TI01373T/09/EN/01.18
71419690
2018-12-10

Technical Information
iTHERM TM131

Trend-setting, high modular and robust RTD or TC thermometer for a wide range of industrial applications

Complete with manufactured thermowell produced from pipe or tube material or to be used with on-site thermowell

Application

- Universal range of application
- 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

Head transmitter

All Endress+Hauser transmitters are available with enhanced accuracy and reliability compared to directly wired sensors. Easy customizing by choosing one of the following outputs and communication protocols:

- Analog output 4 to 20 mA, HART®
- PROFIBUS® PA, FOUNDATION Fieldbus™

Your benefits

- Second process barrier with failure indication offering valuable health status information
- iTHERM QuickSens: fastest response times 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 certification: explosion protection according to ATEX, IECEx, FM, CSA and NEPSI

Endress+Hauser
People for Process Automation

Table of contents

Function and system design

iTHERM ModuLine - thermometer for General Application

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

Differentiating factors when selecting a suitable thermometer

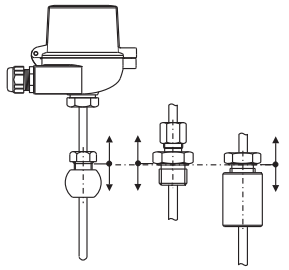
Direct contact ↓

Version with thermowell ↓

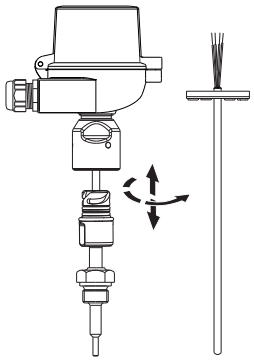
Advanced technology

Advanced thermometers offer cutting-edge technology with features such as a replaceable insert, quick-fastening extension neck (iTHERM QuickNeck), vibration-resistant and fast-response sensor technology (iTHERM StrongSens and QuickSens) and safety features like approvals for use in hazardous areas, second process barrier "Dual Seal" or SIL thermometers

TM111 advanced



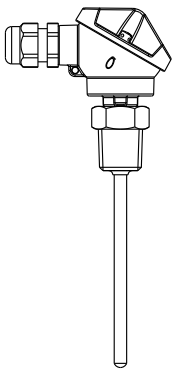
TM131 advanced



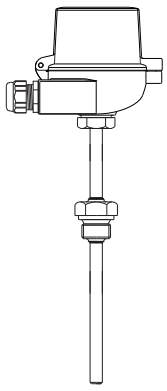
Basic technology

Basic thermometers are characterized by basic sensor technology with features such as a fixed, non-replaceable insert, application in non-hazardous areas, standard extension neck, low-cost unit

TM101 basic



TM121 basic



Measuring principle

Resistance thermometer (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 α = 0.003851 °C^{-1}.

There are generally two different kinds of platinum resistance thermometers:

- **Wire wound (WW):** Here, a double coil of fine, high-purity platinum wire is located in a ceramic support. This 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 it 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. A relatively low principle-based deviation of the resistance/temperature characteristic from the standard characteristic of IEC 60751 can frequently be observed among TF sensors at high temperatures. As a result, the tight limit values of tolerance category A as per IEC 60751 can only be observed with TF sensors at temperatures up to approx. 300 °C (572 °F).

Thermocouples (TC)

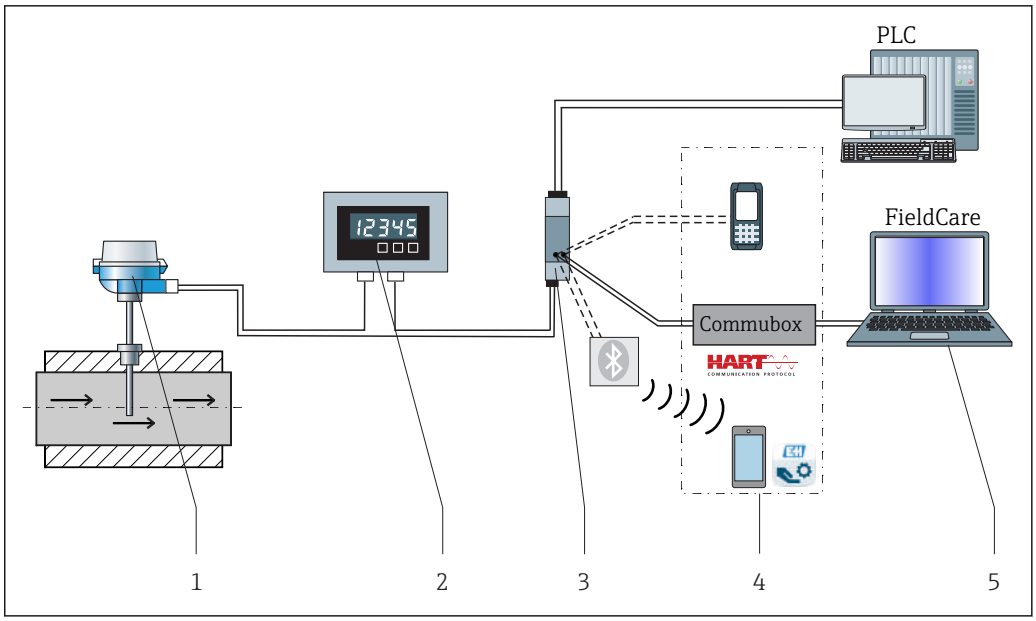
Thermocouples are comparatively simple, robust temperature sensors which use the Seebeck effect for temperature measurement: if two electrical conductors made of different materials are connected at a point, a weak electrical voltage can be measured between the two open conductor ends if the conductors 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 you need for the seamless integration of the measuring point into the overall facility. This includes:

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

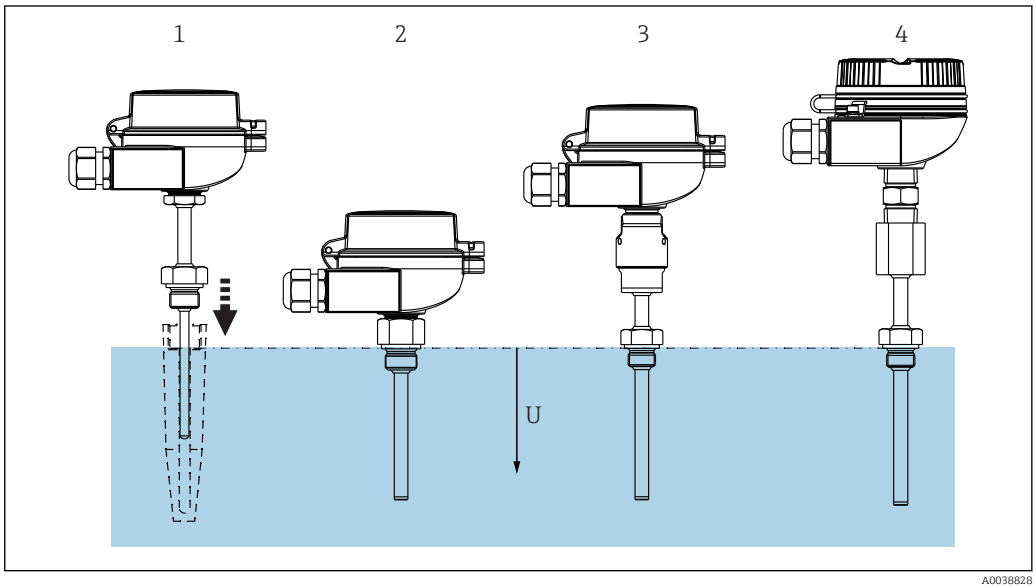
For more information, see the brochure 'System Components - Solutions for a Complete Measuring Point' (FA00016K/EN)



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

1 *Installed iTHERM thermometer with HART® communication protocol*
2 *RIA15 loop powered process display - It is integrated in the current loop and displays the measuring signal or HART® process variables in digital form. The process display unit does not require an external power supply. It is powered directly from the current loop. More information on this can be found in the Technical Information, see "Documentation", .*
3 *Active barrier RN221N - The RN221N (24 V DC, 30 mA) active barrier has a galvanically isolated output for supplying voltage to loop-powered transmitters. The universal power supply works with an input supply voltage of 20 to 250 V DC/AC, 50/60 Hz, which means that it can be used in all international power grids. More information on this can be found in the Technical Information, see "Documentation", .*
4 *Communication examples: HART® handheld communicator FieldXpert, Commubox FXA195 for intrinsically safe HART® communication with FieldCare via the USB interface, Bluetooth® technology with SmartBlue App.*
5 *FieldCare is a FDT-based plant asset management tool from Endress+Hauser, more details see section 'accessories'.*

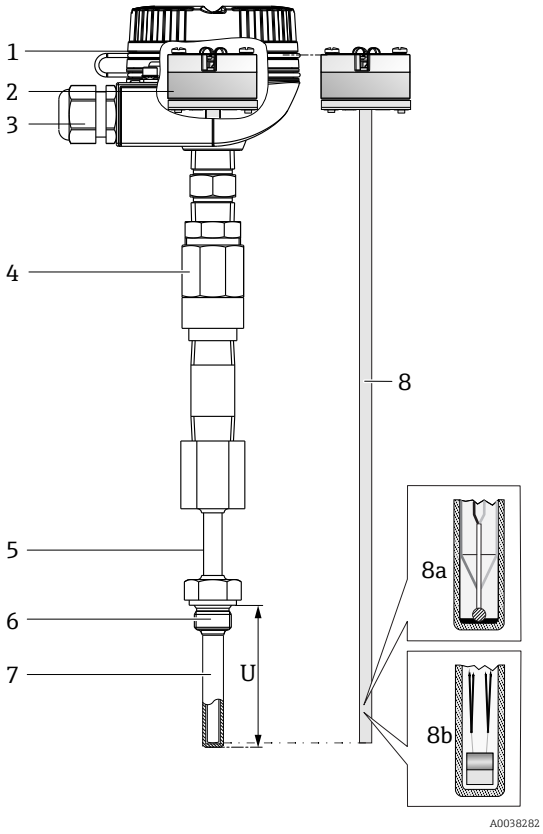
Modular design



2 *The thermometer is available in various versions generally*

1 *Designed for installation in an existing onsite thermowell*
2 *With thermowell without extension*
3 *With QuickNeck and thermowell similar to DIN43772 shape 2 G/F, 3 G/F*
4 *With thermowell and hexagonal lagging*

Design		Options

	1: Terminal head	Variety of terminal heads made of aluminum, Polyamid 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 display unit for added reliability

	2: Wiring, electrical connection, output signal	▪ Ceramic terminal block ▪ Flying leads ▪ Head transmitter (4 to 20 mA, HART®, PROFIBUS® PA, FOUNDATION™ Fieldbus), single-channel or two-channel ▪ Attachable display
	3: Connector or cable gland	▪ PROFIBUS® PA / FOUNDATION™ Fieldbus connector, 4-pin ▪ 8-pin connector ▪ Polyamide or brass cable glands
	4: Extension neck	Different options of extension necks are available ▪ Without neck similar to DIN43772 Form 2 ▪ Lagging according to form 2 F/G, 3G/G removeable neck according to DIN43772 ▪ QuickNeck ▪ 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 ▪ Wiring mistakes avoided
	5: Thermowell lagging	The lagging of the thermowell gives space 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 ▪ Various materials ▪ Various tip shapes (straight, reduced or tapered) **Your benefits:** Quick responding thermowell reducing the t_{90} response time of the temperature measurement by factor 4 in contrast to the traditional design

	8: Insert with:
	8a: iTHERM QuickSens
	8b: iTHERM StrongSens
		Sensor models: RTD - wire wound (WW), thin-film sensor (TF) or thermocouples type K, J or N. Insert diameter Ø3 mm (⅛ in) or Ø6 mm (¼ in), depending on thermowell tip or selection
		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

Input

Measured variable

Temperature (temperature-linear transmission behavior)

Measuring range

Depends on the type of sensor used

Sensor type	Measuring range
Pt100 thin-film	−50 to +400 °C (−58 to +752 °F)
Pt100 thin-film, iTHERM StrongSens, vibration-resistant > 60g	−50 to +500 °C (−58 to +932 °F)
Pt100 thin-film, iTHERM QuickSens, fast-response	−50 to +200 °C (−58 to +392 °F)
Pt100 wire wound, 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

Generally, the measured value can be transmitted in one of two ways:

- Directly-wired sensors - sensor measured values forwarded without a transmitter.
- Via all common protocols by selecting an appropriate Endress+Hauser iTEMP temperature transmitter. All the transmitters listed below 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 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. More information can be found in the Technical Information.

HART® head transmitters
The 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 device configuration tools like FieldCare, DeviceCare or FieldCommunicator 375/475. Integrated Bluetooth® interface for the wireless display of measured values and configuration via E+H SmartBlue (app), optional. For more information, see the Technical Information.

PROFIBUS® PA head transmitters
Universally programmable head transmitter with PROFIBUS® PA communication. Conversion of various input signals into digital output signals. High accuracy over the complete ambient temperature range. The configuration of PROFIBUS PA functions and of device-specific parameters is performed via fieldbus communication. For more information, see the Technical Information.

FOUNDATION Fieldbus™ head transmitters
Universally programmable head transmitter with FOUNDATION Fieldbus™ communication. Conversion of various input signals into digital output signals. High accuracy over the complete ambient temperature range. All transmitters are released for use in all important process control systems. The integration tests are performed in Endress+Hauser's "System World". For more information, see the Technical Information.

Advantages of the iTEMP transmitters:
- Dual or single sensor input (optionally for certain transmitters)
- Pluggable 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 for dual sensor input transmitters, based on Callendar/Van Dusen coefficients

Field transmitter
Field transmitter with HART®, FOUNDATION Fieldbus™ or PROFIBUS® PA communication and backlit display. Can be read easily from a distance, in sunlight and at night. Large measurement value, bargraph and fault indication displayed. Benefits are: dual sensor input, highest reliability in harsh industrial environments, mathematic functions, thermometer drift monitoring and sensor back-up functionality, corrosion detection.

