channels and HART® protocol is used. One channel converts the signals from the temperature sensor to a 4 to 20 mA signal. The second channel uses the sensor breakage detection function in the thermocouple configuration and transmits this failure information via the HART® protocol if the pressure switch is activated. Other configurations are possible on request.
- An Endress+Hauser iTEMP TMT86 temperature transmitter with two channels and PROFINET® protocol is used. One channel converts the signals from the temperature sensor for the PROFINET® communication. The second channel is configured for Dual Seal and transmits the failure information via the PROFINET® protocol if the pressure switch is activated.

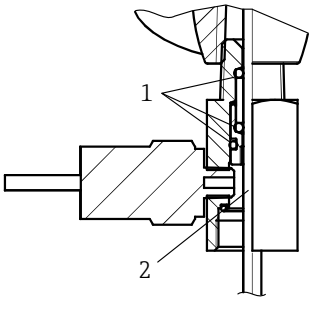


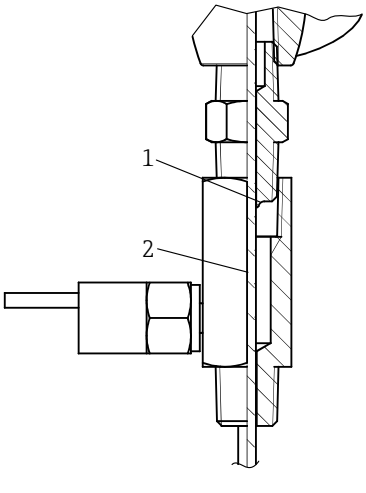
27 Extension neck with Dual Seal technology

1 Terminal head with built-in temperature transmitter
2 Housing with dual cable entry. A suitable cable gland is installed for the cable entry of the pressure switch. The second cable entry is not assigned.
3 Dual Seal
4 Installed pressure switch
5 Upper part of the thermowell

Housing

The Dual Seal option can be selected in two mechanical versions:

Dual Seal with gasket and spring-loaded insert	
 *1 Gaskets* *2 Replaceable insert*	This version enables replacement of the insert. When installed, the insert is spring-loaded, ensuring constant contact with the bottom of the thermowell for optimized response time. In the event of a thermowell defect and pressure build-up in the Dual Seal housing, the gasket package provides a seal. Seal material: FKM

Dual Seal with metallic seal and fixed insert	
 *1 Metallic seal* *2 Fixed insert*	In this design, the insert is welded to the thermometer, forming a metallic seal. No additional seals are used, and the system consists of no moving parts.

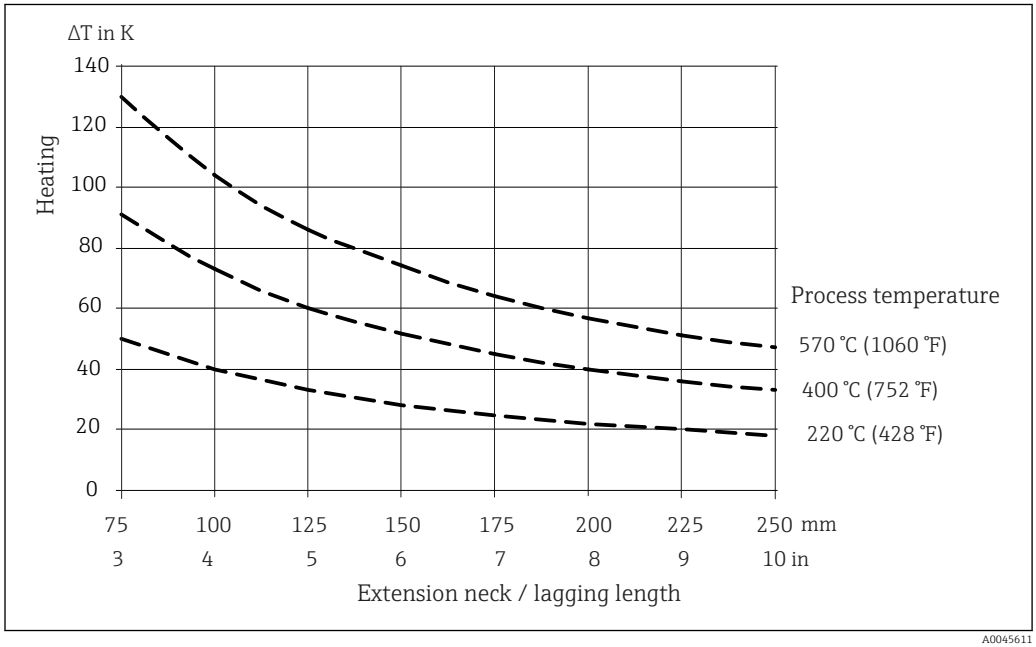
Pressure switch

The switch point of the pressure switch can be selected from two pre-defined switch points:
- Switch point at 0.8 bar
  For critical processes in particular, the maximum process pressures are selected at < 1 bar. This low switch point is necessary to detect a thermowell defect at low pressures. It limits the maximum process temperature due to the enclosed gas volume.
- Switch point at 3.5 bar
  To detect a thermowell defect, the process pressure must be > 3.5 bar.

