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Technical Information
iTHERM ModuLine TM151

Industrial modular thermometer

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

Applications

- For universal use
- Measuring range: −200 to +1 100 °C (−328 to +2 012 °F)
- Pressure range: Up to 500 bar (7 252 psi)

Your benefits

- Easy maintenance and recalibration of the thermometer (sensor can be replaced without interrupting the process)
- 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: Exceptional vibration resistance (> 60 g) for ultimate plant safety
- iTHERM QuickNeck: Cost and time savings thanks to simple, tool-free removal for recalibration
- International certification: e.g. explosion protection in accordance with ATEX, IECEx, CSA and INMETRO; functional safety (SIL)
- iTEMP temperature transmitter with all common communication protocols and optional Bluetooth® connectivity

Endress+Hauser
People for Process Automation

Table of contents

About this document 3
Symbols 3

Function and system design 4
iTHERM ModuLine 4
Measuring principle 5
Measuring system 5
Modular design 7

Input 10
Measured variable 10
Measuring range 10

Output 10
Output signal 10
Family of temperature transmitters 10

Power supply 11
Terminal assignment 11
Terminals 16
Cable entries 16
Overvoltage protection 22

Performance characteristics 22
Reference operating conditions 22
Maximum measurement error 23
Ambient temperature effect 24
Self-heating 24
Response time 24
Calibration 27
Insulation resistance 29

Installation 29
Orientation 29
Installation instructions 29

Environment 30
Ambient temperature range 30
Storage temperature 30
Relative humidity 30
Climate class 30
Degree of protection 30
Shock and vibration resistance 30
Electromagnetic compatibility (EMC) 30

Process 30
Process temperature range 30
Process pressure range 31
Process pressure range 31

Mechanical construction 32
Design, dimensions 32
Weight 41
Materials 41
Thermowell/thermometer connections 43
Process connections 45
Geometry of parts in contact with medium 55
Measuring inserts 55
Surface roughness 57
Terminal heads 57
Extension neck 64
Predefined versions 70

Certificates and approvals 74
MID 74

Ordering information 74

Accessories 74
Device-specific accessories 75
Service-specific accessories 75
Online tools 75
System components 75

Documentation 76

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.
	**Tip** Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Visual inspection

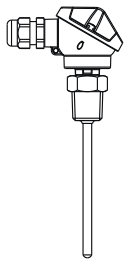
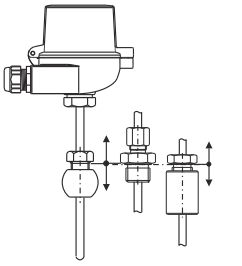
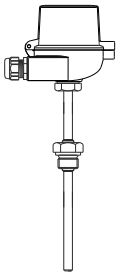
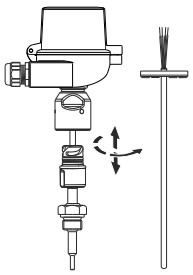
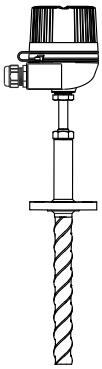
Symbols in graphics

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
	Hazardous area		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 element as the 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 two different versions 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 carrier is then sealed top and bottom with a ceramic protective layer. These 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).

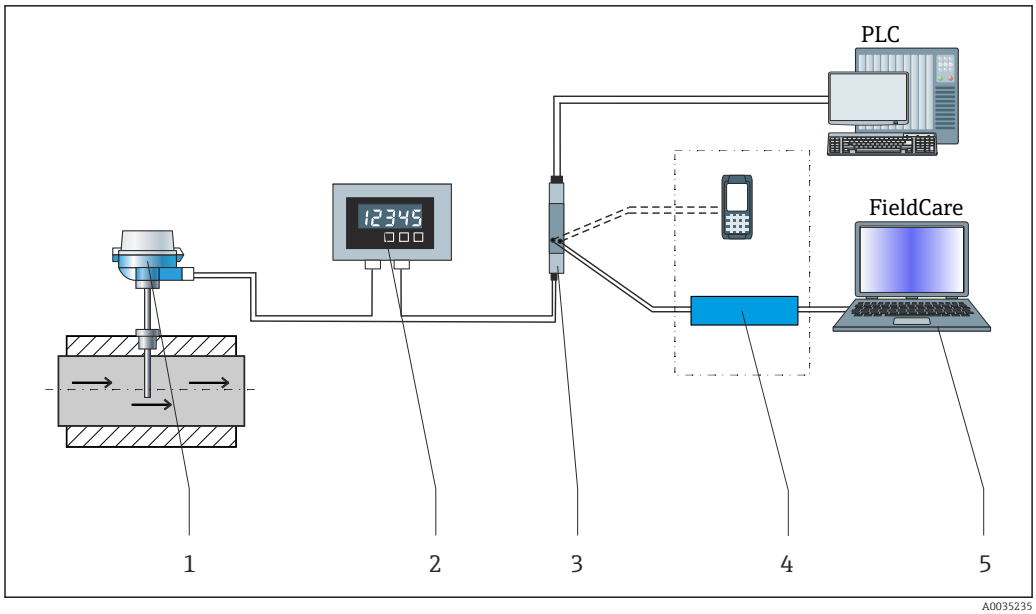
Thermocouples (TC)

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

The manufacturer provides 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. These include:

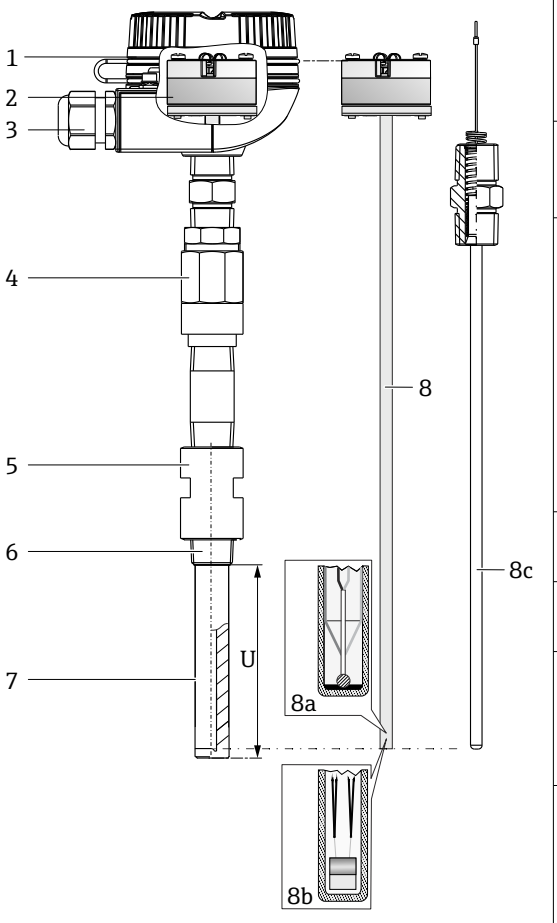
- Power supply unit/barrier
- Display units
- Overvoltage protection

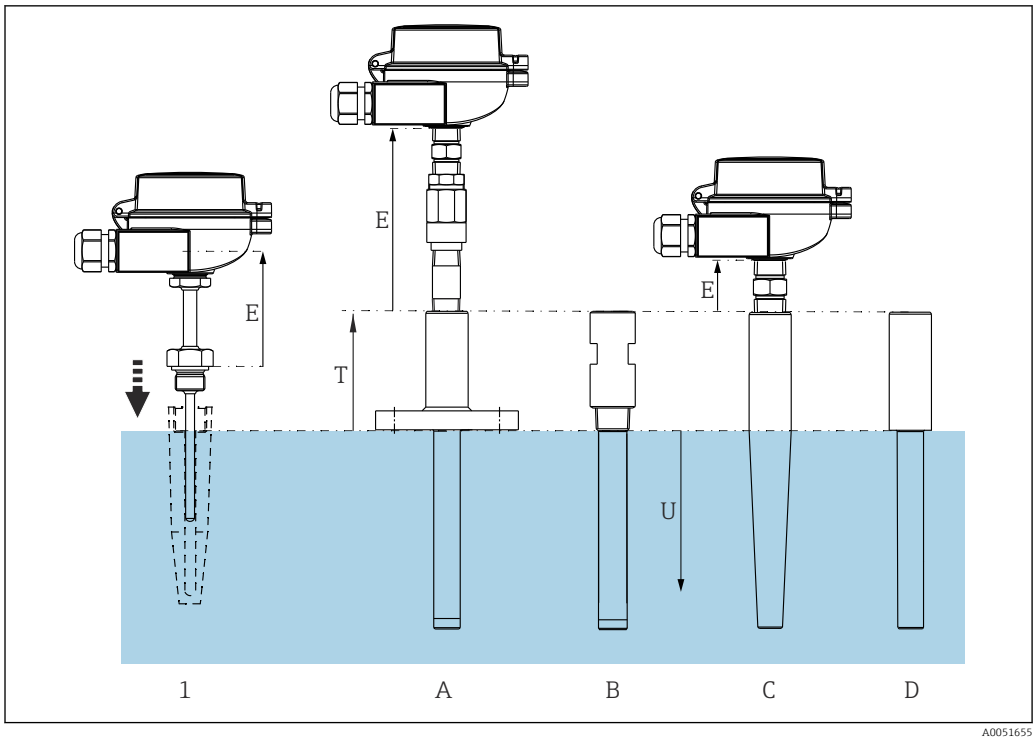


1 Application example, measuring point setup with additional manufacturer components

1 *Installed iTHERM thermometer with HART® communication protocol*
2 *Process indicator from the RIA product family: The process indicator is incorporated into the current loop and displays the measuring signal or the 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 power to 2-wire 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 device), FieldXpert, Commubox FXA195 for intrinsically safe HART® communication with FieldCare via a USB port.*
5 *FieldCare is an FDT-based plant asset management tool; for information on this, see the "Accessories" section.*

Modular design

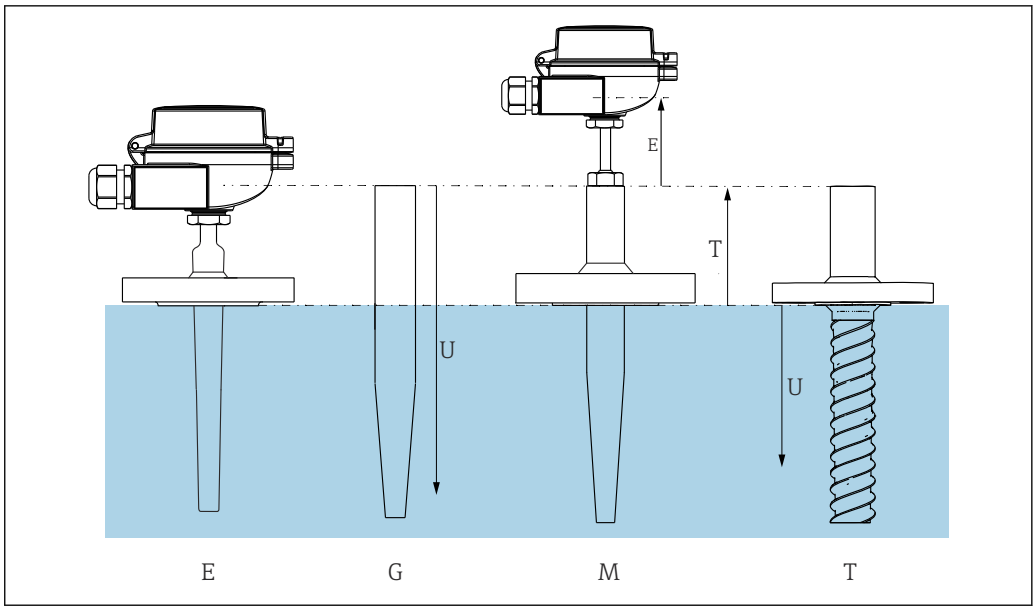
Construction		Options
	1: Terminal head	Variety of terminal heads made of aluminum, polyamide or stainless steel **Advantages:** ▪ Optimum access to terminals thanks to low housing edge of bottom section: ▪ Easier to use ▪ Lower installation and maintenance costs ▪ Optional display: Local process indicator for added reliability
	2: Wiring, electrical connection, output signal	▪ Ceramic terminal block ▪ Flying leads ▪ Head transmitter: 4 to 20 mA, HART®, PROFIBUS® PA, FOUNDATION™ Fieldbus; IO-Link®, Ethernet-APL (1-channel or 2-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 ▪ Extension neck according to DIN 43772 ▪ iTHERM QuickNeck ▪ Extension neck with second process seal ▪ Nipple, nipple-union, or nipple-union-nipple **Advantages:** **iTHERM QuickNeck:** Tool-free removal of the measuring insert: ▪ Saves time/money on frequently calibrated measuring points ▪ Wiring mistakes avoided
	5: Thermowell 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, socket weld
	7: Thermowell	Versions with and without thermowell (for existing thermowells). ▪ Various diameters ▪ Various materials ▪ Various tip shapes (straight, tapered or stepped)
	8: Measuring insert with: 8a: iTHERM QuickSens 8b: iTHERM StrongSens 8c: Central-spring-loaded measuring insert	Sensor models: RTD – wire wound (WW), thin film sensor (TF) or thermocouples type K, J or N. Measuring insert diameter Ø3 mm (0.12 in) or Ø6 mm (0.24 in), depending on thermowell tip or selected thermometer **Advantages:** ▪ **iTHERM QuickSens** – measuring insert with the world's fastest response times: ▪ Fast, highly accurate measurements, delivering maximum process reliability and control ▪ Quality and cost optimization ▪ **iTHERM StrongSens** – measuring insert with unbeatable durability: ▪ Vibration resistance ≤ 60 g: Lower life cycle costs thanks to longer operating life and high plant availability ▪ Automated, traceable production: Top quality and maximum process reliability