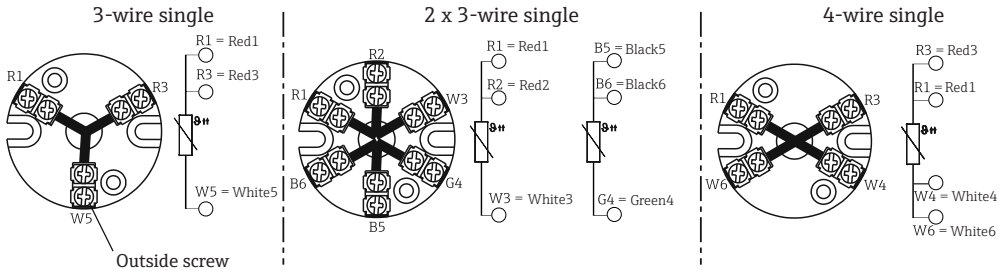
Power supply

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

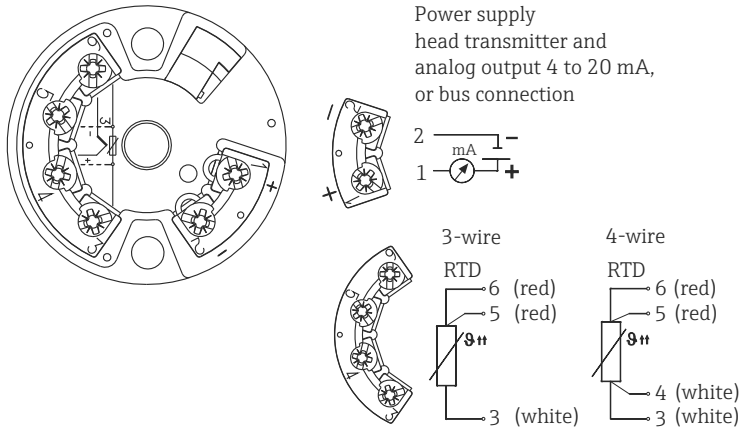
Terminal assignment

Type of sensor connection RTD

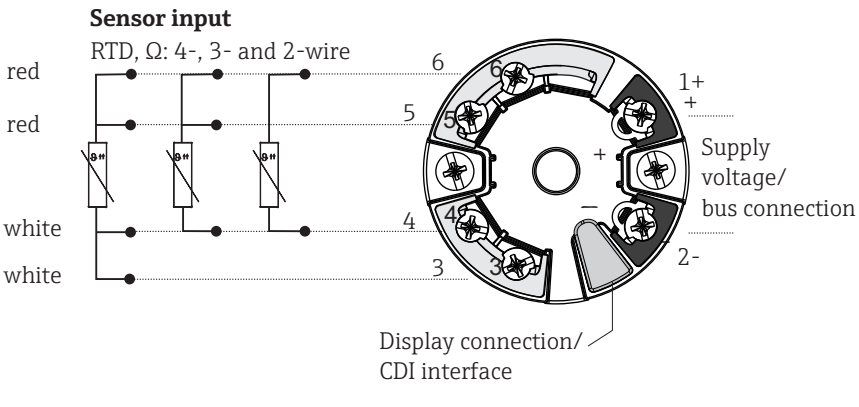
Terminal block mounted



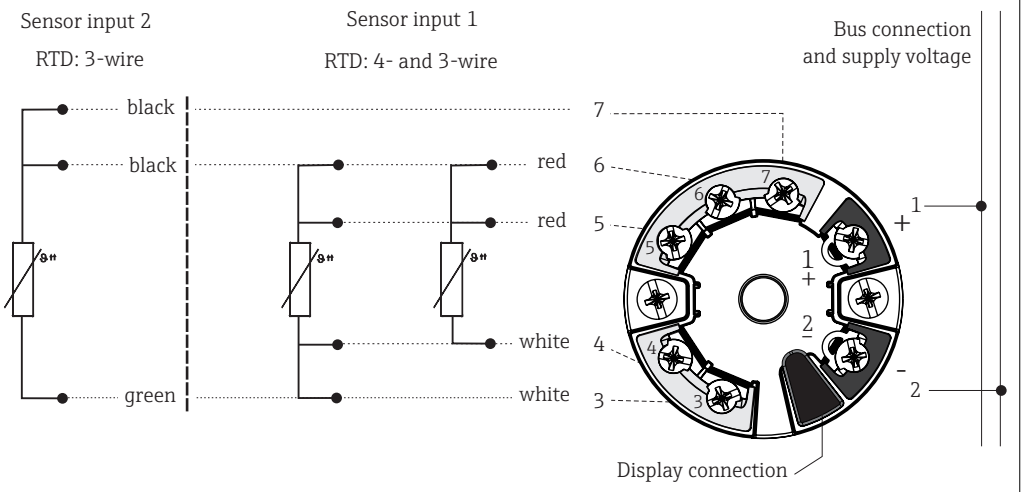
Head mounted transmitter TMT18x (single input)



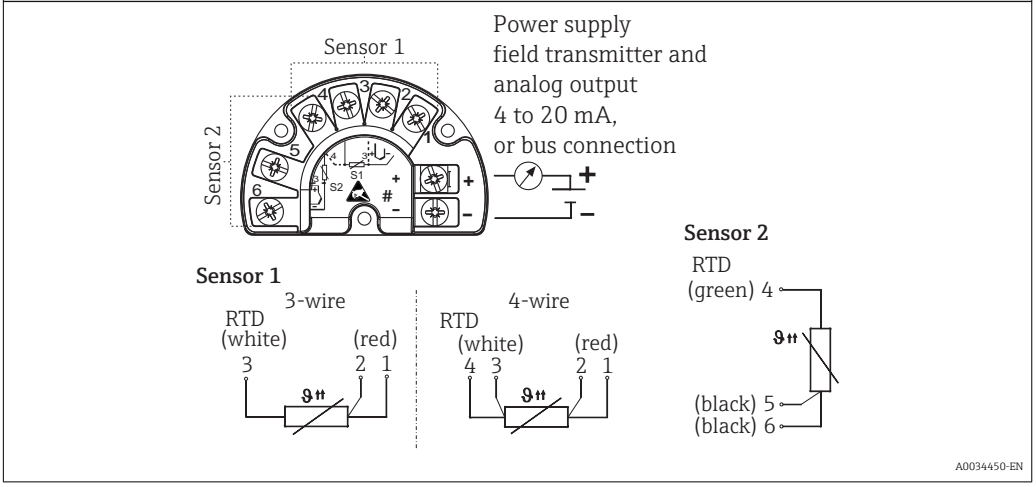
Head mounted transmitter TMT7x (single input)



Head mounted transmitter TMT8x (dual input)

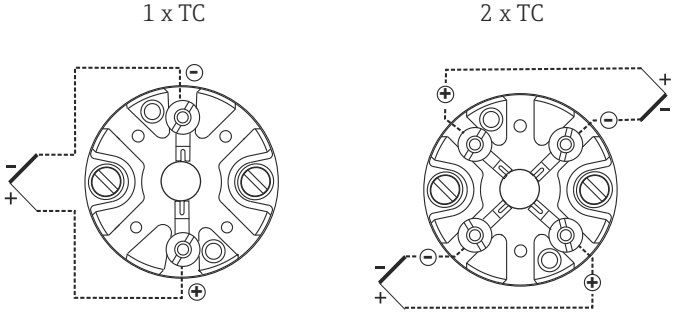


Head mounted field transmitter TMT162 (dual input)

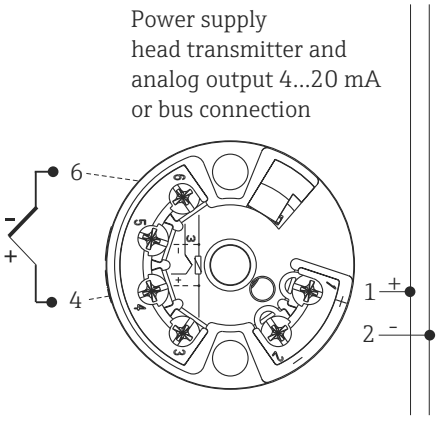


Type of sensor connection thermocouple (TC)

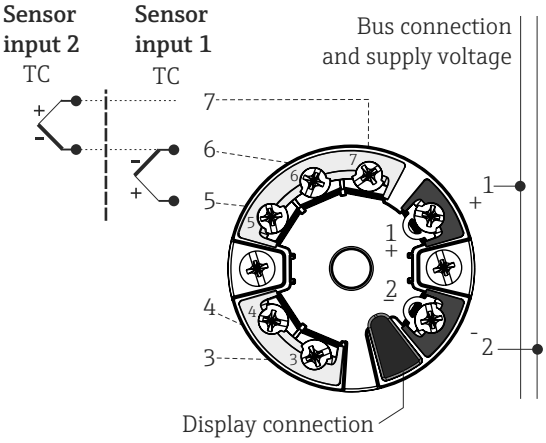
Terminal block mounted



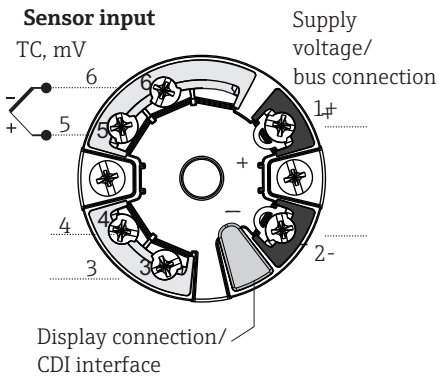
Head mounted transmitter TMT18x (single input)



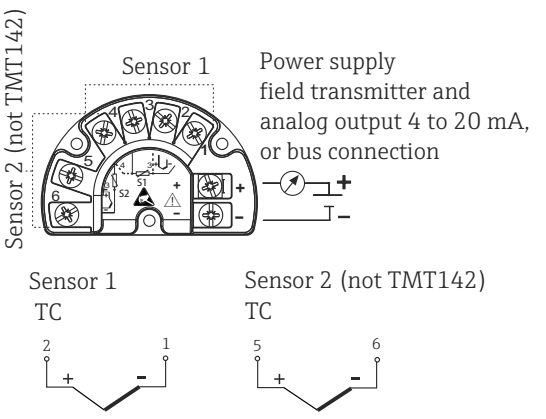
Head mounted transmitter TMT8x (dual input)



Head mounted transmitter TMT7x (single input)



Head mounted field transmitter TMT162 (dual input)



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 (-)

Cable entries

See 'Terminal heads' section

The cable entries has to be selected during configuration of the device. Different terminal heads offer different possibilities of threads and number of available entries.

Connectors

Endress+Hauser offers a wide variety of connectors 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.

We do not recommend to connect 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. Therefore we do not connect thermocouples directly to connectors. In combination with a transmitter thermocouples are connected.

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

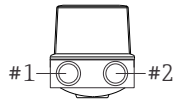
GND	Grounded. Wires marked 'GND' are connected to the internal grounding screw in the terminal head.	RD	Red
BN	Brown	WH	White
GNYE	Green-yellow	PK	Pink
BU	Blue	GN	Green
GY	Gray	BK	Black

Terminal head with one cable entry

Plug	**1x PROFIBUS PA**								**1x FOUNDATION™ Fieldbus (FF)**				**4-pin / 8-pin**							
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	5	6	7	8
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		i			
4-wire terminal block (1x Pt100)			WH	WH			WH	WH			WH	WH			WH	WH				
6-wire terminal block (2x Pt100)	RD (#1) 1)	RD (#1)	WH (#1)		RD (#1)	RD (#1)	WH (#1)		RD (#1)	RD (#1)	WH (#1)				WH		BK	BK	YE	
1x TMT 4 to 20 mA or HART®	+	i	-	i	+	i	-	i	+	i	-	i	+ (#1)	i	- (#1)	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)					+ (#2)	i	- (#2)	i
1x TMT PROFIBUS® PA	+	i	-	GND 2)	+	i	-	GND 2)	Cannot be combined				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)										
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 BN 2 GNYE 3 BU 4 GY A0018929 *3 4-pin plug*				3 GN 2 BN 1 WH 4 YE 8 RD 5 GY 7 BU 6 PK A0018927 *4 8-pin plug*			

1) Second Pt100 is not connected
2) If a plastic housing TA30S or TA30P is used, insulated 'i' instead of grounded GND

Terminal head with two cable entries

Plug	2x PROFIBUS® PA								2x FOUNDATION™ Fieldbus (FF)			
Plug thread  A0021706	M12(#1) / M12(#2)				7/8"(#1) / 7/8"(#2)				7/8"(#1) / 7/8"(#2)			
PIN number	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	
4-wire terminal block (1x Pt100)			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	
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
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)	
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
2x TMT FF									-(#1)/ -(#2)	+(#1)/ +(#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			

Connection combination: insert - transmitter

Insert	Transmitter connection [1]			
	TMT180/TMT7x		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 [2]	Sensor (#1) : transmitter in cover	Cannot be combined	Sensor (#1) : transmitter in cover	Cannot be combined
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	

1) 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 2nd transmitter as standard. The bus address is set to the default value and, if necessary, must be changed manually before commissioning.

2) Only in the terminal head with a high cover, only 1 transmitter possible. A ceramic terminal block is automatically fitted on the insert.

Overvoltage protection

To protect against overvoltage in the power supply and signal/communication cables for the thermometer electronics, Endress+Hauser offers the HAW562 surge arrester for DIN rail mounting and the HAW569 for field housing installation.

For more information see the Technical Information 'HAW562 Surge arrester' TI01012K and 'HAW569 Surge arrester' TI01013K.