Switch point	0.8 bar (11.6 psi)	3.5 bar (50.8 psi) ±1 bar (±14.5 psi)
Maximum pressure	200 bar (2 900 psi)	
Ambient temperature range	−20 to +80 °C (−4 to +176 °F)	

Process temperature range	Up to +180 °C (+356 °F)	Up to +400 °C (+752 °F)
Dimensions	Min. extension neck length T = 110 mm (4.33 in) Max. thermowell length U = 300 mm (11.81 in) Max. thermowell diameter D1 = 30 mm (1.18 in)	Min. extension neck length T = 100 mm (3.94 in)

As illustrated in the following diagram, the length of the extension neck can influence the temperature in the terminal head. This temperature must remain within the limit values defined in the "Operating conditions" section.



28 Heating of the terminal head as a function of the process temperature. Temperature in terminal head = ambient temperature 20 °C (68 °F)+ ΔT

The diagram can be used to calculate the transmitter temperature.

Example: At a process temperature of 220 °C (428 °F) and with a total lagging and extension neck length (T+ E) of 100 mm (3.94 in), the heat conduction is 40 K (72 °F). The determined transmitter temperature is less than 85 °C (maximum ambient temperature for iTEMP temperature transmitter).

Result: The temperature of the transmitter is OK; the length of the lagging is sufficient.

Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

Ordering information

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

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

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

Accessories

The accessories currently available for the product can be selected at www.endress.com:

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2. Open the product page.
3. Select **Spare parts & Accessories**.

Service-specific accessories

DeviceCare SFE100
DeviceCare is an Endress+Hauser configuration tool for field devices using the following communication protocols: HART, PROFIBUS DP/PA, FOUNDATION Fieldbus, IO/Link, Modbus, CDI and Endress+Hauser Common Data Interfaces.

Technical Information TI01134S

www.endress.com/sfe100

FieldCare SFE500
FieldCare is a configuration tool for Endress+Hauser and third-party field devices based on DTM technology.
The following communication protocols are supported: HART, WirelessHART, PROFIBUS, FOUNDATION Fieldbus, Modbus, IO-Link, EtherNet/IP, PROFINET and PROFINET APL.

Technical Information TI00028S

www.endress.com/sfe500

Netilion
With the Netilion IIoT ecosystem, Endress+Hauser enables the optimization of plant performance, digitization of workflows, sharing of knowledge and improved collaboration. Drawing upon decades of experience in process automation, Endress+Hauser offers the process industry an IIoT ecosystem designed to effortlessly extract insights from data. These insights allow process optimization, leading to increased plant availability, efficiency, reliability and ultimately a more profitable plant.

www.netilion.endress.com

SmartBlue app
SmartBlue from Endress+Hauser allows easy wireless field device configuration via Bluetooth® or WLAN. By providing mobile access to diagnostic and process information, SmartBlue saves time, even in hazardous and difficult-to-access environments.



A0033202

29 *QR code for free Endress+Hauser SmartBlue app*

Online tools

Product information over the entire life cycle of the device: www.endress.com/onlinetools

System components

Surge arrester modules from the HAW product family

Surge arrester modules for DIN rail and field device mounting, for the protection of plants and measuring instruments with power supply and signal/communication lines.

More detailed information: www.endress.com

Process indicators from the RIA product family

Easily readable process indicators with various functions: loop-powered indicators for displaying 4 to 20 mAvalues, display of up to four HART variables, process indicators with control units, limit value monitoring, sensor power supply, and galvanic isolation.

Universal application thanks to international hazardous area approvals, suitable for panel mounting or field installation..

For more information, please refer to: www.endress.com

RN series active barrier

Single- or two-channel active barrier for safe separation of 0/4 to 20 mA standard signal circuits with bidirectional HART transmission. In the signal duplicator option, the input signal is transmitted to two galvanically isolated outputs. The device has one active and one passive current input; the outputs can be operated actively or passively.

For more information, please refer to: www.endress.com

Documentation

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the device version:

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid for your device** The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	**Guide that takes you quickly to the 1st measured value** The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	**Your reference document** The Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	**Reference for your parameters** The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Safety instructions (XA)	Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. These are an integral part of the Operating Instructions. The nameplate indicates which Safety Instructions (XA) apply to the device.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is a constituent part of the device documentation.



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