2 Different thermowell versions available

1 For installation in a separate thermowell
A Flanged, references acc. to ASME/Universal
B With thread, references acc. to ASME/Universal
C For weld-in, references acc. to ASME/Universal
D Socket weld, references acc. to ASME/Universal

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



3 Different thermowell versions available

E Flanged, references acc. to NAMUR
G For weld-in, references acc. to DIN
M Flanged, references acc. to DIN
T Flanged, iTHERM TwistWell

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:

- Directly wired sensors: Sensor measured values forwarded without an iTEMP transmitter.
- Via all common protocols by selecting the appropriate iTEMP transmitter.

All iTEMP transmitters are mounted directly in the terminal head and wired to 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.

4-20 mA head transmitter
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 transmitter
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 transmitter
Universally programmable iTEMP head transmitter with PROFIBUS PA communication. Conversion of various input signals into digital output signals. High measurement accuracy over the complete operating temperature range. PROFIBUS PA functions and device-specific parameters are configured via fieldbus communication.

FOUNDATION Fieldbus™ head transmitters
Universally programmable iTEMP head transmitter with FOUNDATION Fieldbus™ communication. Conversion of various input signals into digital output signals. High measurement accuracy over the complete operating temperature range. All iTEMP transmitters 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 transmitter 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:
- Dual 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).

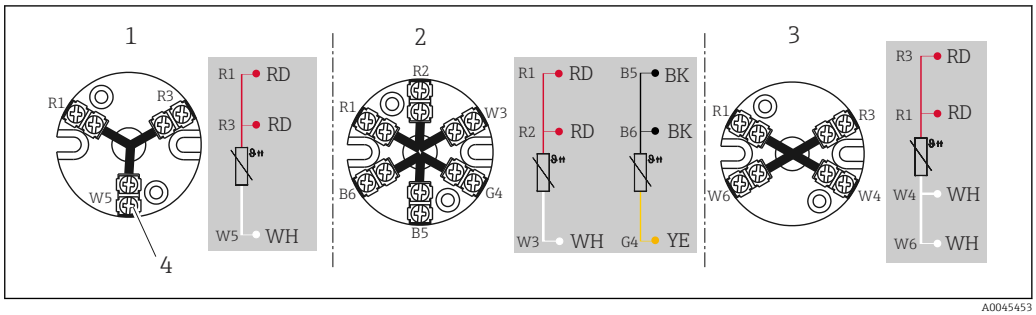
Power supply

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

Terminal assignment

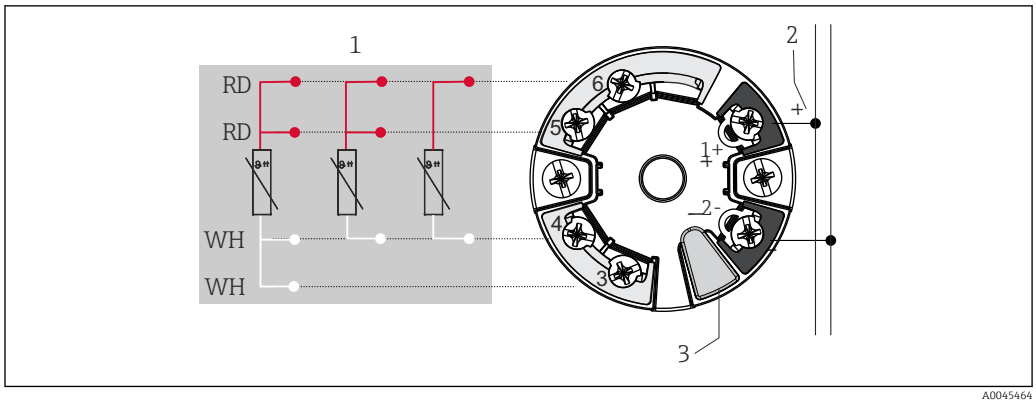
RTD sensor connection type

3-wire measurement	4-wire measurement
Three wires are connected to the RTD sensor. Two wires conduct the measuring current and the third is used to compensate the cable resistance. **Advantage:** Good compensation for symmetrical cables.	Four wires are connected to the RTD sensor. Two wires conduct the measuring current and two measure the voltage directly at the RTD sensor. **Advantage:** Maximum precision regardless of cable length or symmetry.



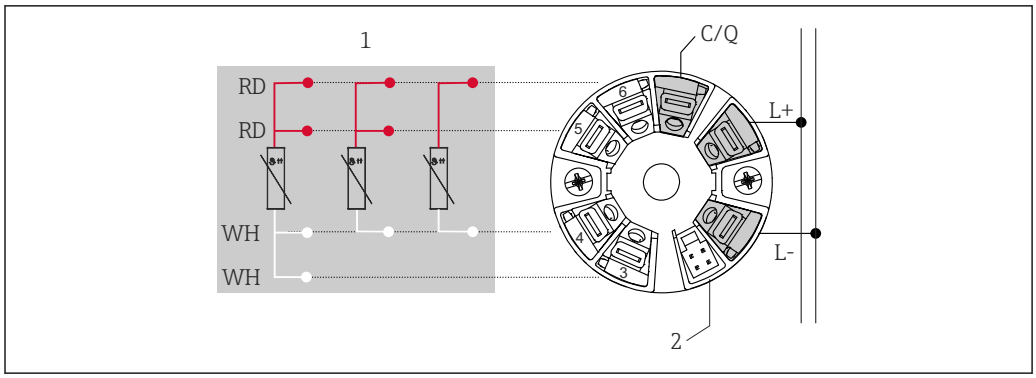
4 *Mounted ceramic terminal block*

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



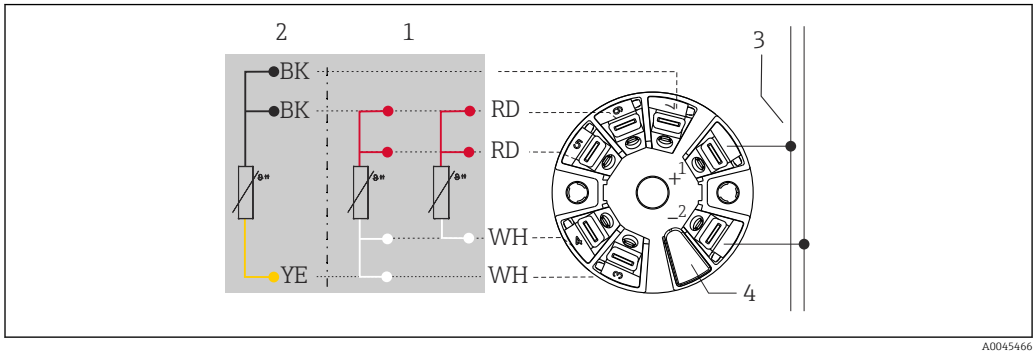
5 *Head-mounted iTEMP TMT7x transmitter or iTEMP TMT31 (single sensor input)*

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



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

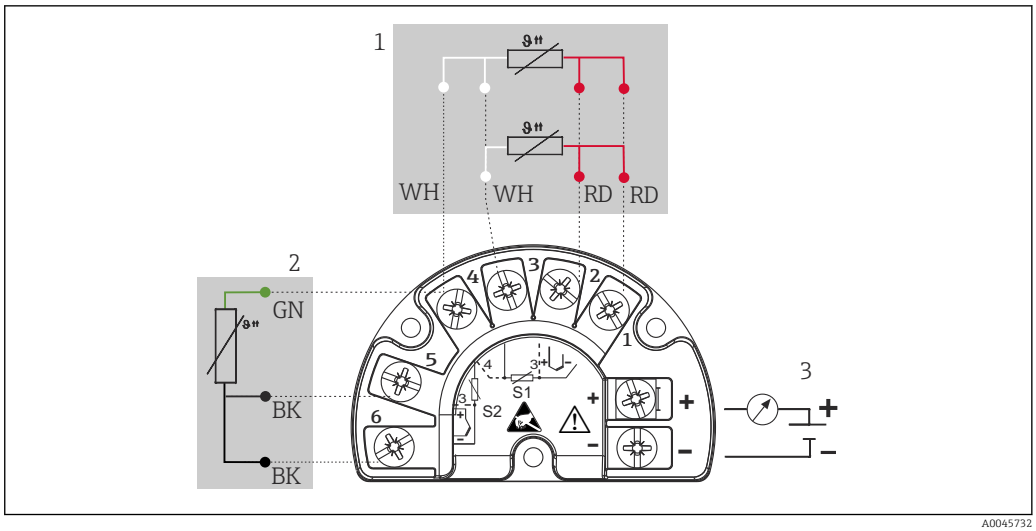
1 *RTD sensor input: 4-, 3- and 2-wire*
2 *Display connection*
L+ *18 to 30 V_{DC} power supply*
L- *0 V_{DC} power supply*
C/Q *IO-Link or switch output*



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

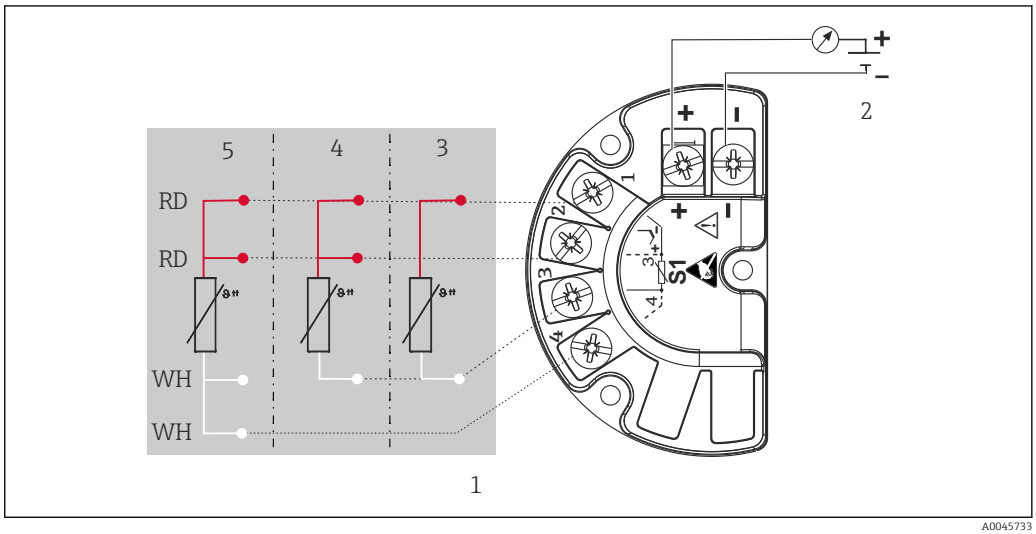
1 *Sensor input 1, RTD, 4- and 3-wire*
2 *Sensor input 2, RTD, 3-wire*
3 *Fieldbus connection and power supply*
4 *Display connection*