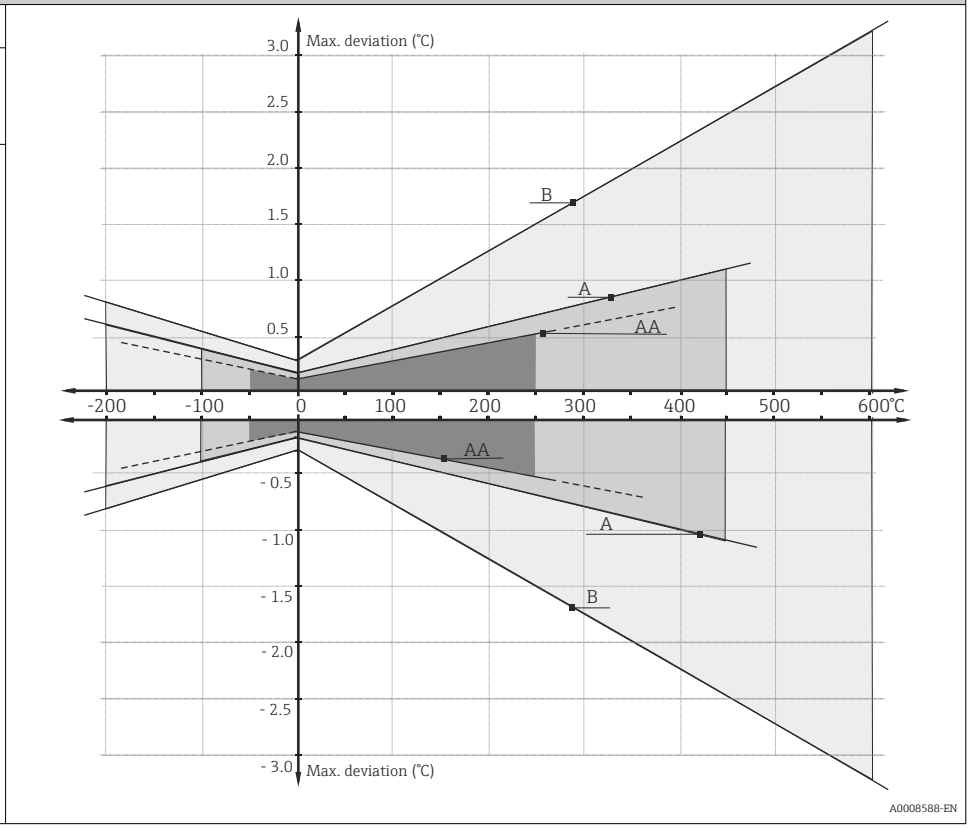
Performance characteristics

Reference conditions

These data are relevant for determining the accuracy of the temperature transmitters used. More information on this can be found in the Technical Information of the iTEMP temperature transmitters.

Maximum measured error

RTD resistance thermometer corresponding to IEC 60751

Class	max. Tolerances (°C)	Characteristics
RTD maximum error type TF		
Cl. A	± (0.15 + 0.002 · |t| [1])	
Cl. AA, former 1/3 Kl. B	± (0.1 + 0.0017 · |t|) [1]	
Cl. B	± (0.3 + 0.005 · |t| [1])	

1) |t| = absolute value °C

For measurement errors in °F, calculate using equations in °C, then multiply the outcome by 1.8.

Temperature ranges

Sensor type	Operating temperature range	Class A	Class AA
Pt100 (TF) iTHERM® StrongSens	−50 to +500 °C (−58 to +932 °F)	−30 to +300 °C (−22 to +572 °F)	0 to 200 °C (−58 to +392 °F)
iTHERM® QuickSens	−50 to 200 °C (−58 to 392 °F)	−50 to 200 °C (−58 to 392 °F)	0 to 150 °C (32 to 302 °F)

Sensor type	Operating temperature range	Class A	Class AA
Thin film sensor (TF)	−50 to 400 °C (−58 to 752 °F)	−50 to 250 °C (−58 to 482 °F)	0 to 100 °C (32 to 212 °F)
Wire-wound sensor (WW)	−200 to 600 °C (−328 to 1 112 °F)	−200 to 600 °C (−328 to 1 112 °F)	−50 to 250 °C (−58 to 482 °F)

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

Standard	Type	Standard tolerance	Special tolerance
ASTM E230/ANSI MC96.1		Deviation, the larger respective value applies	
	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

Influence of ambient temperature

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

Self heating

RTD elements are passive resistances 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 temperature transmitter (very small measurement current) is connected.

Response time

Tests in water at 0.4 m/s (1.3 ft/s), according to IEC 60751; 10 K temperature step change.

Response time without heat transfer paste, in water. Typical results 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 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	10	22	8	20	6	18	7	20	8	20
	Tapered	15	42	4	17	15	40	14	41	12	38	12	40	12	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	8	20	10	20	8	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	20	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 protection tube.

Calibration

Calibration of thermometers

Calibration involves comparing the measured values of a device under test (DUT) with those of a more precise calibration standard using a defined and reproducible measurement method. The aim is to determine the deviation of the DUT's measured values from the true value of the measured variable. Two different methods are used for thermometers:

- Calibration at fixed-point temperatures, 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 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 into which the DUT and the reference thermometer, where necessary, can project to a sufficient degree, are typically used for thermometer calibrations. The measurement uncertainty can increase due to heat dissipation errors and short immersion lengths. The existing measurement uncertainty is listed on the individual calibration certificate. For accredited calibrations according to ISO17025, the measurement uncertainty shouldn't be twice as high as the accredited measurement uncertainty. If this is exceeded, only a factory calibration can be performed.

Evaluation of thermometers

If a calibration with an acceptable uncertainty of measurement and transferable measurement results is not possible, Endress+Hauser offers customers a thermometer evaluation measurement service, if technically feasible. This is the case when:

- The process connections/flanges are too big or the immersion length (IL) is too short to allow the DUT to be immersed sufficiently in the calibration bath or furnace (see the following table), or
- Due to heat conduction along the thermometer tube, the resulting sensor temperature generally deviates significantly from the actual bath/furnace temperature.

The measured value of the DUT is determined using the maximum possible immersion depth and the specific measuring conditions and measurement results are documented on an evaluation certificate.

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 using temperature transmitters from Endress+Hauser, 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 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 your 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 insertion length (IL) for inserts required to perform a correct calibration

Due to restrictions of the furnace geometries, minimum immersion lengths must be maintained at high temperatures in order to be able to perform a calibration with acceptable measurement uncertainty. The same applies when a temperature head transmitter is used. Due to the heat dissipation, minimum immersion lengths must be maintained in order to ensure 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 needed [2]
251 to 550 °C (483.8 to 1022 °F)	300 mm (11.81 in)
551 to 600 °C (1023.8 to 1 112 °F)	400 mm (15.75 in)

1) With TMT a minimum of 150 mm (5.91 in) is required
2) At a temperature of +80 to +250 °C (+176 to +482 °F) with TMT a minimum of50 mm (1.97 in) is required

Insulation resistance

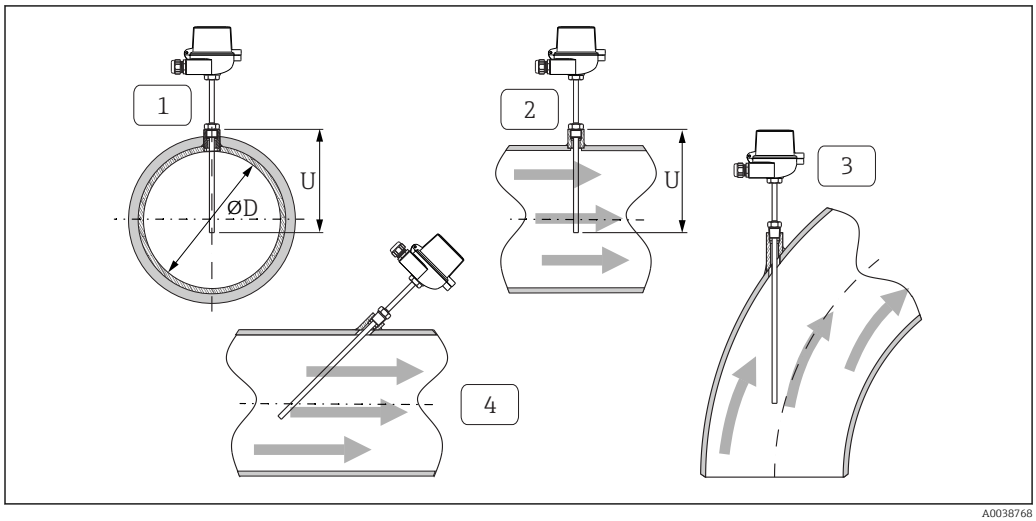
- RTD:
  Insulation resistance according to IEC 60751 > 100 MΩ at 25 °C between terminals and sheath material measured with a minimum test voltage of 100 V DC
- TC:
  Insulation resistance according to IEC 1515 between terminals and sheath material with a test voltage of 500 V DC:
  - > 1 GΩ at 20 °C
  - > 5 MΩ at 500 °C

Installation

Orientation

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

Installation instructions



5 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 accuracy. If the immersion length is too small, errors in the measurement are caused by heat conduction via the process connection and the container wall. Therefore, if installing in a pipe the immersion length should be at least half the pipe diameter. Installation at an angle (see 3 and 4) could be another solution. When determining the immersion length or installation depth 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 head transmitter	−40 to 85 °C (−40 to 185 °F)
With mounted head transmitter and display	−20 to 70 °C (−4 to 158 °F)

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

Storage temperature

For information, see the ambient temperature above.

Humidity

Depends on the transmitter used. If Endress+Hauser iTEMP head transmitters are used:
- Condensation permitted as per IEC 60 068-2-33
- Max. rel. humidity: 95% as per 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.)

Shock and vibration resistance

The Endress+Hauser inserts exceed the IEC 60751 requirements stating a shock and vibration resistance of 3g within a range of 10 to 500 Hz. The vibration resistance of the measurement point depends on sensor type and construction. Refer to the following table:

Sensor type	Vibration resistance for the sensor tip
Pt100 (WW)	> 30 m/s² (3g)
Pt100 (TF), increased vibration resistance	> 40 m/s² (4g)
iTHERM StrongSens Pt100 (TF)	> 600 m/s² (60g)
Thermocouple Inserts	> 30 m/s² (3g)

Electromagnetic compatibility (EMC)

Depends on the head transmitter used. For details see the Technical Information. → 46

Process

Process temperature range

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

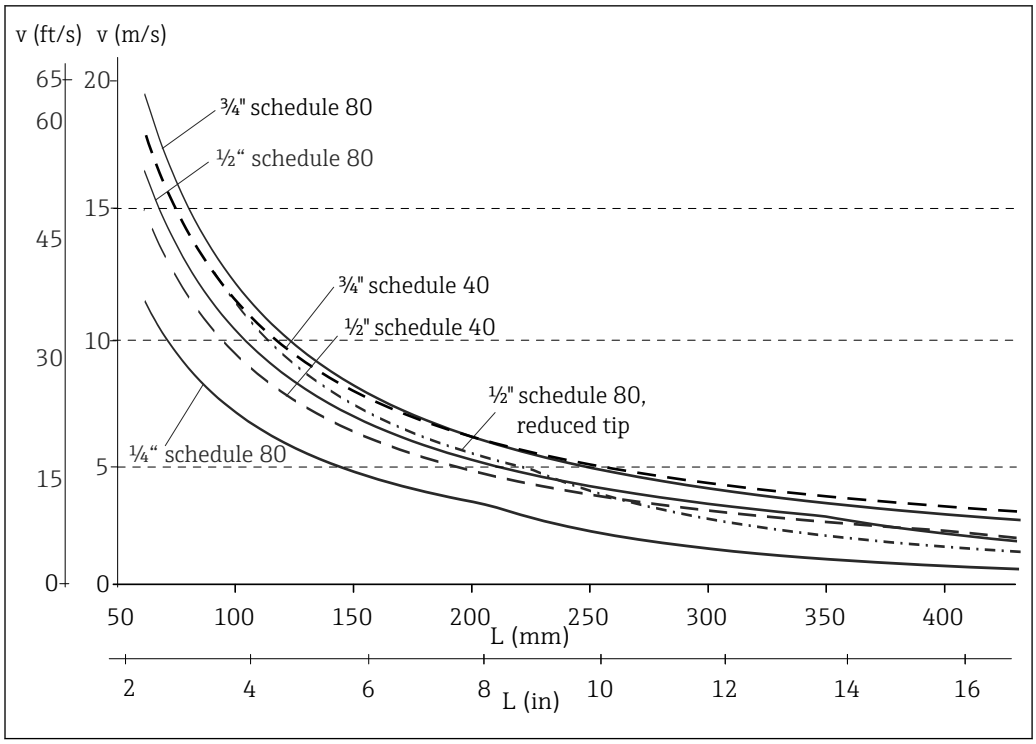
Process pressure range

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 in the TW Sizing Module for protection tubes in the Endress+Hauser Applicator software. See 'Accessories' section. → 45

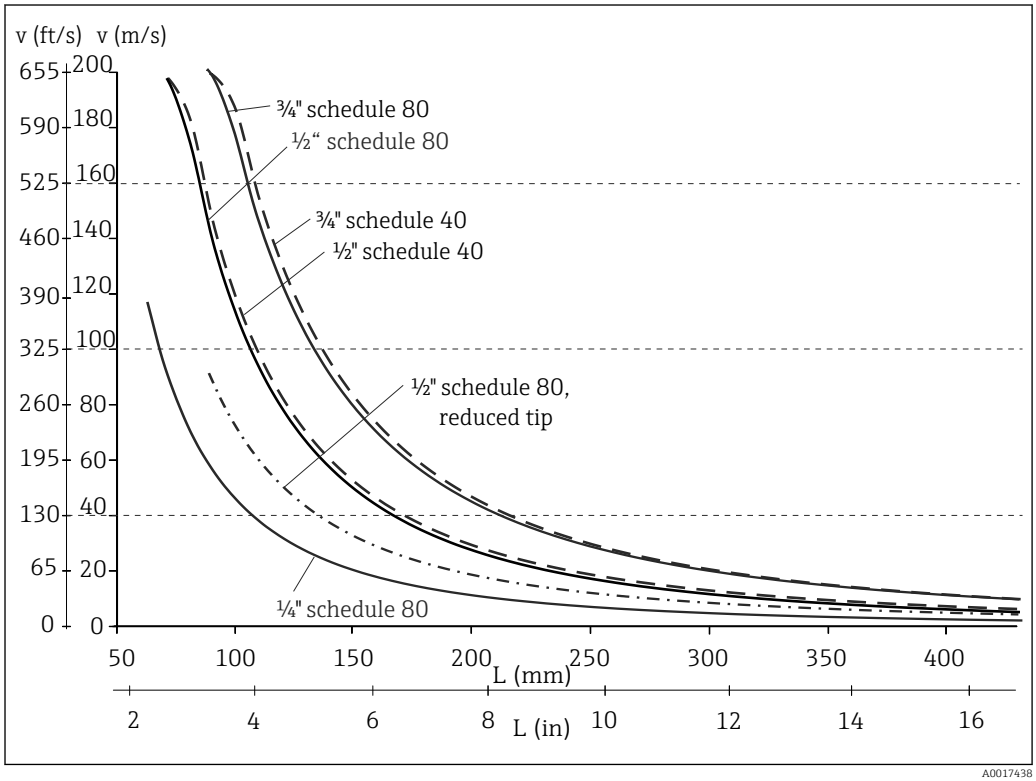
Permitted flow velocity depending on the immersion length

The highest flow velocity tolerated by the thermometer diminishes with increasing sensor immersion length exposed to the stream of the fluid. In addition it is dependent on the diameter of the thermometer tip, on the kind of measuring medium, on the process temperature and on 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).