Mounted field transmitter: Fitted with screw terminals



8 *iTEMP TMT162 (dual input)*

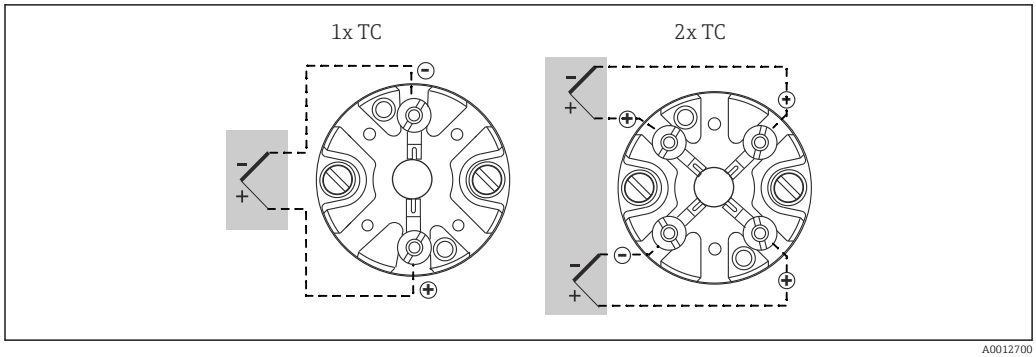
1 *Sensor input 1, RTD: 3- and 4-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply field transmitter and analog output 4 to 20 mA or fieldbus connection*



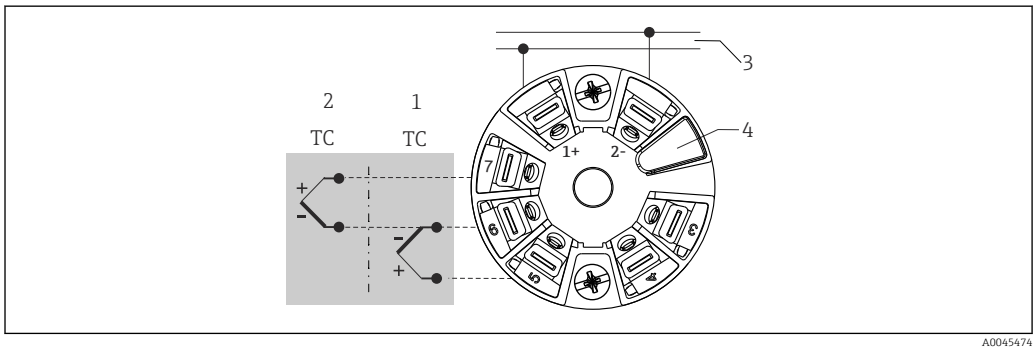
9 *iTEMP TMT142B (single input)*

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

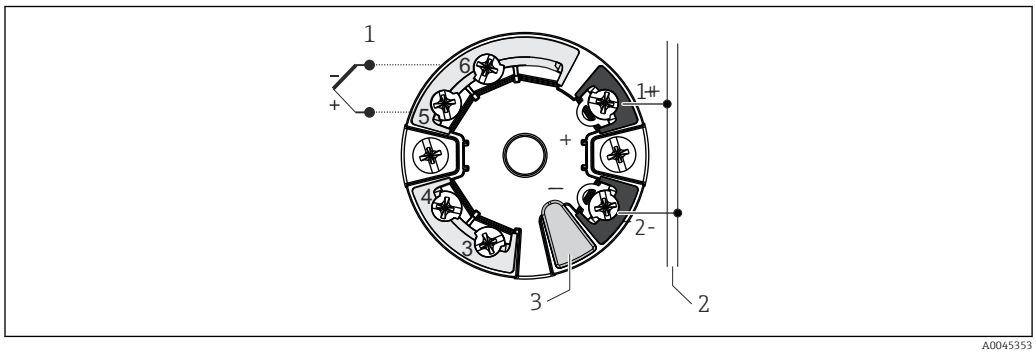


10 *Installed ceramic terminal block for thermocouples.*



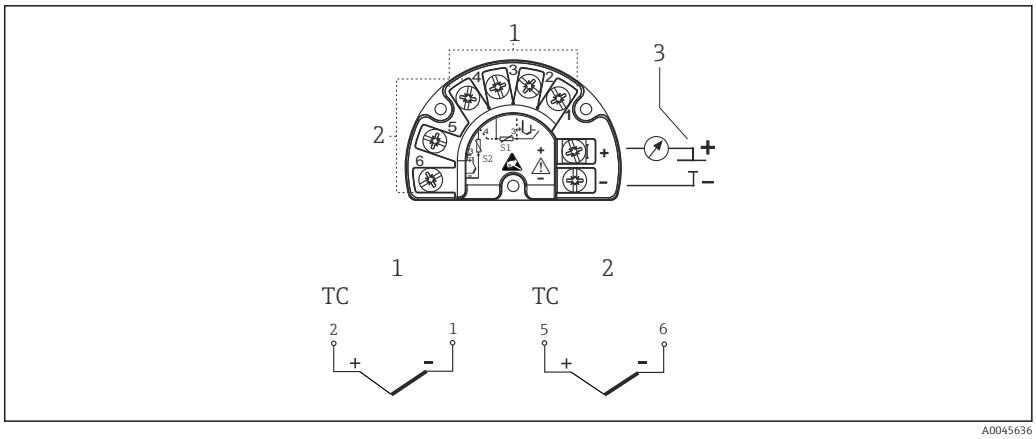
11 *Head-mounted iTEMP TMT8x transmitter (dual sensor input)*

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



12 *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*



13 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 (-)

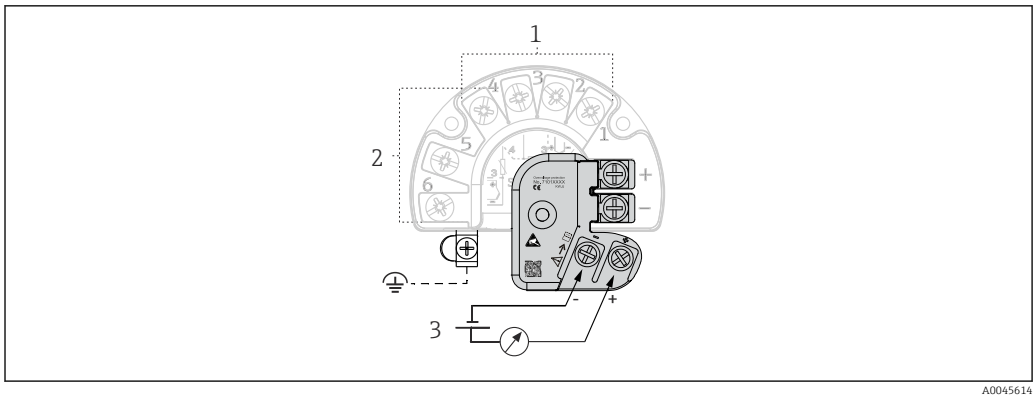
Integrated overvoltage protection

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



14 *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 plugs

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

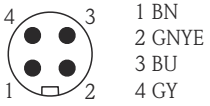
Terminal head with a cable entry [1)]

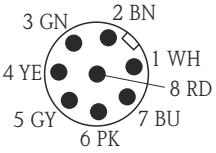
Plug	1x PROFIBUS PA								1x FOUNDATION™ Fieldbus (FF)				1x PROFINET and Ethernet-APL™			
Plug thread	M12				7/8"				7/8"				M12			
PIN number	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Electrical connection (terminal head)																
Flying leads and TC	Not connected (not insulated)															
3-wire terminal block (1x Pt100)	RD	RD	WH		RD	RD	WH		RD	RD	WH		Cannot be combined		Cannot be combined	
4-wire terminal block (1x Pt100)			WH	WH			WH	WH			WH	WH			Cannot be combined	
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)					
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)				
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	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
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"> 

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)]

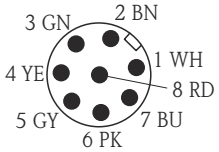
Plug	2x PROFIBUS PA								2x FOUNDATION™ Fieldbus (FF)				2x PROFINET and Ethernet-APL™			
Plug thread  A0021706	M12(#1) / M12(#2)				7/8"(#1)/7/8"(#2)				7/8"(#1)/7/8"(#2)				M12 (#1)/M12 (#2)			
PIN number	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Electrical connection (terminal head)																
Flying 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		Cannot be combined		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	+/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	 A0018929 1 BN 2 GNYE 3 BU 4 GY	 A0018930 1 BN 2 GNYE 3 BU 4 GY	 A0018931 1 BU 2 BN 3 GY 4 GNYE	 A0052119 1 RD 2 GN			

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	 A0018929 1 BN 2 GNYE 3 BU 4 GY				 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 overvoltage 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.

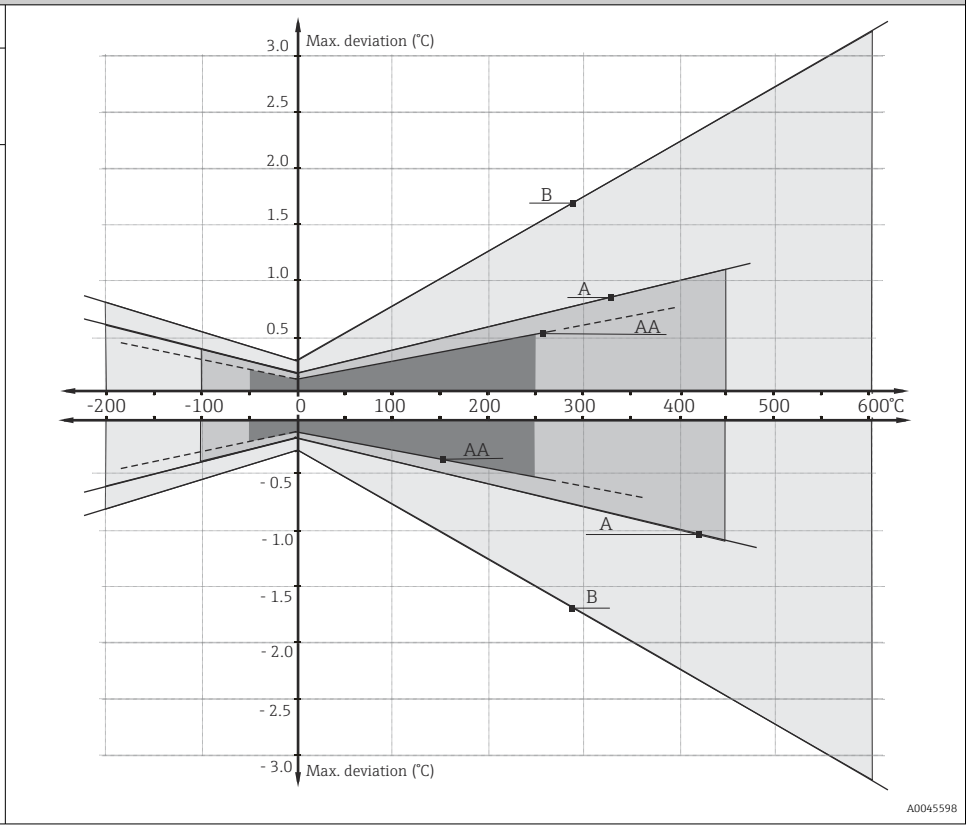
Performance characteristics

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 according 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| = absolute temperature value °C

To obtain 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 1200 °C) ±2.5 °C (−40 to +333 °C) ±0.0075 |t| [1] (333 to 1200 °C)	1	±1.5 °C (−40 to +375 °C) ±0.004 |t| [1] (375 to 1000 °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 1260 °C)	±1.1 K or ±0.004 |t| [1] (0 to 1260 °C)

1) |t| = absolute value in °C

The materials for thermocouples are generally supplied so 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 low measurement current) is used.

Response time

Exemplary tests were carried out in water with 0.4 m/s and with a temperature jump of 25 K in order to determine the typical values in the table. The actual values depend on production tolerances and installation conditions. Standard deviations in accordance with the normal deviation are to be expected.

Response times in seconds (s). The times depend on the geometries in contact with the medium. The table contains all the predefined versions. Dimensions in mm (inch)

RTD sensor connection type

					Standard Pt100 (TF)	Wire wound Pt100 (WW)	iTHERM QuickSens	iTHERM StrongSens
Type	**Geometry**	**Root Ø D1**	**Tip Ø D2**	**Bore Ø Di**	**t_{90}**	**t_{90}**	**t_{90}**	**t_{90}**
ASME	Straight	16 mm (0.63 in)		6.5 mm (0.25 in)	71	74	54	75
		19 mm (0.75 in)			72	75	55	76
		22.2 mm (0.87 in)			75	78	58	79
		25.4 mm (1 in)			80	83	64	84
	Tapered	16 mm (0.63 in)	15 mm (0.6 in)		71	74	54	75
		19.5 mm (0.77 in)			71	74	54	75
		22.2 mm (0.87 in)			71	74	54	75
		25.4 mm (1 in)			71	74	54	75
		26.7 mm (1.05 in)	17 mm (0.67 in)		71	74	54	75
		27 mm (1.06 in)			71	74	54	75
		33.4 mm (1.31 in)	20 mm (0.79 in)		73	76	56	77
	Stepped	16 mm (0.63 in)	12.7 mm (0.5 in)	6.5 mm (0.25 in)	70	73	54	75
		19 mm (0.75 in)			70	73	54	75
		22.2 mm (0.87 in)			70	73	54	75
DIN	Tapered	18 mm (0.71 in)	9 mm (0.35 in)	3.5 mm (0.14 in)	-	-	-	-
		24 mm (0.95 in)	12.5 mm (0.49 in)	6.5 mm (0.25 in)	71	74	54	75
		26 mm (1.02 in)			71	74	54	75
NAMUR	Tapered	20 mm (0.79 in)	13 mm (0.51 in)	7 mm (0.28 in)> 6.1 mm (0.24 in)	27	32	19	33
iTHERM TwistWell	Tapered	22 mm (0.87 in)	15 mm (0.6 in)	6.5 mm (0.25 in)	71	74	55	75
		25 mm (0.98 in)	17 mm (0.67 in)		72	75	55	76
		30 mm (1.18 in)	22 mm (0.87 in)		77	80	61	82

RTD + QuickSleeve sensor connection type

					Pt100 (TF) + QuickSleeve	Pt100 (WW) + QuickSleeve	iTHERM QuickSens + QuickSleeve
Type	**Geometry**	**Root Ø D1**	**Tip Ø D2**	**Bore Ø Di**	**t_{90}**	**t_{90}**	**t_{90}**
ASME	Straight	16 mm (0.63 in)		6.5 mm (0.25 in)	59	62	53
		19 mm (0.75 in)			60	63	54
		22.2 mm (0.87 in)			63	66	57
		25.4 mm (1 in)			69	72	63
	Tapered	16 mm (0.63 in)	15 mm (0.6 in)		59	62	53
		19.5 mm (0.77 in)			59	62	53
		22.2 mm (0.87 in)			59	62	53
		25.4 mm (1 in)			59	62	53
		26.7 mm (1.05 in)	17 mm (0.67 in)		59	62	53
		27 mm (1.06 in)			59	62	53
		33.4 mm (1.31 in)	20 mm (0.79 in)		61	64	53
	Stepped	16 mm (0.63 in)	12.7 mm (0.5 in)	6.5 mm (0.25 in)	58	62	53
		19 mm (0.75 in)			58	62	53
		22.2 mm (0.87 in)			58	62	53
DIN	Tapered	18 mm (0.71 in)	9 mm (0.35 in)	3.5 mm (0.14 in)	-	-	-
		24 mm (0.95 in)	12.5 mm (0.49 in)	6.5 mm (0.25 in)	59	62	53
		26 mm (1.02 in)			59	62	53
NAMUR	Tapered	20 mm (0.79 in)	13 mm (0.51 in)	7 mm (0.28 in)> 6.1 mm (0.24 in)	-	-	-
iTHERM TwistWell	Tapered	22 mm (0.87 in)	15 mm (0.6 in)		59	62	53
		25 mm (0.98 in)	17 mm (0.67 in)	6.5 mm (0.25 in)	60	63	54
		30 mm (1.18 in)	22 mm (0.87 in)		66	69	60

Thermocouple (TC) sensor connection type

					Thermocouple		
					Type J	Type K	Type N
Type	**Geometry**	**Root Ø D1**	**Tip Ø D2**	**Bore Ø Di**	t_{90}	t_{90}	t_{90}
ASME	Straight	16 mm (0.63 in)		6.5 mm (0.25 in)	71	71	71
		19 mm (0.75 in)			72	72	72
		22.2 mm (0.87 in)			75	75	75
		25.4 mm (1 in)			80	80	80
	Tapered	16 mm (0.63 in)	15 mm (0.6 in)	6.5 mm (0.25 in)	71	71	71
		19.5 mm (0.77 in)			71	71	71
		22.2 mm (0.87 in)			71	71	71
		25.4 mm (1 in)			71	71	71
		26.7 mm (1.05 in)	17 mm (0.67 in)		71	71	71
		27 mm (1.06 in)			71	71	71
		33.4 mm (1.31 in)	20 mm (0.79 in)		73	73	73
	Stepped	16 mm (0.63 in)	12.7 mm (0.5 in)	6.5 mm (0.25 in)	70	70	70
		19 mm (0.75 in)			70	70	70
		22.2 mm (0.87 in)			70	70	70
DIN	Tapered	18 mm (0.71 in)	9 mm (0.35 in)	3.5 mm (0.14 in)	-	-	-
		24 mm (0.95 in)	12.5 mm (0.49 in)	6.5 mm (0.25 in)	71	71	71
		26 mm (1.02 in)			71	71	71
NAMUR	Tapered	20 mm (0.79 in)	13 mm (0.51 in)	7 mm (0.28 in)> 6.1 mm (0.24 in)	27	27	27
iTHERM TwistWell	Tapered	22 mm (0.87 in)	15 mm (0.6 in)	6.5 mm (0.25 in)	71	71	71
		25 mm (0.98 in)	17 mm (0.67 in)		72	72	72
		30 mm (1.18 in)	22 mm (0.87 in)		77	77	77

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

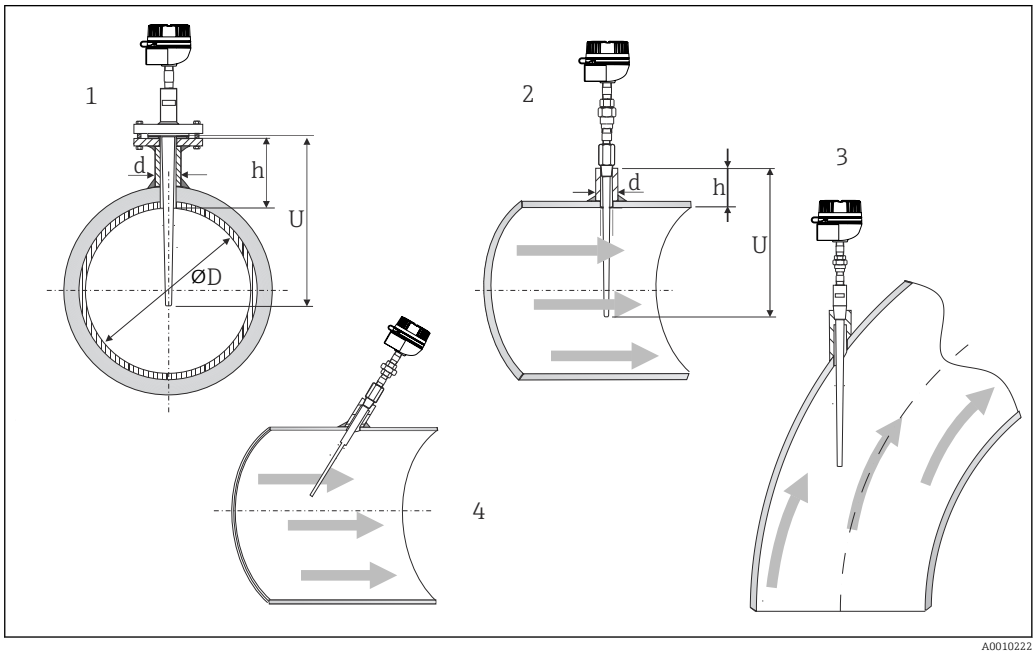
- RTD:
  Insulation resistance between the terminals and the extension neck, as per IEC 60751 > 100 MΩ at +25 °C, measured with a minimum testing voltage of 100 V_{DC}.
- TC:
  Insulation resistance as per IEC 61515 between terminals and sheath material for a test voltage of 500 V_{DC}:
  - > 1 GΩ at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

Installation

Orientation

No restrictions. Self-draining in the process must be ensured, depending on the application.

Installation instructions



15 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).

For the best installation, apply the following rule: h ~ d; U > D/2 +h.

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)

Storage temperature

−40 to +85 °C (−40 to +185 °F).

Relative 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)..

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.

The mechanical loading capacity as a function of the installation and process conditions can be verified in the "Thermowell Calculation Tool" contained in the manufacturer's 'Applicator' online tool. See "Accessories" section.

Permitted flow velocity depending on the immersion length and process medium

The maximum flow velocity tolerated by the thermowell diminishes with increasing thermowell immersion length exposed to the stream of the fluid. It depends on the shape and size of the thermowell, the process connection, the medium type, process temperature and process pressure.

Process connection	Standard	Max. process pressure
Weld-in version/socket weld	NPS	≤ 500 bar (7 252 psi)
Flange	ASME B16.5	Depending on the flange pressure rating 150, 300, 600, 900/1500 or 2500 psi at 20 °C (68 °F)
Thread	ISO 965-1 / ASME B1.13M ISO 228-1 ANSI B1.20.1 DIN EN 10226-1 /	400 bar (5 802 psi) at +400 °C (+752 °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.

The mechanical loading capacity as a function of the installation and process conditions can be verified in the "Thermowell Calculation Tool" contained in the manufacturer's 'Applicator' online tool. See "Accessories" section.

Permitted flow velocity depending on the immersion length and process medium

The maximum flow velocity tolerated by the thermowell diminishes with increasing thermowell immersion length exposed to the stream of the fluid. It depends on the shape and size of the thermowell, the process connection, the medium type, process temperature and process pressure.