6 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

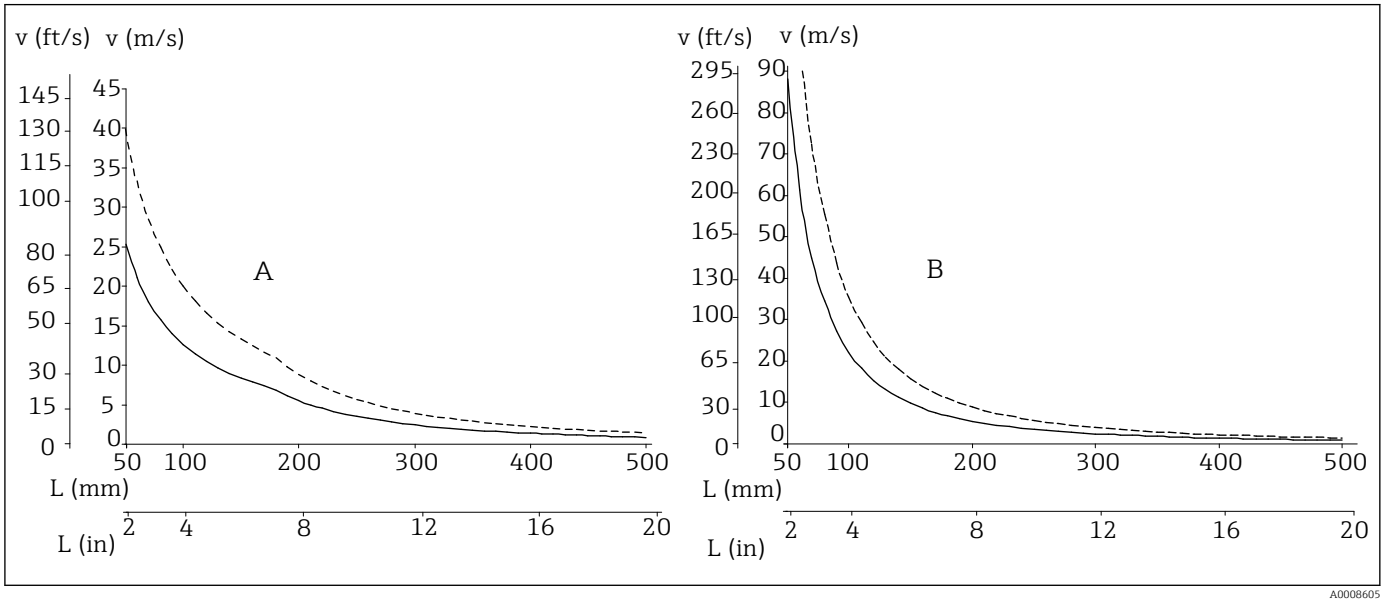


7 Permitted flow velocities with different thermometer diameters in the process medium superheated steam at T = 400 °C (752 °F)

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

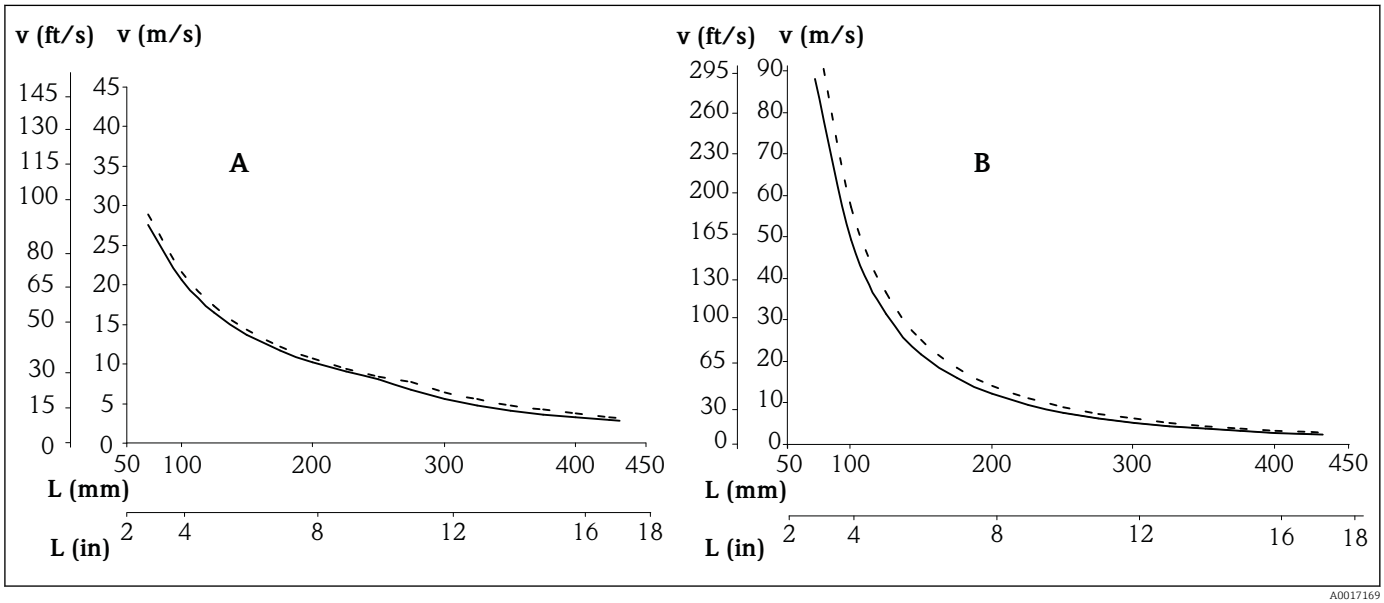
Permitted flow velocity depending on the immersion length and process medium

The highest flow velocity tolerated by the thermometer diminishes with increasing insert immersion length exposed to the stream of the fluid. In addition it is dependent on the diameter of the thermometer tip, on the kind of measuring medium, on the process temperature and on 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).



8 *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



9 *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

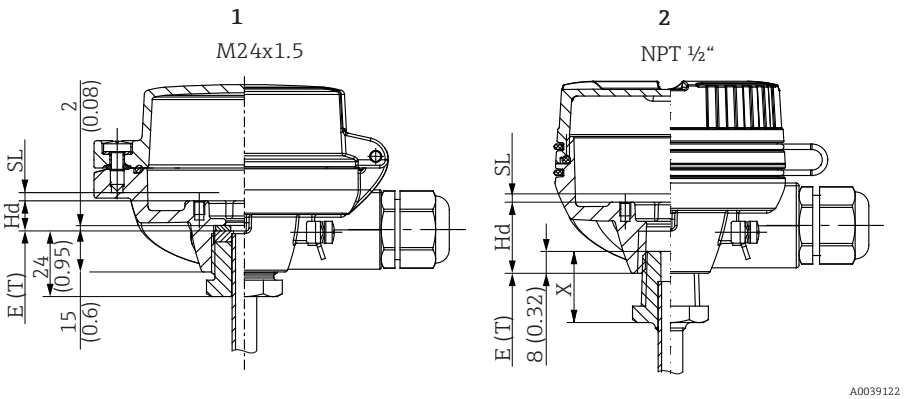
Design, dimensions

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

- Thermometer without thermowell
- Thermometer without neck DIN43772 Form 2
- Lagging DIN 43772 Form 2G, 2F, 3G, 3F
- Lagging + QuickNeck
- Removeable neck Ø11 mm, 12 mm; DIN 43772
- Removeable neck Ø12 mm; M20 connection; DIN 43772
- Nipple connection
- Nipple-Union connection
- Nipple-Union-Nipple connection

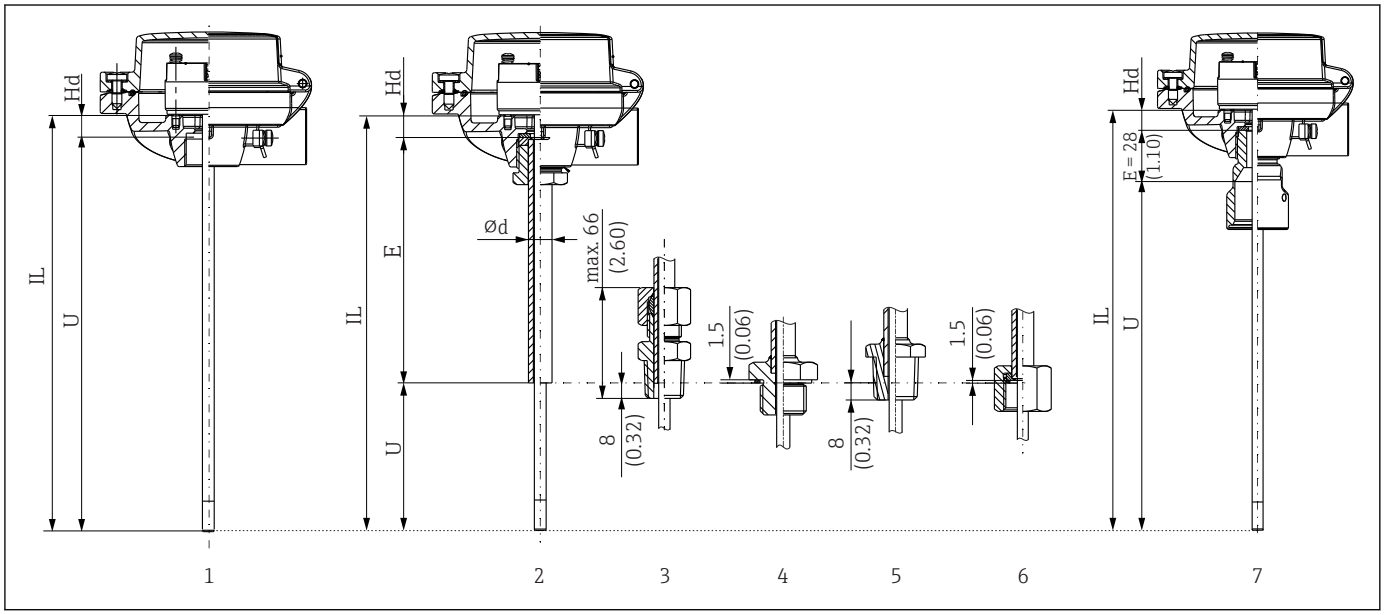
Various dimensions, such as the immersion length U for example, are variable values and are therefore indicated as items in the following dimensional drawings.

Variable dimensions:

Item	Description
E	Extension neck length, variable depending on the configuration or predefined for the version with iTHERM QuickNeck
IL	Insertion length of insert
L	Thermowell length (U+T)
B	Protection tube base thickness: predefined, depends on thermowell version (see also the individual table data)
T	Length of thermowell lagging: variable or predefined, depends on protection tube 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).  10 *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 Head top distance* *SL Spring load*
ØID	Thermowell diameter, see following combination table

Thermometer without thermowell

For installation in an existing thermowell

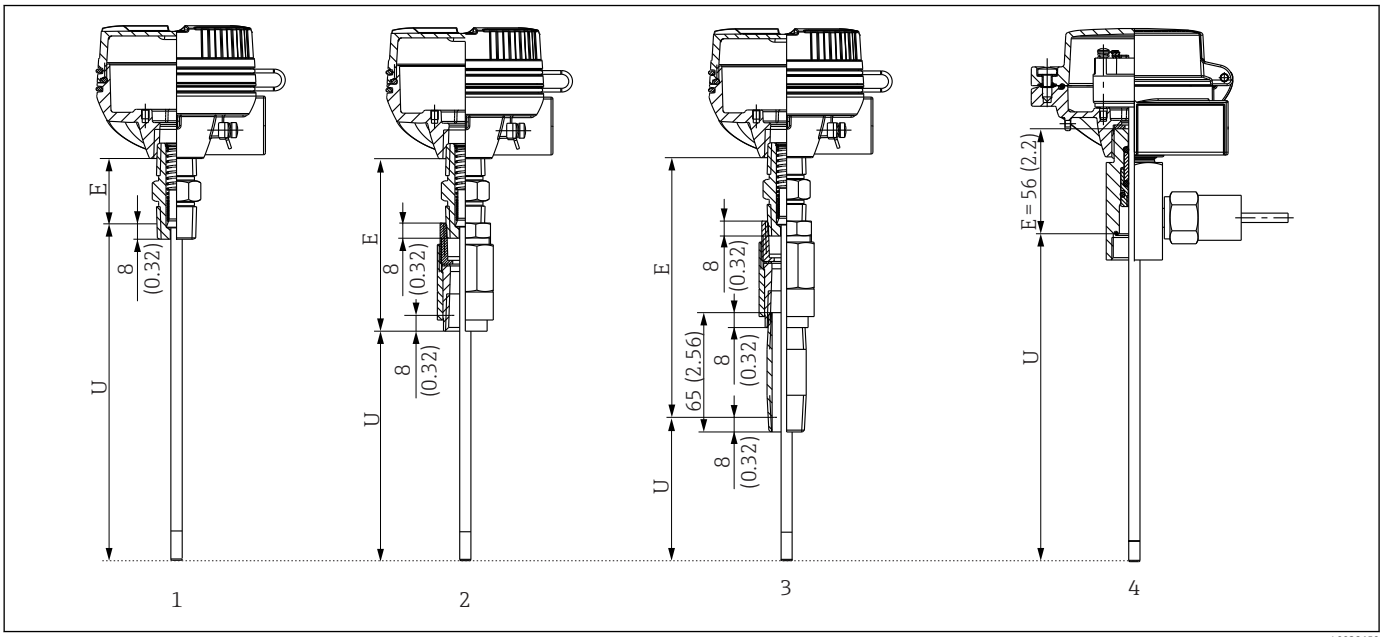


1 *Thermometer without neck to be assembled into existing thermowell*
2 *Version with removeable neck, Ød = 11 mm or 12 mm, DIN 43772, process connection in order code is used to select the connection to the thermowell*
3 *Compression fitting as thermowell connection for the version with removeable neck*
4 *Male thread M24 as thermowell connection for the version with removeable neck*
5 *Male thread NPT ½" as thermowell connection for the version with removeable neck*
6 *G3/8" cap nut for thermowell connection for the version with removeable neck*
7 *QuickNeck upper part to be assembled into existing thermowell with QuickNeck*

Can be selected for all versions: thread M24x1.5 or ½" NPT to terminal head

Calculation of insert length IL

Version 1	IL = U + Hd
Version 2, including 3, 4, 5 and 6	IL = U + E + Hd
Version 7	IL = U + E + Hd E = 28 mm (1.10 in) for head thread: M24x1.5 E = 21 mm (0.83 in) for head thread: NPT ½"
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)	

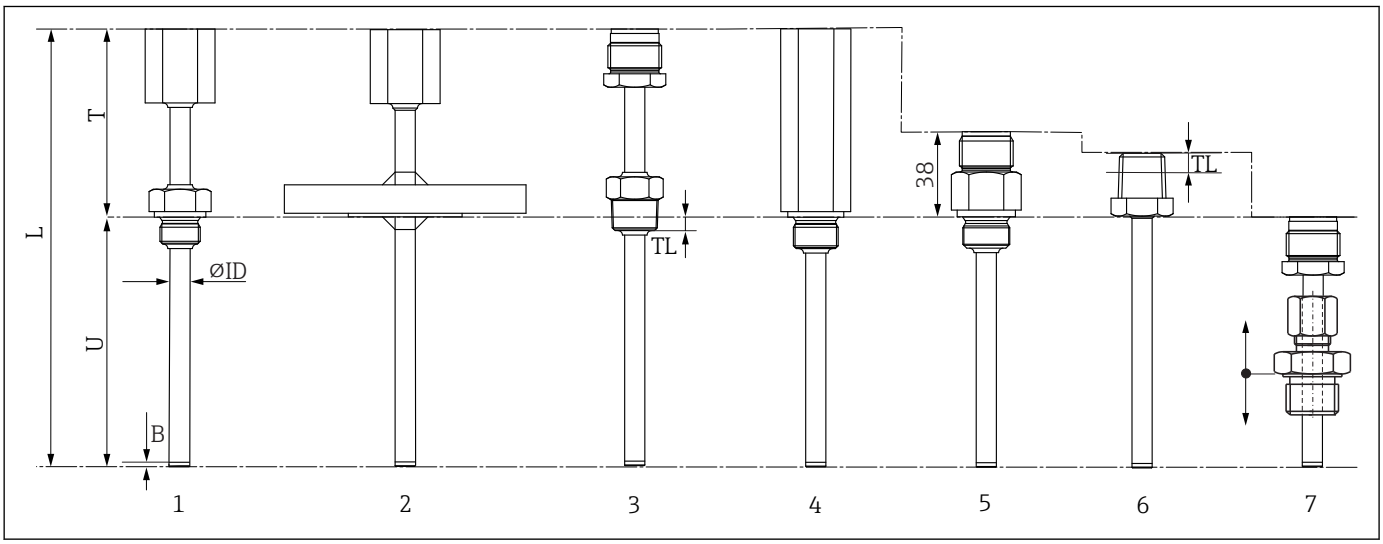


A0038659

1 *Thermometer with nipple NPT ½" connection to be assembled into existing thermowell*
2 *Thermometer with nipple-union NPT ½" female connection to be assembled into existing thermowell*
3 *Thermometer with nipple-union-nipple NPT ½" connection to be assembled into existing thermowell*
4 *Thermometer with neck of second process seal, M24x1.5 thread adapter nut for thermowell connection*

Can be selected for all versions: thread M24x1.5 or ½" NPT to terminal head

Thermometer with thermowell

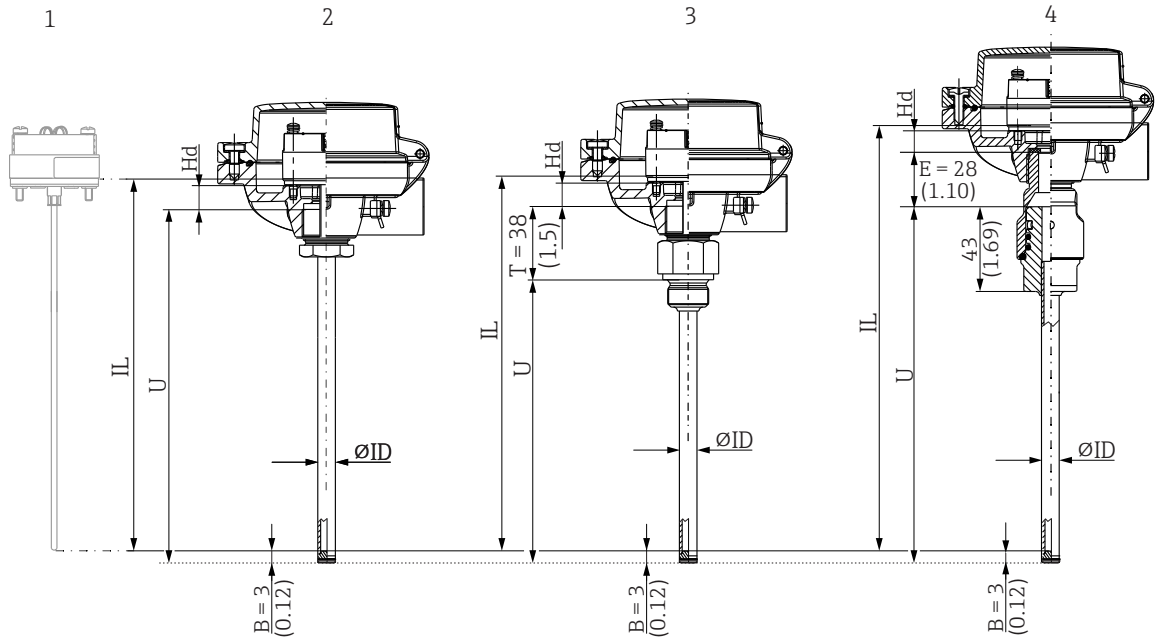


A0038643

11 *Types of thermowell*

1 *Metric threaded process connection with extension*
2 *Flanged process connection with extension*
3 *NPT threaded process connection with extension*
4 *Threaded process connection with hexagonal lagging*
5 *Threaded process connection with hexagonal lagging*
6 *Weld-in adapter without extension*
7 *Adjustable compression fitting without extension*

Without extension neck and without lagging



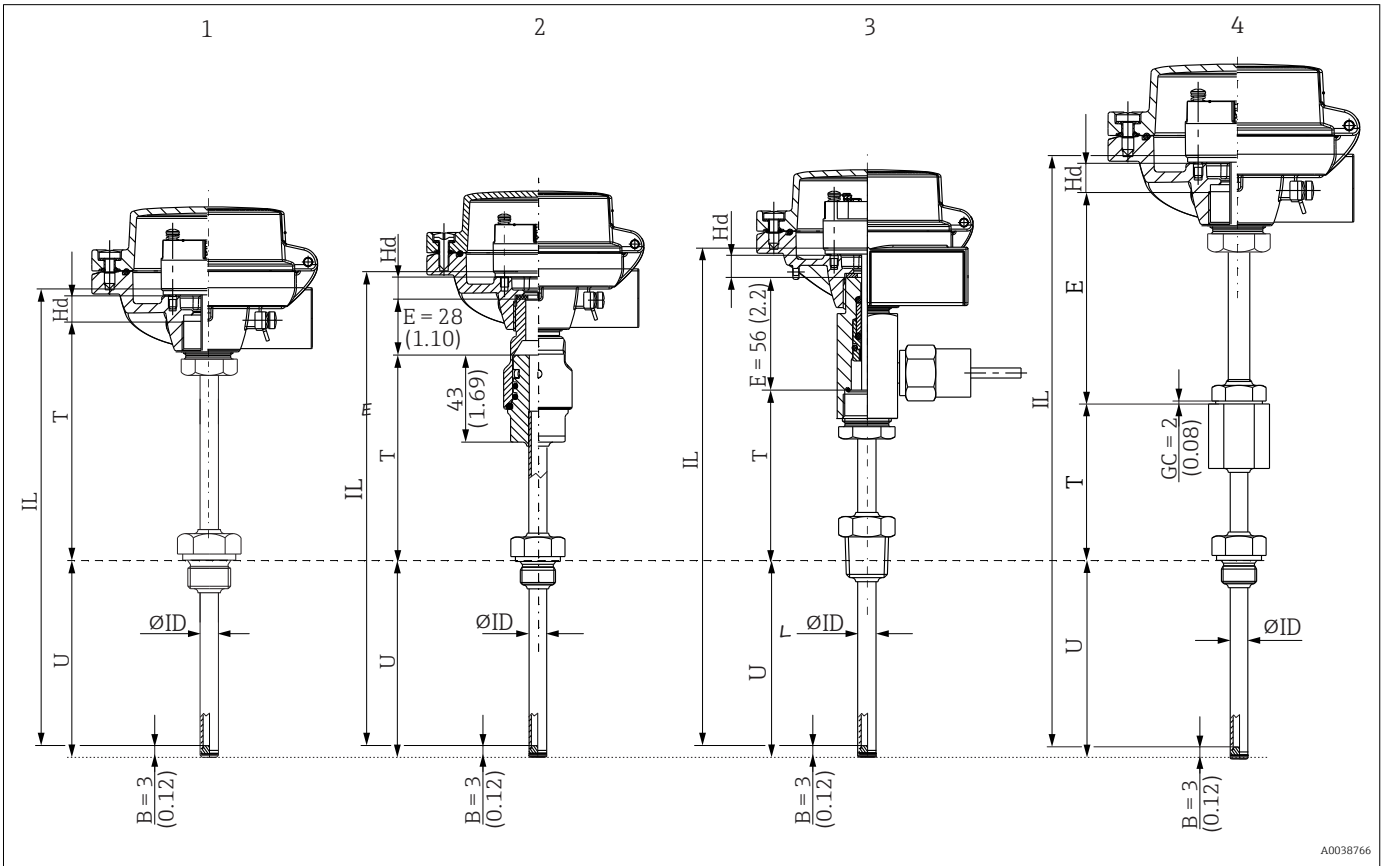
1 Insert with mounted head transmitter as example
2 Without process connection
3 With threaded process connection
4 With quick-neck process connection

Calculation of insert length IL

Version 2	IL = U + Hd - B + SL [1)]
Version 3	IL = U + T + Hd - B + SL [1)]
Version 4	IL = U + E + Hd - B + SL [1)] E = 28 mm (1.10 in) for head thread: M24x1.5 E = 21 mm (0.83 in) for head thread: NPT ½"

1) SL (spring load) = 3 mm (0.12 in)

Continuous, with or without removeable extension neck



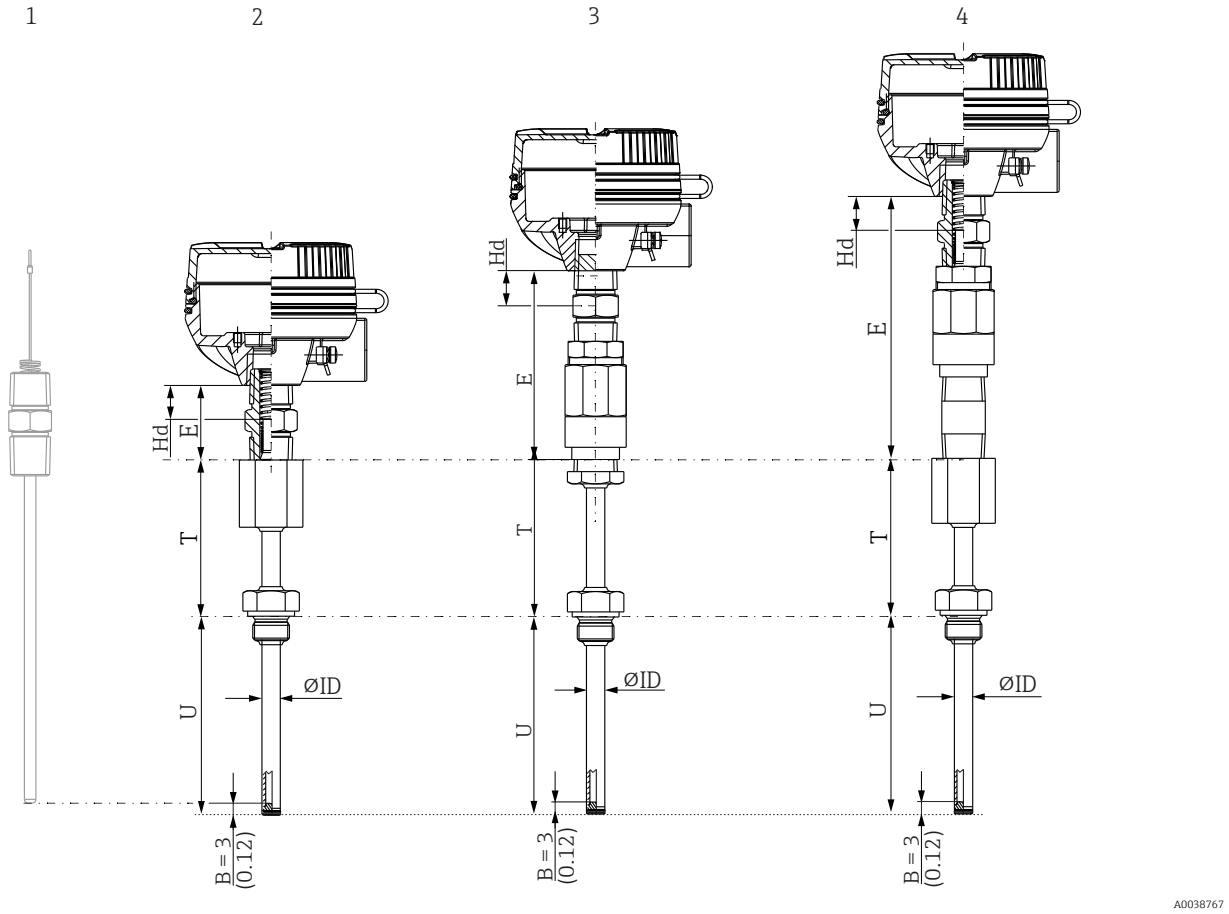
1 With lagging as per DIN 43772
2 With lagging and quick-neck connection
3 With lagging and second process seal
4 With lagging and removeable neck

Calculation of insert length IL

Version 1	IL = U + T + Hd - B + SL [1)]
Version 2	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"
Version 3	IL = U + T + E + Hd - B + SL
Version 4	IL = U + T + E + Hd - B + SL + GC [2)] GC = gasket compensation

1) SL (spring load) = 3 mm (0.12 in)
2) SL (spring load) = 3 mm (0.12 in)

With lagging, hexagonal, with removeable extension neck or nipple / nipple-union-nipple connection



1 Insert
2 With thermowell, lagging and removeable neck
3 With lagging and nipple-union connection NPT ½" (female)
4 With lagging and nipple-union-nipple connection NPT ½"

Calculation of insert length IL

Version 2, 3 and 4	IL = U + T + E + Hd - B + SL

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
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	-	-

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
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	AlloyC277	-	-	-	-	-	-
NPT ½", AlloyC276	AlloyC277	AlloyC278	-	-	-	-	-	-
G ½", AlloyC276	AlloyC278	AlloyC279	-	-	-	-	-	-
M20 x 1.5, AlloyC600	Alloy600	Alloy600	-	-	-	-	-	-
NPT ½", AlloyC600	Alloy600	Alloy600	-	-	-	-	-	-
G ½", AlloyC600	Alloy600	Alloy600	-	-	-	-	-	-
Weld-in adapter								
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	-	-	-	-
With flange	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

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
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, Tantal > 316Ti	-	316Ti + 12 mm	316Ti + 13 mm	-	-	-	-	-
DN50 PN40 B1 EN1092-1, Tantal > 316Ti	-	316Ti + 12 mm	316Ti + 13 mm	-	-	-	-	-
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 options.