Process connection	Standard	Max. process pressure
Weld-in version/socket weld	NPS	≤ 500 bar (7 252 psi)
Flange	ASME B16.5	Depending on the flange pressure rating 150, 300, 600, 900/1500 or 2500 psi at 20 °C (68 °F)
Thread	ISO 965-1 / ASME B1.13M ISO 228-1 ANSI B1.20.1 DIN EN 10226-1 /	400 bar (5 802 psi) at +400 °C (+752 °F)

Mechanical construction

Design, dimensions

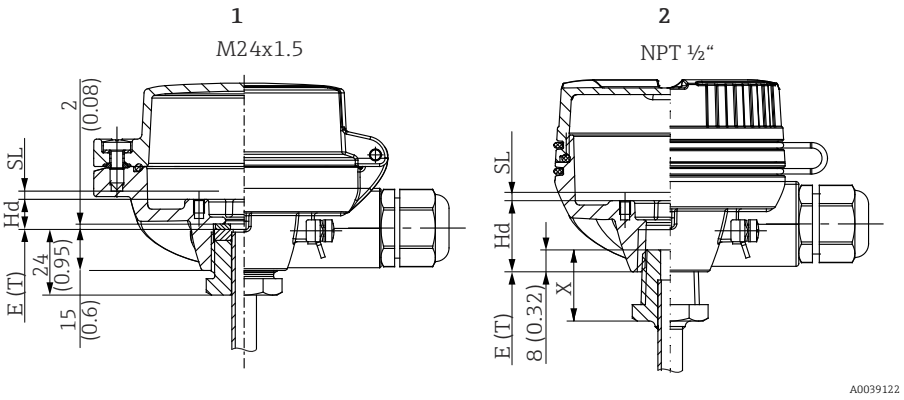
All dimensions in mm (in). The design of the thermometer depends on the type selected:
- Thermometer for installation in a separate thermowell
- Thermometer with thermowell, based on ASME: ANSI flanges, NPT thread, socket weld and weld-in version
- Thermometer with thermowell, based on DIN: EN flanges, M-thread or G-thread, socket weld and weld-in version
- Thermometer with thermowell, based on NAMUR and TwistWell, flanges

The mechanical loading capacity depending on the installation and process conditions can be checked online using the "TW Sizing Thermowell Module" calculation tool for thermowells in the Endress+Hauser Applicator software. See "Accessories" section.

Various dimensions, such as the immersion length U, the thermowell 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 predefined for the version with iTHERM QuickNeck
IL	Insertion length of measuring insert
L	Thermowell length (U+T)
T	Length of thermowell lagging: Variable or predefined, depending on the thermowell version (see also the individual table data)
U	Immersion length: Variable, depending on the configuration
L_Gp	Thread length (complete thread length)
L_Gp_e	Thread engagement length
Gp	Process connection thread
B	Thermowell base thickness (default value 6 mm (0.24 in) – other thickness optionally available)
D1	Root diameter
D2	Tip diameter
C1	Length of tapered part
Re1	Stepped length of tip
Di1	Bore diameter
Di2	Bore diameter of tip
De1	Lagging diameter
Ge1	Thermometer connection thread

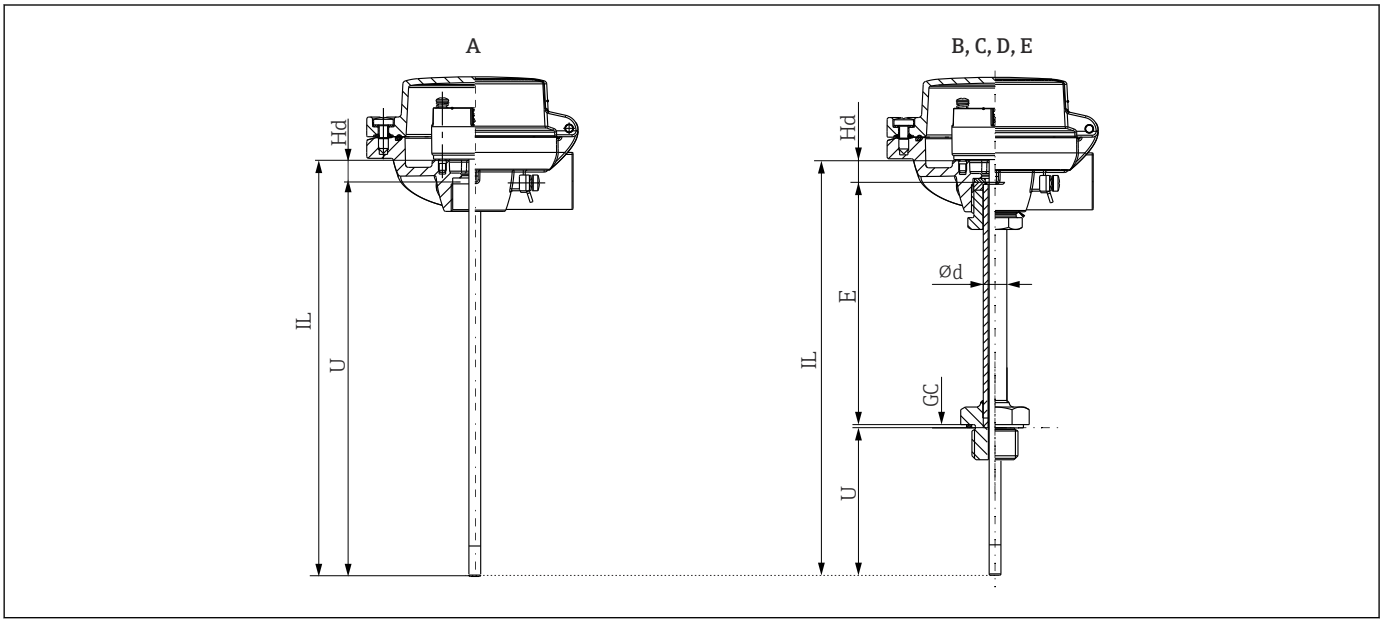
Item	Description
Hd, SL	Variable for calculating the insertion length of the measuring insert, depending on different screw-in lengths in the terminal head thread M24x1.5 or ½" NPT, see measuring insert length calculation (IL).  *16 Different screw-in lengths in the terminal head thread for M24x1.5 and ½" NPT* *1 Metric thread M24x1.5* *2 Conical thread NPT ½"* *Hd Distance in terminal head* *SL Spring travel*
GC	Gasket compensation only for metric threads

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



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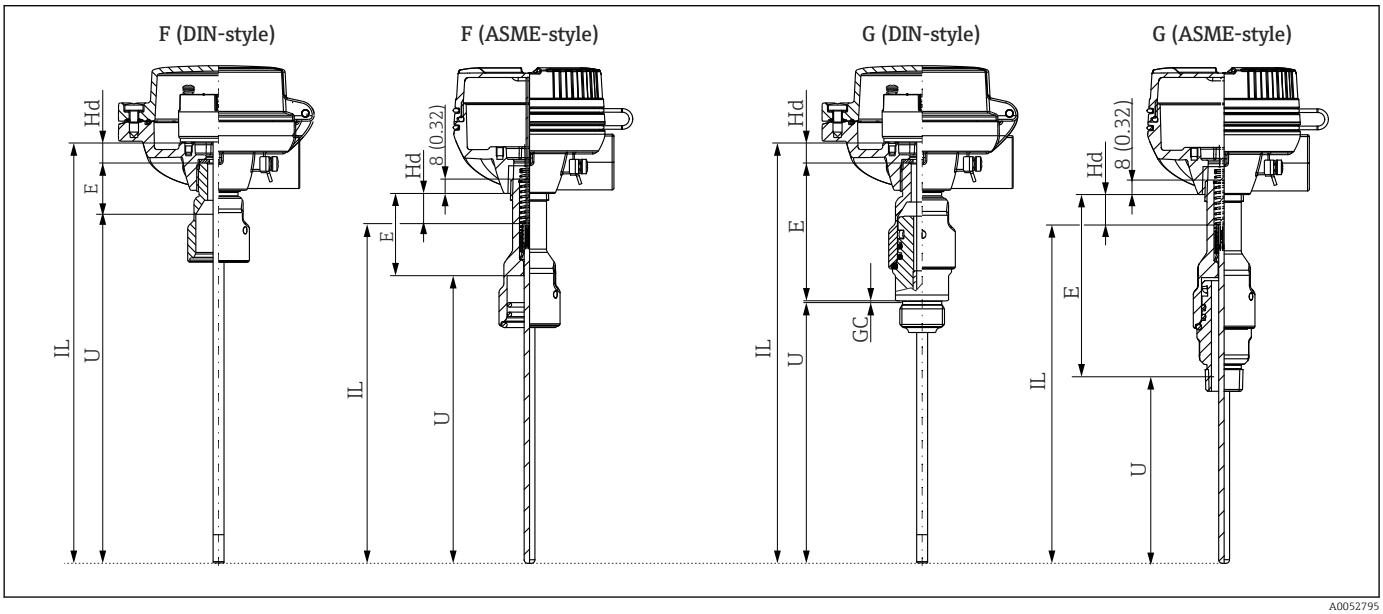

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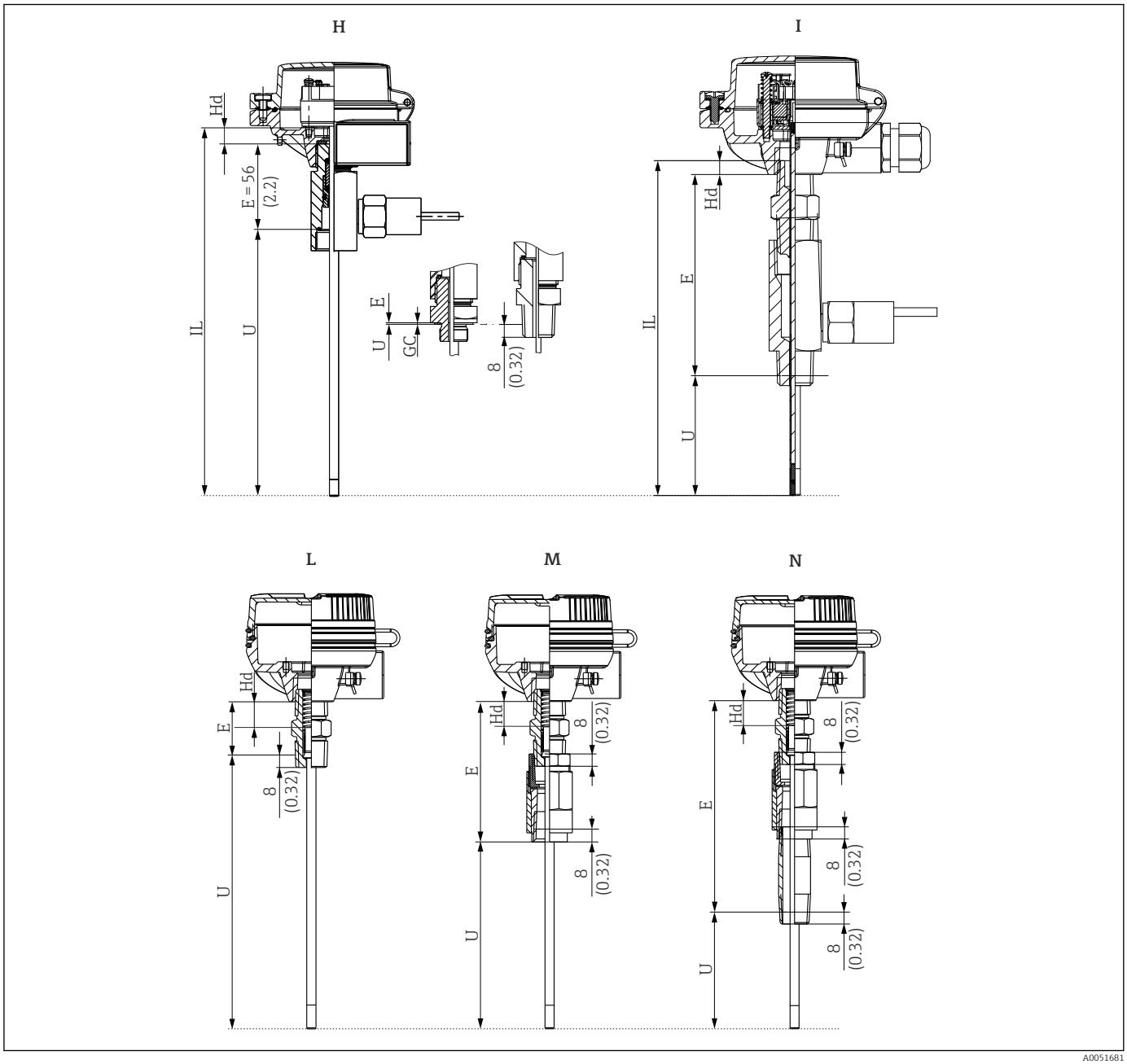
- Option A: Without extension neck (female thread M24, M20x1.5 or NPT ½") [1)]
- Options B, C, D, E: Removable extension neck; choose metric thread for connection to thermowell.
- Option F (DIN-style): iTHERM QuickNeck upper part with iTHERM TS111.
- Option F (ASME-style): iTHERM QuickNeck upper part with iTHERM TS211.
- Option G (DIN-style): iTHERM QuickNeck, complete, with iTHERM TS111.
- Option G (ASME-style): iTHERM QuickNeck, complete, with iTHERM TS211.