Material

Extension neck 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.

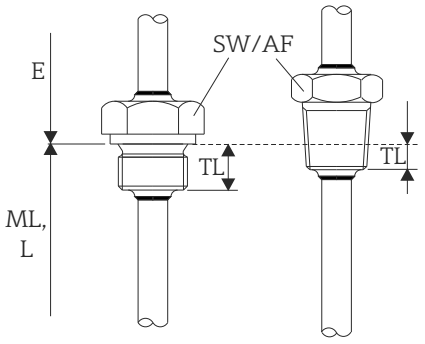
Please be aware, the maximum temperature is always also depending on the used temperature sensor!

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316/1.4401	X5CrNiMo 17-12-2	650 °C (1202 °F) [1]	▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration)
AISI 316L/1.4404 1.4435	X2CrNiMo17-12-2 X2CrNiMo18-14-3	650 °C (1202 °F) [1]	▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a 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 (1292 °F) [1]	▪ Properties comparable to 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	1100 °C (2012 °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
AlloyC276/2.4819	NiMo16Cr15W	1100 °C (2012 °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 (1499 °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

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
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)	Polytetrafluorethylen	200 °C (392 °F)	▪ Resistant to almost all chemicals ▪ High temperature stability
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 compressive loads and in non-corrosive media. Please contact your Endress+Hauser sales team for further information.

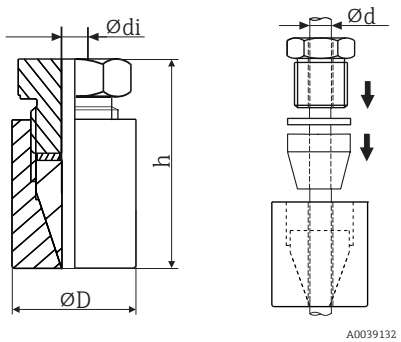
Process connections

Threaded process connection	Version		Thread engagement length TL in mm (in)	Wrench size	Max. process pressure
 12 *Cylindrical (left side) and conical (right side) version*	M	M20x1.5	14 mm (0.55 in)	27 mm (1.06 in)	Maximum static process pressure for threaded process connection: ▪ 140 bar (2 031 psi) at +40 °C (+140 °F) ▪ 85 bar (1 233 psi) at +400 °C (+752 °F)
		M18x1	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	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)	
	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)	

Due to deformation 316L compression fittings can only be used once, all parts of it! The assembly must be fixed in different positions (grooves in thermowell). PEEK compression fittings must never be run at a temperature below the assembly temperature because of loss of tightness by thermal contraction of PEEK.

For higher requirements: SWAGELOCK or similar fittings are urgently recommended.

Weld-in adapter

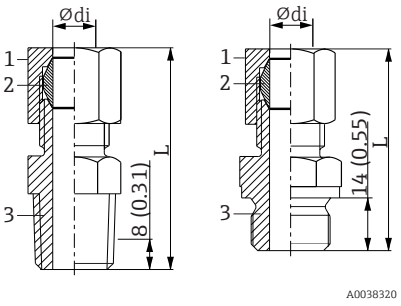
Type TK40	Version	Dimensions			Technical properties [1]
	Cylindrical	Φdi	ΦD	h	
Weld-in adapter 	Ferrule material 316L Thread G½"	9.2 mm (0.36 in)	30 mm (1.18 in)	57 mm (2.24 in)	$P_{max.}$ = 10 bar (145 psi), $T_{max.}$ = +200 °C (+392 °F) for ELASTOSIL ferrule, tightening torque = 5 Nm

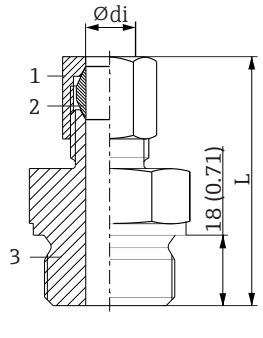
1) All the pressure specifications apply for cyclic temperature load

Due to deformation 316L compression fittings can only be used once, all parts of it! The assembly must be fixed in different positions (grooves in thermowell). PEEK compression fittings must never be run at a temperature below the assembly temperature because of loss of tightness by thermal contraction of PEEK.

For higher requirements: SWAGELOCK or similar fittings are urgently recommended

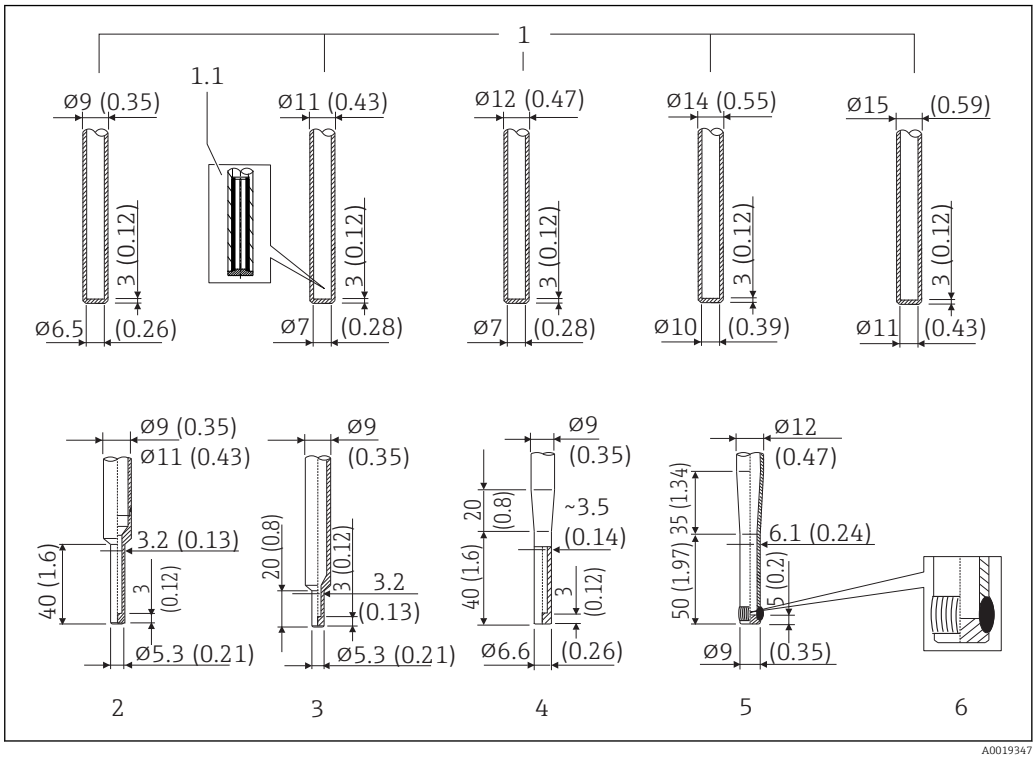
Compression fitting

Type TK40	Version	Dimensions			Technical properties
		Φdi	L	Wrench size	
 *1 Nut* *2 Sleeve* *3 Process connection*	NPT ½" , ferrule material 316L G ½" , ferrule material 316L	9 mm (0.35 in), minimum torque = 70 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
		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			

Type TK40	Version	Dimensions			Technical properties
		Ødi	L	Wrench size	
 *1 Nut* *2 Sleeve* *3 Process connection*	G 1", ferrule material 316L	12 mm (0.47 in), minimum torque = 90 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
		14 mm (0.55 in), minimum torque = 110 Nm			

Tip shape

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 Φ4.3 mm (0.17 in) and 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).



13 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)

Pos. No.	Tip shape	Insert diameter
1	Straight	6 mm (0.24 in)
1.1	Tip assembly detail: fast response time design is available for Φ11 mm (0.43 in) and Φ 12 mm (0.47 in) as option. The gap between insert and thermowell is filled with stable heat transfer material.	
2	Reduced, L ≥ 50 mm (1.97 in)	3 mm (0.12 in)
3	Reduced, L ≥ 30 mm (1.18 in) [1]	3 mm (0.12 in)
4	Tapered, L ≥ 70 mm (2.76 in) [1]	3 mm (0.12 in)
5	Tapered DIN43772-3G, L ≥ 90 mm (3.54 in) [1] [2]	6 mm (0.24 in)
6	Welded tip, weld quality according to EN ISO 5817 - quality class B	

1) not with material alloy C276, alloy600, 321, 316 and 446
2) Tip assembly detail: fast response time design is available as option. The gap between insert and thermowell is filled with stable heat transfer material.

It is possible to check the mechanical loading capacity as a function of the installation and process conditions online in the TW Sizing Module for thermowells in the Endress+Hauser Applicator software. See 'Accessories' section.

Inserts

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

Sensor	Standard thin-film	iTHERM StrongSens	iTHERM QuickSens [1]	Wire wound	
Sensor design; connection method	1x Pt100, 3- or 4-wire, mineral insulated	1x Pt100, 3- or 4-wire, mineral insulated	1x Pt100, 3- or 4-wire ▪ Φ6 mm (¼ in), mineral insulated ▪ Φ3 mm (⅛ in), teflon insulated	1x Pt100, 3- or 4-wire, mineral insulated	2x Pt100, 3-wire, mineral insulated
Vibration resistance of the insert tip	> 3g	Enhanced vibration resistance > 60g	▪ Φ3 mm (⅛ in) > 3g ▪ Φ6 mm (¼ in) > 60g	> 3g	
Measuring range; accuracy class	−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	3 mm (⅛ in), 6 mm (¼ in)	6 mm (¼ in)	3 mm (⅛ in), 6 mm (¼ in)		

1) Recommended for immersion lengths U < 70 mm (2.76 in)

TC thermocouples	Type K	Type J	Type N
Sensor design	Mineral insulated, Alloy600 sheated cable	Mineral insulated, stainless steel sheathed cable	Mineral insulated, Alloy TD sheated 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	3 mm (⅛ in), 6 mm (¼ in)		

The iTHERM inserts are available as a spare part. The insertion length (IL) depends on the immersion length of the protection tube (U), the length of the extension neck (E), the thickness of the base (B), the length of the protection tube shaft (L) and the variable length (X). The insertion

length (IL) must be taken into consideration when replacing the unit. Formulas for calculating IL
→ 25

For more information on the deployed insert iTHERM TS111 and TS211 with enhanced vibration resistance and fast-response sensor, see the Technical Information (TI01014T/09/ and TI01411T/09/).

Spare parts currently available for your product can be found online at: http://www.products.endress.com/spareparts_consumables. Choose the corresponding 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

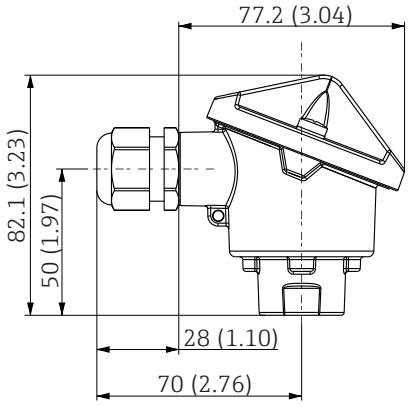
Values for wetted surfaces:

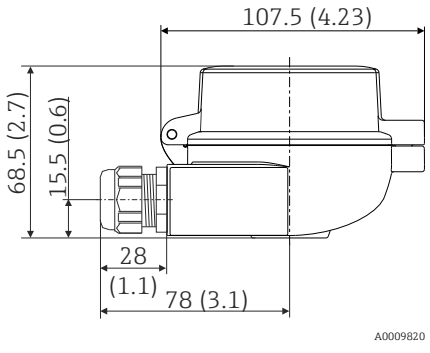
Standard surface	$R_a \leq$ 0.76 µm (0.03 µin)

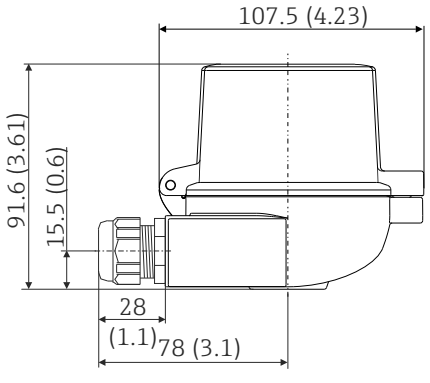
Terminal heads

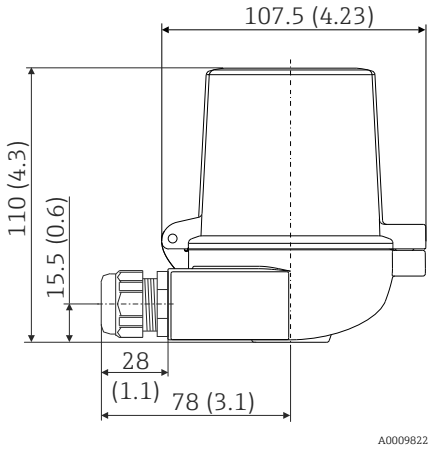
All terminal heads have an internal shape and size in accordance with DIN EN 50446, flat face and a thermometer connection with a M24x1.5 or ½" NPT thread. All dimensions in mm (in). The sample cable glands in the diagrams correspond to M20x1.5 connections with non-Ex polyamide cable glands. Specifications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

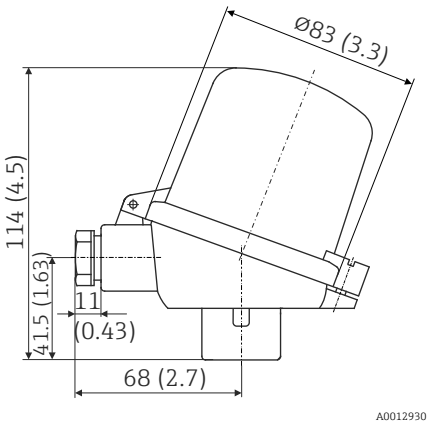
As a special feature, Endress+Hauser offers terminal heads with optimized terminal accessibility for easy installation and maintenance.

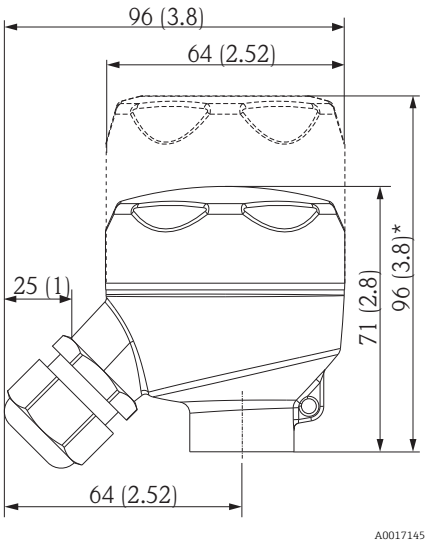
TA20AB	Specification
	▪ Protection class: IP 66/68, NEMA 4x ▪ Temperature: −40 to +100 °C (−40 to +212 °F), polyamide cable gland ▪ Material: aluminum; polyester powder coated Seals: silicone ▪ Threaded cable entry: NPT ½" and M20x1.5 ▪ Color: blue, RAL 5012 ▪ Weight: approx. 300 g (10.6 oz)

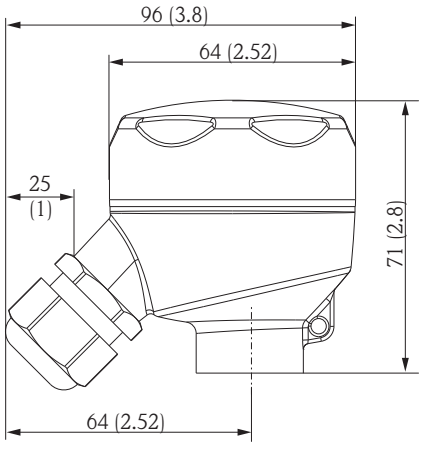
TA30A	Specification
	▪ Available with one or two cable entries ▪ Protection class: IP66/68 (NEMA Type 4x encl.) ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", ½" NPT and M20x1.5; ▪ Protection armature connection: M24x1.5 ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 330 g (11.64 oz) ▪ Ground terminal, internal and external ▪ With 3-A® symbol

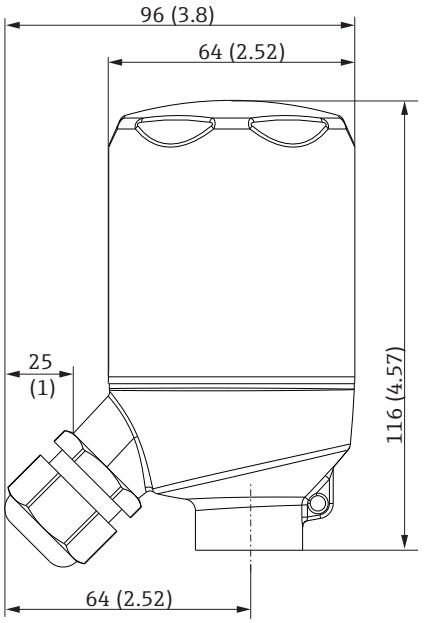
TA30A with display window	Specification
	▪ Available with one or two cable entries ▪ Protection class: IP66/68 (NEMA Type 4x encl.) ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", ½" NPT and M20x1.5 ▪ Protection armature connection: M24x1.5 ▪ Head color: blue, RAL 5012 Cap color: gray, RAL 7035 ▪ Weight: 420 g (14.81 oz) ▪ with TID10 display ▪ Ground terminal, internal and external ▪ 3-A® marked

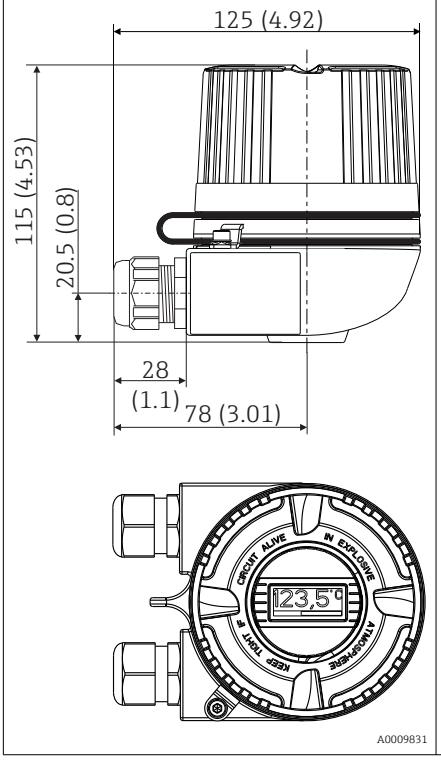
TA30D	Specification
	▪ Available with one or two cable entries ▪ Protection class: IP66/68 (NEMA Type 4x encl.) ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", ½" NPT and M20x1.5 ▪ Protection armature connection: M24x1.5 ▪ 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 color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 390 g (13.75 oz) ▪ Ground terminal, internal and external ▪ With 3-A® symbol

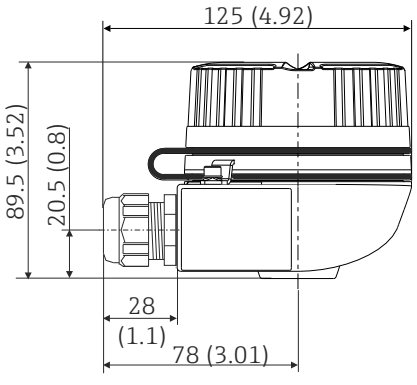
TA30P	Specification
	▪ Protection class: IP65 ▪ Max. temperature: −40 to +120 °C (−40 to +248 °F) ▪ Material: polyamide (PA), antistatic Seals: silicone ▪ Threaded cable entry: M20x1.5 ▪ Protection armature connection: M24x1.5 ▪ Two head transmitters can be mounted. In the standard version, one transmitter 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) ▪ Types of protection for use in hazardous locations: Intrinsic Safety (G Ex ia) ▪ Ground terminal: only internal via auxiliary clamp ▪ With 3-A® symbol

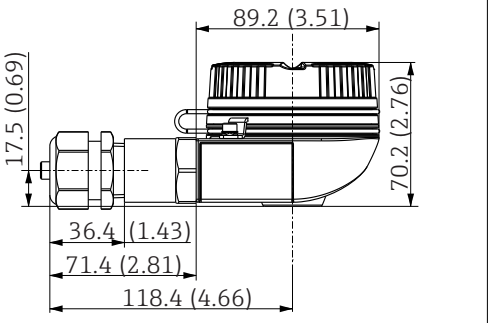
TA30R (optionally with display window in cover)	Specification
 * Dimensions of version with display window in cover	▪ Degree of protection - standard version: IP69K (NEMA Type 4x encl.) Degree of protection - version with display window: IP66/68 (NEMA Type 4x encl.) ▪ Temperature: −50 to +130 °C (−58 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 ½" NPT 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 ▪ Protection armature connection: M24x1.5 or ½" NPT ▪ Ground terminal: internal in standard version; external terminal optionally available ▪ With 3-A® symbol

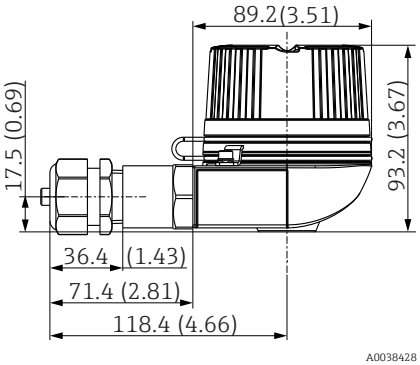
TA30R	Specification
	▪ Degree of protection - standard version: IP69K (NEMA Type 4x encl.) ▪ Temperature: −50 to +130 °C (−58 to +266 °F) without cable gland ▪ Material: stainless steel 316L, abrasive-blasted or hand-polished Seals: silicone, optional EPDM for applications free from paint-wetting impairment substances ▪ Cable entry thread ½" NPT and M20x1.5 ▪ Weight: 360 g (12.7 oz) ▪ Protection armature connection: M24x1.5 or ½" NPT ▪ Ground terminal: internal in standard version; external terminal optionally available ▪ With 3-A® symbol

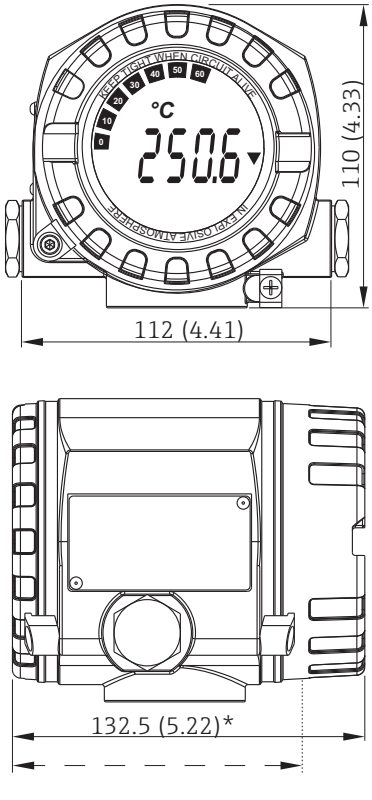
TA30R (high version for two transmitters)	Specification
	▪ Degree of protection: IP69K (NEMA Type 4x encl.) ▪ Temperature: −50 to +130 °C (−58 to +266 °F) without cable gland ▪ Material: stainless steel 316L, abrasive-blasted or polished Seals: EPDM ▪ Cable entry thread ½" NPT and M20x1.5 ▪ Weight: 460 g (16.23 oz) ▪ For two head transmitter ▪ Protection armature connection: M24x1.5 or ½" NPT ▪ Ground terminal: internal in standard version; external terminal optionally available ▪ Available in conjunction with 3-A marked sensors

TA30H with display window in cover	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 ▪ Thread: ½" NPT, ¾" NPT, M20x1.5, G½" ▪ Extension neck/thermowell connection: ½" NPT ▪ Color of aluminum head: blue, RAL 5012 ▪ Color of aluminum cap: gray, RAL 7035 ▪ Weight: ▪ Aluminum: approx. 860 g (30.33 oz) ▪ Stainless steel: approx. 2 900 g (102.3 oz) ▪ Head transmitter optionally available with TID10 display

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 ▪ Thread: ½" NPT, ¾" NPT, M20x1.5, G½" ▪ Extension neck/thermowell connection: ½" NPT ▪ 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)

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 coated ▪ Thread: M20x1.5 ▪ Extension neck/thermowell connection: NPT ½" ▪ Color of head: blue, RAL 5012 ▪ Color of cap: gray, RAL 7035 ▪ Weight: approx. 400 g (14.11 oz) ▪ Ground terminal: internal and external

TA30EB with display window in cover	Specification
	▪ Flameproof (XP) version, explosion-protected, captive 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 coated ▪ Thread: ½" NPT, ¾" NPT, M20x1.5, G½" ▪ Extension neck/thermowell connection: ½" NPT ▪ Color of head: blue, RAL 5012 ▪ Color of cap: gray, RAL 7035 ▪ Weight: approx. 400 g (14.11 oz)

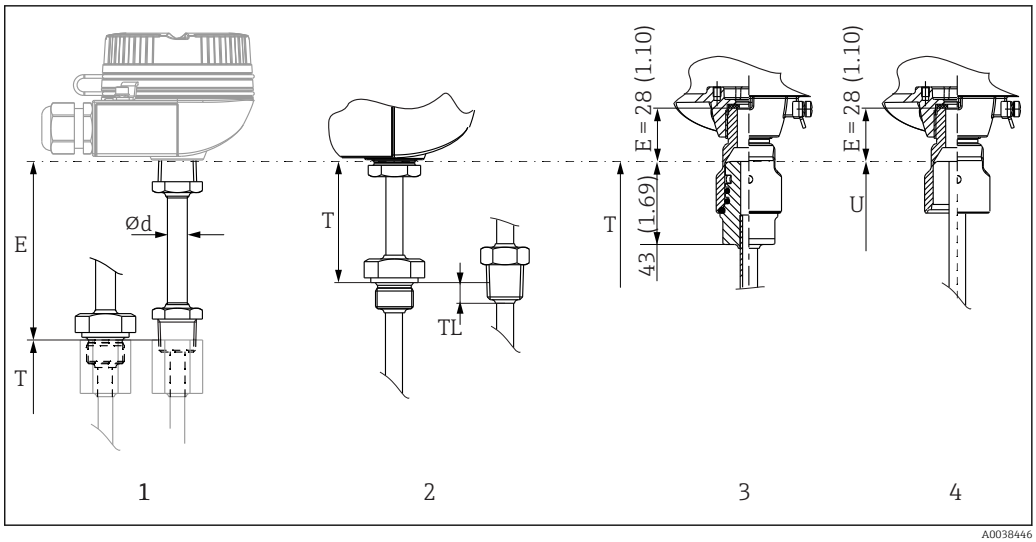
Temperature field transmitter iTEMP TMT162	Specification
 * Dimensions without display = 112 mm (4.41 in)	▪ Separate electronics compartment and connection compartment ▪ Protection class: IP67, NEMA type 4x ▪ Material: Die-cast aluminum housing AlSi10Mg with powder coating on polyester base or stainless steel 316L ▪ Display rotatable in 90° increments ▪ Cable entry: 2x ½" NPT ▪ Brilliant 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)