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- Option H: Extension neck with second process seal, with gasket, replaceable measuring insert (thread M24x1.5 female fitting to thermowell) or with male thread.
- Option I: Extension neck with second process seal, with metal seal, fixed measuring insert (thread NPT 1/2" male thread to thermowell).
- Options L, M, N: NPT ½" nipple, nipple-union or nipple-union-nipple connection.

1) Configuration feature 50: Process/thermowell connection

Calculation of measuring insert length IL

Option A: Without neck	**IL = U + Hd**
Option A for use with NAMUR thermowell	Thermowell iTHERM ModuLine TT151 type NF1: U_{TM151} = 304 mm (11.97 in); IL = 315 mm (12.4 in) Thermowell iTHERM ModuLine TT151 type NF2: U_{TM151} = 364 mm (14.33 in); IL = 375 mm (14.8 in) Thermowell iTHERM ModuLine TT151 type NF3: U_{TM151} = 424 mm (16.7 in); IL = 435 mm (17.13 in)
Options B, C, D, E: Removable extension neck	Metric thread version: **IL = U + E + Hd + GC** NPT thread version: **IL = U + E + Hd**

Option F (DIN-style): iTHERM QuickNeck, upper part	**IL = U + E + Hd** Length E = 28 mm (1.10 in) for M24x1.5 to terminal head Length E = 21 mm (0.83 in) for NPT ½" to terminal head
Option F (ASME-style): iTHERM QuickNeck, upper part	**IL = U + E + Hd** Length E = 46 mm (1.81 in) for M24x1.5 to terminal head Length E = 44 mm (1.73 in) for NPT ½" to terminal head
Option G (DIN-style): iTHERM QuickNeck, complete	DIN-style: Thermowell connection as cylindrical thread (M14; M18; G½") **IL = U + E + Hd + GC** Length E = 74 mm (2.91 in) for M24x1.5 to terminal head Length E = 68 mm (2.68 in) for NPT ½" to terminal head
Option G (ASME-style): iTHERM QuickNeck, complete	ASME-style: Thermowell connection as conical thread (NPT ½") **IL = U + E + Hd + GC** Length E = 101 mm (3.98 in)
Option H: Second process seal	Thermowell connection as female thread M24x1.5 **IL = U + E + Hd+GC** Length E = 56 mm (2.2 in) for M24x1.5 to terminal head Length E = 48 mm (1.89 in) for NPT ½" to terminal head
	Thermowell connection as cylindrical thread (M14; M18; G½") **IL = U + E + Hd + GC** Length E = 85 mm (3.35 in) for M24x1.5 to terminal head Length E = 76 mm (3 in) for NPT ½" to terminal head
	Thermowell connection as conical thread NPT ½" **IL = U + E + Hd** Length E = 147 mm (5.79 in) for application: Non-Ex, Ex ia, GP, IS Length E = 158 mm (6.22 in) for application: Ex d, XP

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)

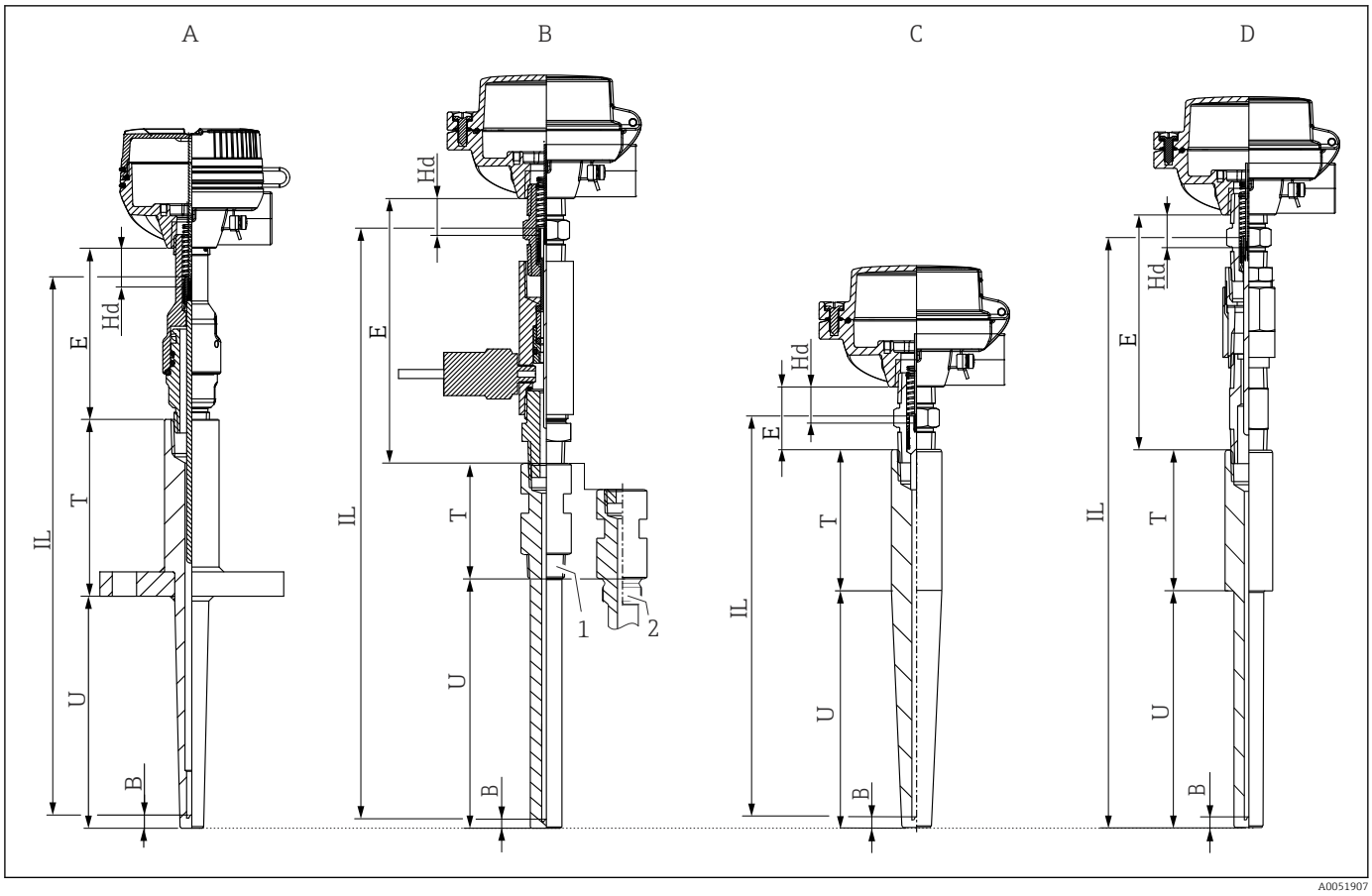
Hd for head thread M24x1.5 (TA30A, TA30D, TA30P, TA30R, TA20AB) = 11 mm (0.43 in) Hd for head thread NPT ½" (TA30EB) = 26 mm (1.02 in) Hd for head thread NPT ½" (TA30H) = 41 mm (1.61 in) GC seal compensation = 2 mm (0.08 in)	

Thermometer with thermowell according to ASME standard

The thermometer always has a thermowell.

The thermometer can be configured as follows [2)]

2) See also configuration feature 020/030: Thermowell/thermometer structure



- Option A: Based on ASME B40.9, with flange.
- Option B: Based on ASME B40.9, with thread.
- 1: NPT thread.
- 2: Metric thread.
- Option C: Based on ASME B40.9, for weld-in.
- Option D: Based on ASME B40.9, with socket weld.

Calculation of measuring insert length IL

		Non-Ex/Ex ia/GP/IS application	Ex d/XP application
Version A	**IL = U + T + E + Hd - B + SL** SL = spring pre-load = 6 mm (0.24 in) B = 6 mm (0.24 in)	Hd = −17 mm (−0.67 in) E = 101 mm (3.98 in)	Hd = 10 mm (0.39 in) E = 101 mm (3.98 in)
Version B	**IL = U + T + E + Hd - B + SL** SL = spring pre-load = 6 mm (0.24 in) B = 6 mm (0.24 in)	Hd = −17 mm (−0.67 in) E = 147 mm (5.79 in)	Hd = 10 mm (0.39 in) E = 158 mm (6.22 in)
Version C	**IL = U + T + E + Hd - B + SL** SL = spring pre-load = 6 mm (0.24 in) B = 6 mm (0.24 in)	Hd = −17 mm (−0.67 in) E = 35 mm (1.38 in)	Hd = 10 mm (0.39 in) E = 47 mm (1.85 in)
Version D	**IL = U + T + E + Hd - B + SL** SL = spring pre-load = 6 mm (0.24 in) B = 6 mm (0.24 in)	Hd = −17 mm (−0.67 in) E = 142 mm (5.6 in)	Hd = 10 mm (0.39 in) E = 154 mm (6.06 in)

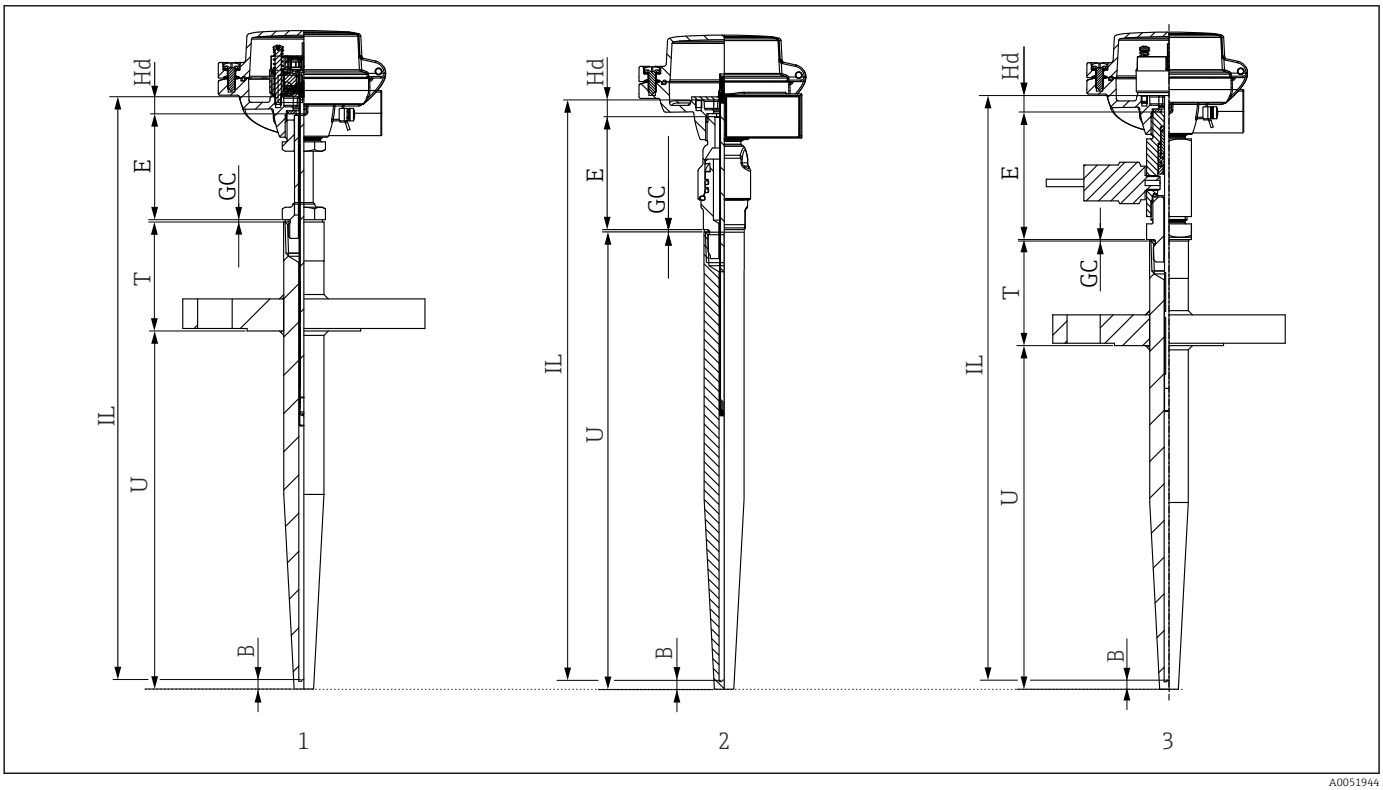
The length E specifications are nominal values and may vary due to the tolerances of the NPT threads.