Cable glands and connectors

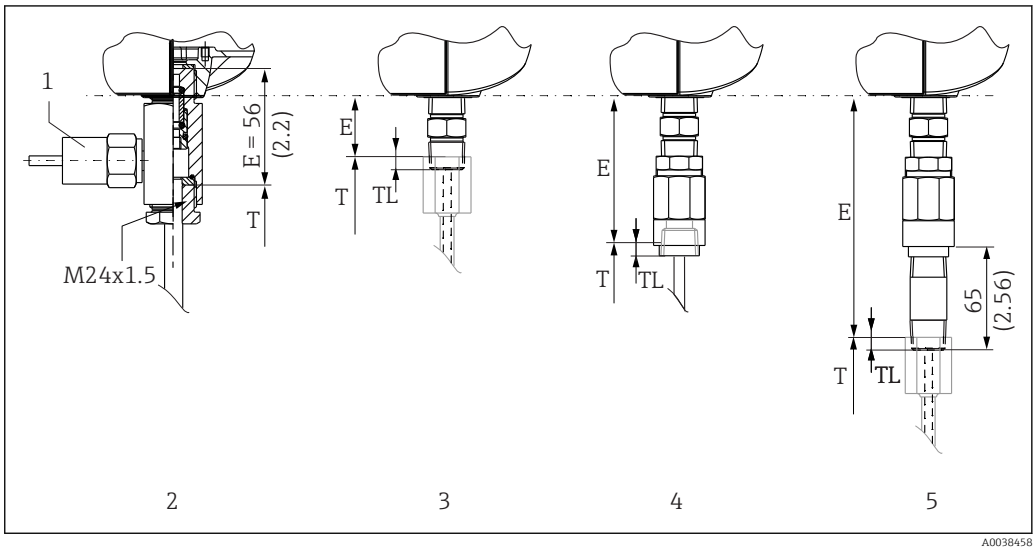
Type	Suitable for cable entry	Degree of protection	Temperature range	Suitable cable diameter
Cable gland, polyamide blue (indication of Ex-i circuit)	½" NPT	IP68	−30 to +95 °C (−22 to +203 °F)	7 to 12 mm (0.27 to 0.47 in)
Cable gland, polyamide	½" NPT, ¾" NPT, M20x1.5 (optionally 2x cable entry)	IP68	−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, brass	M20x1.5	IP68 (NEMA Type 4x)	−20 to +130 °C (−4 to +266 °F)	
Fieldbus connector (M12x1 PA, 7/8" PA, FF)	½" NPT, M20x1.5	IP67, NEMA Type 6	−40 to +105 °C (−40 to +221 °F)	-
Fieldbus connector (M12, 8-pin)	M20x1.5	IP67	−30 to +90 °C (−22 to +194 °F)	-

For explosion proof thermometers no cable glands are assembled.

Extension neck The neck tube is the part between the process connection and the terminal head.

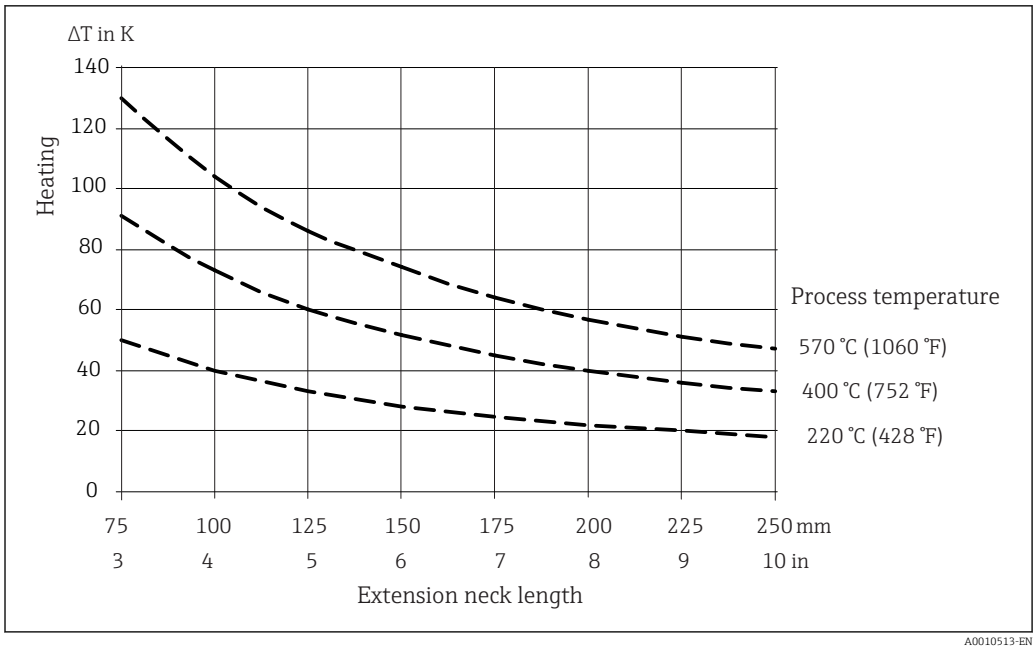


1 Removable neck, with G½" thread as standard, optionally either with M20x1.5 or NPT ½" thread
2 Part of continuous thermowell, no extension neck itself
3 Continuous thermowell + iTHERM QuickNeck seperable
4 iTHERM QuickNeck - upper half - to mount in existing thermowell with iTHERM QuickNeck



1 Pressure transmitter at the second process seal neck
2 Extension neck with second process seal
3 Nipple NPT ½"
4 Nipple-union NPT ½" female thread
5 Nipple-union-nipple NPT ½"

As illustrated in the following figure, the neck tube length may influence the temperature in the terminal head. It ist necessary that this temperature is kept within the limit values defined in the chapter "Operating conditions".



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

Using the diagramm, the temperature of the transmitter can be calculated.

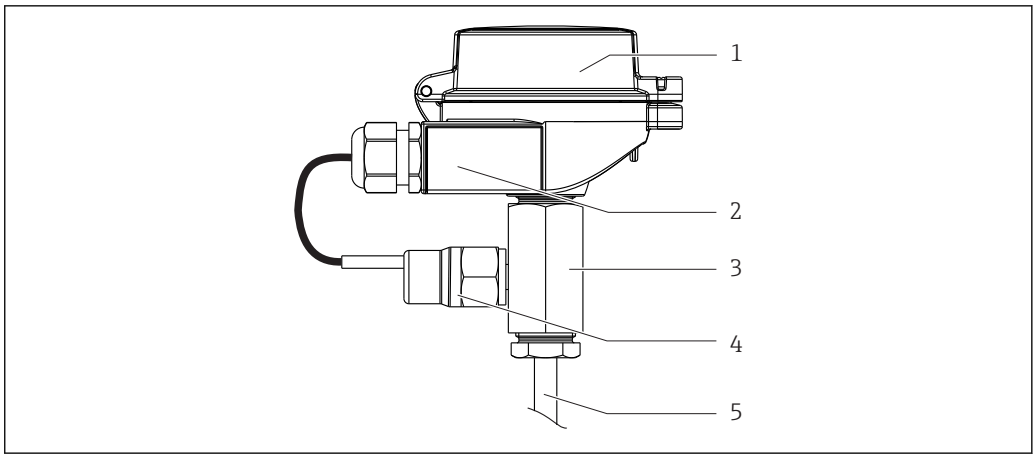
Example: At a process temperature of 220 °C (428 °F) and a lagging length of 100 mm (3.94 in) the heat transfer is 40 K (72 °F). Thus the transmitter temperature is 40 K (72 °F) plus the ambient temperature, e.g. 25 °C (77 °F): 40 K (72 °F) + 25 °C (77 °F) = 65 °C (149 °F).

Result: The temperature of the transmitter is o.k., the length of the lagging is sufficient.

Neck with second process seal

As a special version of the neck a second process seal is available as an optional component between the thermowell and the terminal head. In case of a thermowell failure no process fluid enters the terminal head and wiring system. The process media will be withhold inside the thermowell. A pressure switch gives a signal in case of rising pressure inside the second process seal device to warn maintenance personal of dangerous condition. Measuring operation may continue for a small transition time depending on pressure, temperature and process media until the thermowell is replaced.

Transmitter interconnection: A dual channel Endress+Hauser temperature transmitter TMT82 with HART®-protocol is used. One channel transmits the temperature sensor signals into a 4 to 20 mA signal. The second channel uses the sensor breakage detection in thermocouple configuration and transmits this failure information via HART®-protocol if the pressure switch switches. Other configurations may be produced on request.



15 *Extension neck with second process seal*

1 *Terminal head with built in temperature transmitter*
2 *Housing with dual cable entry*
3 *Second process seal*
4 *Installed pressure transmitter*
5 *Upper part of the thermowell*

Maximum pressure	200 bar (2 900 psi)
Switching point	3.5 bar (50.8 psi)±1 bar (±14.5 psi)
Ambient temperature range	−30 to +140 °C (−22 to +284 °F)
Process temperature range	Up to +400 °C (+752 °F), minimum required extension neck length T = 100 mm (3.94 in)

Recommendation:

Due to the aging of the internal seals we recommend a replacement of the dual seal components every 5 years even if no failure of the thermowell occured. In case of a thermowell failure the dual seal components shall be replaced with the thermowell.

Certificates and approvals

CE mark

The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing to it the CE-mark.

Ex approvals

For further details on the available Ex versions (ATEX, IECEx, CSA, etc.), please contact your Endress +Hauser sales organization. All relevant data for hazardous areas can be found in separate Ex documentation. If required, please request copies.

Other standards and guidelines

- EN 60079: ATEX certification for hazardous areas
- IEC 60529: Degrees of protection provided by enclosures (IP code)
- IEC 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC 60751: Industrial platinum resistance thermometers
- EN 50281-1-1: Electrical apparatus protected by enclosures
- DIN 43772: Protection tubes
- DIN EN 50446: Terminal heads

Electromagnetic compatibility (EMC)

EMC to all relevant requirements of the IEC/EN 61326-series and NAMUR Recommendation EMC (NE21). For details, refer to the Declaration of Conformity.

Maximum fluctuations during EMC-tests: < 1 % of measuring span.

Interference immunity to IEC/EN 61326-series, requirements for industrial areas

Interference emission to IEC/EN 61326-series, electrical equipment Class B

PED approval

The thermometer complies with paragraph 3.3 of the Pressure Equipment Directive (97/23/CE) and is not marked seperately.

Test on thermowell

Thermowell pressure tests are carried out in accordance with the specifications in DIN 43772. With regard to thermowells with tapered or reduced tips that do not comply with this standard, these are tested using the pressure of corresponding straight thermowells. Sensors for use in hazardous areas are also always subjected to a comparative pressure during the tests. Tests according to other specifications can be carried out on request. The liquid penetration test verifies that there are no cracks in the welded seams of the thermowell.

Material certification

The material certificate 3.1 (according to standard EN 10204) can be requested separately. The "short form" certificate includes a simplified declaration with no enclosures of documents related to the materials used in the construction of the single sensor and guarantees the traceability of the materials through the identification number of the thermometer. The data related to the origin of the materials can subsequently be requested by the client if necessary.

Calibration

The "Factory calibration" is carried out according to an internal procedure in a laboratory of Endress +Hauser accredited by the European Accreditation Organization (EA) to ISO/IEC 17025. A calibration which is performed according to EA guidelines (SIT/Accredia) or (DKD/DAkkS) may be requested separately. The calibration is performed on the replaceable insert of the thermometer. In the case of thermometers without a replaceable insert, the entire thermometer - from the process connection to the tip of the thermometer - is calibrated.

Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.
- From your Endress+Hauser Sales Center: www.addresses.endress.com

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

Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: ▪ Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections. ▪ Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: Via the Internet: https://portal.endress.com/webapp/applicator
Configurator	Product Configurator - the tool for individual product configuration ▪ Up-to-the-minute configuration data ▪ Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language ▪ Automatic verification of exclusion criteria ▪ Automatic creation of the order code and its breakdown in PDF or Excel output format ▪ Ability to order directly in the Endress+Hauser Online Shop The Configurator is available on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.
DeviceCare SFE100	Configuration tool for devices via fieldbus protocols and Endress+Hauser service protocols. DeviceCare is the tool developed by Endress+Hauser for the configuration of Endress+Hauser devices. All smart devices in a plant can be configured via a point-to-point or point-to-bus connection. The user-friendly menus enable transparent and intuitive access to the field devices. For details, see Operating Instructions BA00027S
FieldCare SFE500	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition. For details, see Operating Instructions BA00027S and BA00065S

W@M	Life cycle management for your plant W@M supports with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle. The application already contains the data of your Endress+Hauser device. Endress +Hauser also takes care of maintaining and updating the data records. W@M is available: Via the Internet: www.endress.com/lifecyclemanagement

Documentation

Operating manual for modular thermometers in industrial applications (BA01915T/09)

Technical Information:
- iTEMP temperature head transmitter:
  - TMT71, PC-programmable, single-channel, RTD, TC, Ω, mV (TI01393T/09/en)
  - HART® TMT72, PC-programmable, single-channel, RTD, TC, Ω, mV (TI01392T/09/en)
  - TMT180, PC-programmable, single-channel, Pt100 (TI088R/09/en)
  - HART® TMT82, two-channel, RTD, TC, Ω, mV (TI01010T/09/en)
  - PROFIBUS® PA TMT84, two-channel, RTD, TC, Ω, mV (TI138R/09/en)
  - HART®, FOUNDATION Fieldbus™, PROFIBUS® TMT162, two-channel, RTD, TC, Ω, mV (TI00086R/09/en)
- Thermowell:
  Welded Thermowell iTHERM TT131 (TI01442T/09/en)
- Insert:
  iTHERM TS111 (TI01014T/09) and iTHERM TS211 (TI01411T/09)
- Supplementary documentation ATEX/IECEx:
  - ATEX, IECEx Ex d, Ex-ta/tb: XA01799T/09
  - ATEX, IECEx Ex ia: XA01817T/09

www.addresses.endress.com

Endress+Hauser

People for Process Automation