Thermometer with thermowell according to DIN standard

The thermometer always has a thermowell.

Thermowell, based on DIN 43772, Form 4F describes a flange, Form 4 the weld-in form as a process connection.

The thermometer can be configured as follows [2)]



1 Version E: Version with flange and removable extension neck.
2 Version G: Weld-in version with iTHERM QuickNeck.
3 Version E: Version with flange and extension neck with second process seal.

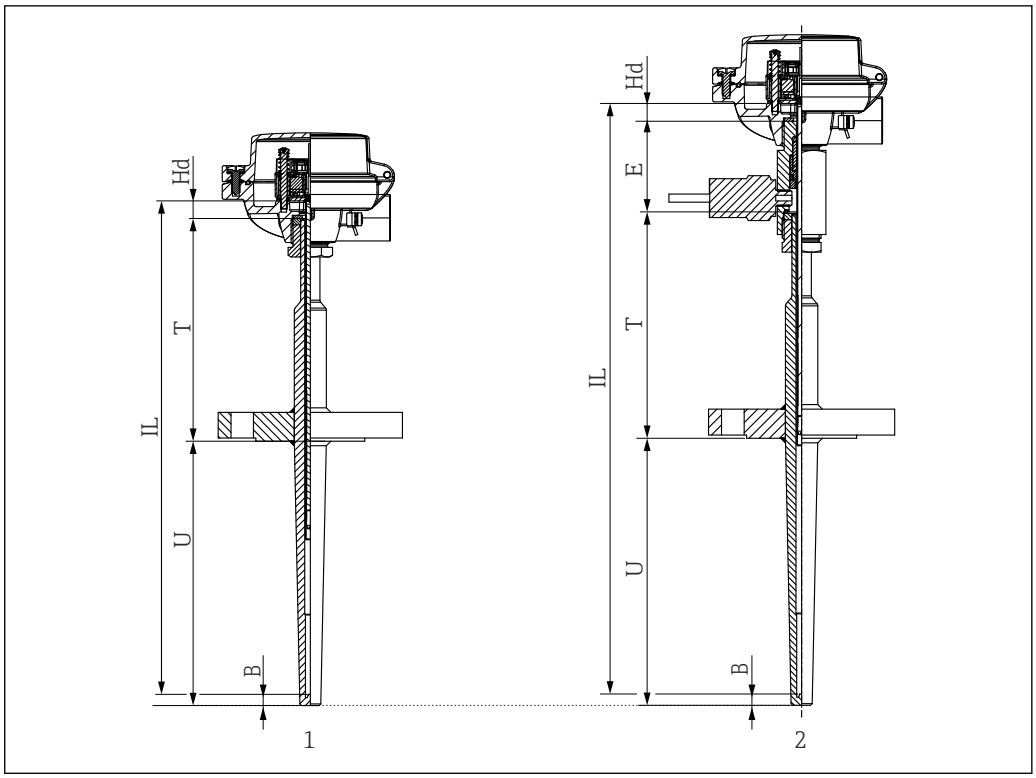
Calculation of measuring insert length IL

		Non-Ex/Ex ia/GP/IS application	Ex d/XP application
Version E with removable extension neck (feature 30: B, C, D)	**IL = U + T + E + Hd - B + GC + SL** SL = spring pre-load = 3 mm (0.12 in) B = 6 mm (0.24 in) GC = 2 mm (0.078 in)	Hd = 11 mm (0.43 in) E = variable	Hd = 26 mm (1.02 in) E = variable
Version G with iTHERM QuickNeck (feature 30: G)	**IL = U + T + E + Hd - B + GC + SL** SL = spring pre-load = 3 mm (0.12 in) B = 6 mm (0.24 in) GC = 2 mm (0.078 in)	Hd = 11 mm (0.43 in) E = 74 mm (2.91 in)	Hd = 26 mm (1.02 in) E = 68 mm (2.67 in)
Version E with extension neck with second process seal (feature 30: H)	**IL = U + T + E + Hd - B + GC + SL** SL = spring pre-load = 3 mm (0.12 in) B = 6 mm (0.24 in) GC = 2 mm (0.078 in)	Hd = 11 mm (0.43 in) E = 85 mm (3.35 in)	Hd = 26 mm (1.02 in) E = 76 mm (3 in)

Thermometer with thermowell according to NAMUR NE 170

The thermometer always has a thermowell.

The thermometer can be configured as follows [2)]



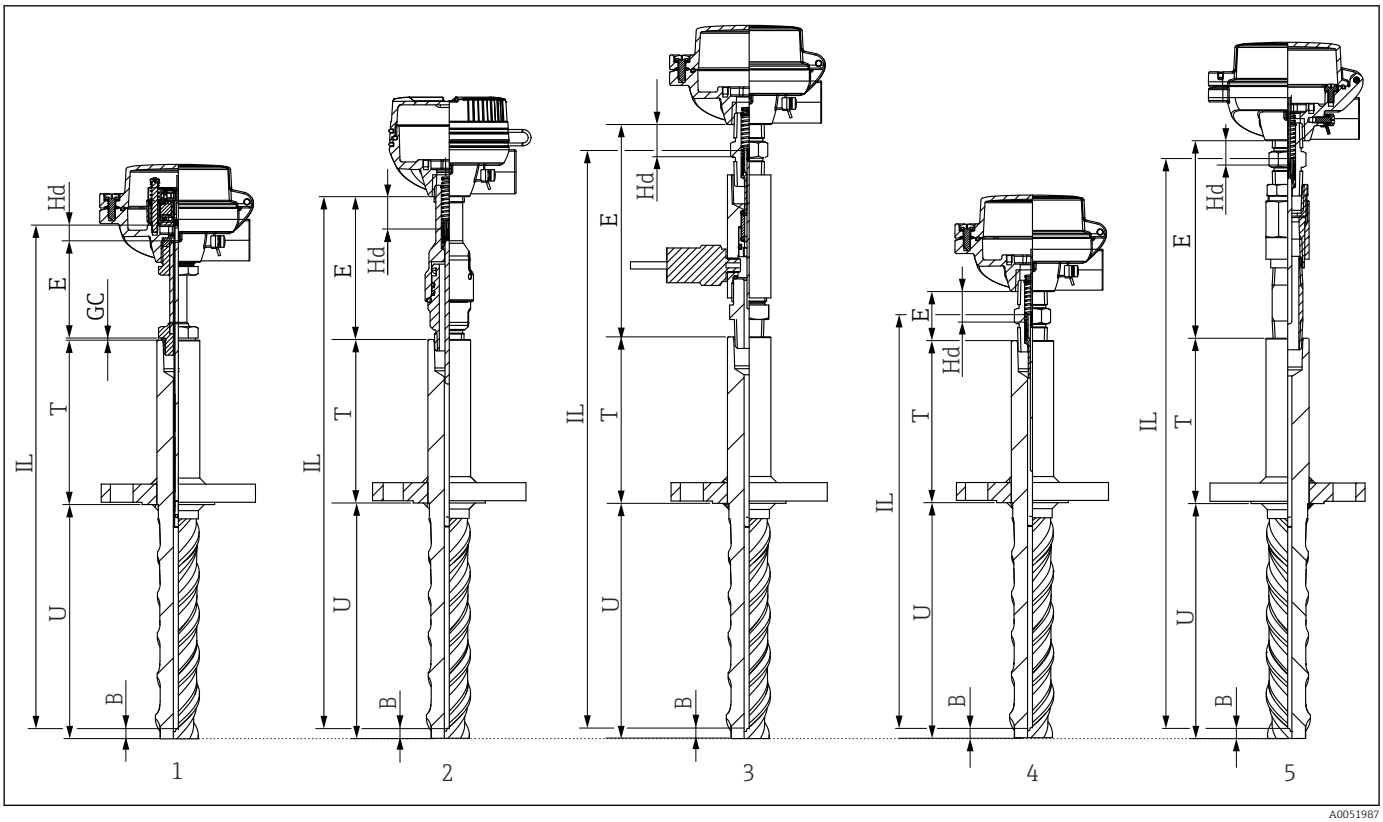
1 Version M without extension neck.
2 Version M, extension neck with second process seal.

Calculation of measuring insert length IL

		Non-Ex/Ex ia/GP/IS application	Ex d/XP application
Version M without extension neck (feature 30: A)	**IL = U + T + Hd - B + SL** Hd = 11 mm (0.43 in) B = 7 mm (0.28 in) SL = spring pre-load = 3 mm (0.12 in)	-	-
Version M, extension neck with second process seal (feature 30: H)	**IL = U + T + E + Hd - B + SL** B = 7 mm (0.28 in) SL = spring pre-load = 3 mm (0.12 in)	Hd = 11 mm (0.43 in) E = 56 mm (2.2 in)	Hd = 26 mm (1.02 in) E = 48 mm (1.9 in)

Thermometer with iTHERM TwistWell thermowell

The thermometer can be configured as follows: [2)]



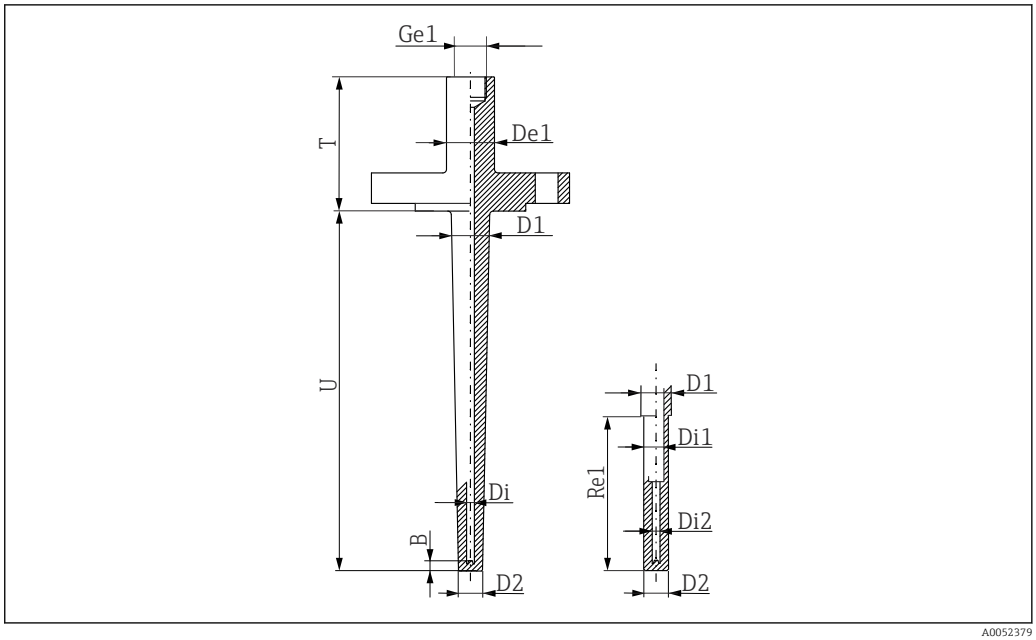
1 Version T; iTHERM TwistWell, with flange and removable extension neck according to DIN standard.
2 Version T; iTHERM TwistWell, with flange and iTHERM QuickNeck.
3 Version T; iTHERM TwistWell, with flange and extension neck with second process seal.
4 Version T; iTHERM TwistWell, with flange and nipple connection.
5 Version T; iTHERM TwistWell, with flange and nipple-union-nipple connection.

Calculation of measuring insert length IL

		Non-Ex/Ex ia/GP/IS application	Ex d/XP application
1: With flange and removable extension neck according to DIN standard	**IL = U + T + E + Hd - B + GC + SL** B = 6 mm (0.24 in) SL = spring pre-load = 3 mm (0.12 in) GC = 2 mm (0.078 in)	Hd = 11 mm (0.43 in) E = variable	Hd = 26 mm (1.02 in) E = variable
2: With flange and iTHERM QuickNeck	**IL = U + T + E + Hd - B + SL** B = 6 mm (0.24 in) SL = spring pre-load = 6 mm (0.24 in)	Hd = −17 mm (−0.67 in) E = 101 mm (3.98 in)	Hd = 10 mm (0.39 in) E = 101 mm (3.98 in)
3: With flange and extension neck with second process seal	**IL = U + T + E + Hd - B + SL** B = 6 mm (0.24 in) SL = spring pre-load = 6 mm (0.24 in)	Hd = 11 mm (0.43 in) E = 147 mm (5.79 in)	Hd = 26 mm (1.02 in) E = 158 mm (6.22 in)
4: With flange and nipple connection	**IL = U + T + E + Hd - B + SL** B = 6 mm (0.24 in) SL = spring pre-load = 6 mm (0.24 in)	Hd = −17 mm (−0.67 in) E = 35 mm (1.38 in)	Hd = 10 mm (0.39 in) E = 47 mm (1.85 in)
5: With flange and nipple-union-nipple connection		Hd = −17 mm (−0.67 in) E = 142 mm (5.6 in)	Hd = 10 mm (0.39 in) E = 158 mm (6.22 in)

The length E specifications are nominal values and may vary due to the tolerances of the NPT threads.

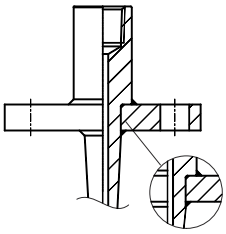
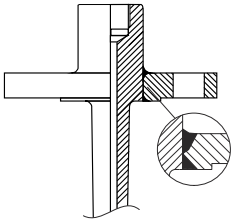
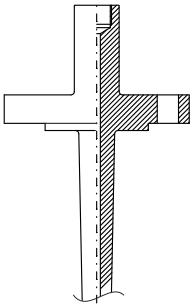
Forged thermowell



To avoid having to use welded flanged process connections, you can opt for a forged thermowell. This offers the highest level of fatigue resistance in accordance with ASME PTC 19.3 TW. Opting for a forged thermowell does away with the need for welding seam checks and prevents welding seam faults. It can be used in extreme process environments.

This applies to the following thermowell versions: Flanged, references acc. to ASME/Universal/DIN

Versions of flanged thermowells

Welded on both sides	With full penetration welding	Forged – not welded
 A0052792	 A0052794	 A0052702
▪ Suitable for most applications ▪ Meets requirements with an acceptable benefit-cost ratio	▪ Suitable for harsh application environments ▪ Stronger welded connection ▪ Higher costs	▪ Suitable for harsh application environments ▪ No welding ▪ Cheaper alternative to flange connection with full penetration welding

Weight

0.5 to 37 kg (1 to 82 lbs) for standard versions

Materials

The temperatures for continuous operation specified in the following table are intended as reference values for use of the various materials in air and without any significant mechanical load. The

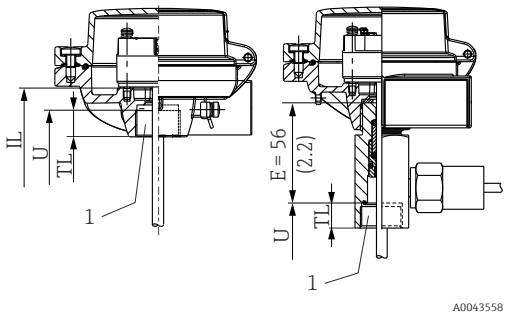
maximum operating temperatures can be reduced considerably in cases where abnormal conditions such as high mechanical load occur or in aggressive media.

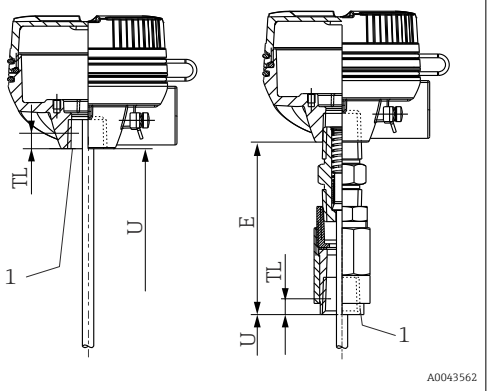
Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316L	X5CrNiMo 17-12-2	650 °C (1 202 °F) [1]	▪ Austenitic stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion resistance in chlorinated and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration)
AISI 316Ti/ 1.4571	X6CrNiMoTi17-12-2	700 °C (1 292 °F)	▪ Properties comparable with AISI 316L ▪ 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
Alloy 600/2.4816	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
Alloy C276/2.4819	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 347/1.4550	X6CrNiNb18-10	900 °C (1 652 °F)	▪ Austenitic stainless steel ▪ Better intercrystalline corrosion resistance in oxidizing environments ▪ Good welding properties ▪ For high-temperature applications like furnaces
AISI 310 / 1.4845	X15CrNi25-21	1 100 °C (2 012 °F)	▪ Austenitic stainless steel ▪ Generally good resistance to oxidizing and reducing atmospheres ▪ Due to the higher chromium content, good resistance to oxidizing aqueous solutions and neutral salts melting at higher temperatures ▪ Only low resistance to sulfur-containing gases
AISI A105/ 1.0460	C22.8	450 °C (842 °F)	▪ Heat-resistant steel ▪ Resistant in nitrogen-containing atmospheres and atmospheres that are low in oxygen; not suitable for acids or other aggressive media ▪ Often used in steam generators, water and steam pipes, pressured vessels
AISI A182 F11/1.7335	13CrMo4-5	550 °C (1 022 °F)	▪ Low alloy, heat-resistant steel with chromium and molybdenum additions ▪ Better corrosion resistance compared to non-alloy steels, not suitable for acids and other aggressive media ▪ Often used in steam generators, water and steam pipes, pressured vessels

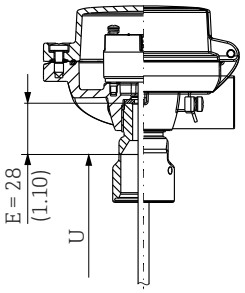
Material name	Short form	Recommended max. temperature for continuous use in air	Properties
Titanium/ 3.7035	-	600 °C (1 112 °F)	▪ A light metal with very high corrosion resistance and strength values ▪ Very good resistance to many oxidizing mineral and organic acids, saline solutions, sea water etc. ▪ Prone to fast embrittlement at high temperatures through the absorption of oxygen, nitrogen and hydrogen ▪ Compared to other metals, titanium reacts readily with many media (O_2, N_2, Cl_2, H_2) at higher temperatures and/or increased pressure ▪ Can only be used in chlorine gas and chlorinated media at comparatively low temperatures (<400 °C)
1.5415	16Mo3	530 °C (986 °F)	▪ Alloyed creep-resistant steel ▪ Particularly well suited as pipe material for boiler construction, super heater tube, superheated steam and collecting pipe, stove and line pipes, for heat exchangers and for the purposes of oil-refining industries
Duplex S32205	X2CrNi-MoN22-5-3	300 °C (572 °F)	▪ Austenitic ferritic steel with good mechanical properties ▪ High resistance to general corrosion, pitting, chlorine-induced or transgranular stress corrosion ▪ Comparatively good resistance to hydrogen-induced stress corrosion
1.7380	10CrMo9-10	580 °C (1076 °F)	▪ Alloyed, heat-resistant steel ▪ Particularly suitable for steam boilers, boiler parts, boiler drums, pressure vessels for apparatus constructions and similar purposes

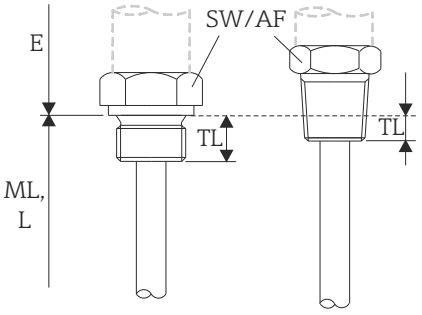
1) Can be used to a limited extent up to 800 °C (1472 °F) for low mechanical loads and in non-corrosive media. For further information, please contact the manufacturer's sales department.

Thermowell/thermometer connections

Connection thread Metric female thread	Type of fitting		Thread length TL	Width across flats	
 *1 Female thread*	M	M24x1.5	14 mm (0.55 in)	30 mm (1.18 in)	The metric female thread is not designed as a process connection. This connection is only available for thermometers without a thermowell.

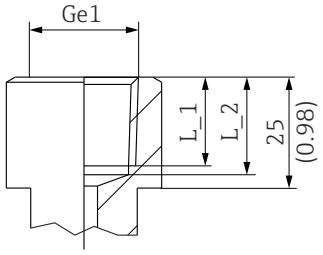
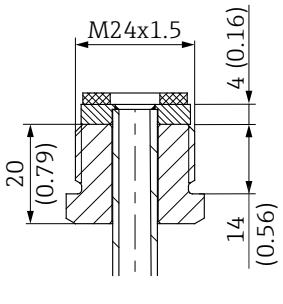
Connection thread Conical female thread	Type of fitting		Thread length TL	Width across flats	
 *1 Female thread*	NPT	NPT ½"	8 mm (0.32 in)	22 mm (0.87 in)	The conical female thread is not designed as a process connection. This connection is only available for thermometers without a thermowell.

iTHERM QuickNeck (upper half)	
	iTHERM QuickNeck (upper half) is used for connection to an existing thermowell with iTHERM QuickNeck (lower part).

Connection thread Male thread	Type of fitting		Thread length TL	Width across flats	Max. process pressure
 *17 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)	
	G [2]	G ½" DIN/BSP	15 mm (0.6 in)	27 mm (1.06 in)	
	NPT	NPT ½"	8 mm (0.32 in)	22 mm (0.87 in)	

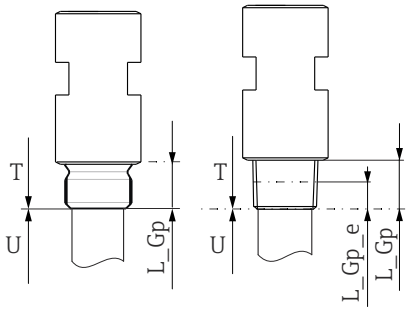
1) Maximum pressure specifications only for the thread. The failure of the thread is calculated, taking the static pressure into consideration. The calculation is based on a fully tightened thread (TL = thread length)
2) DIN ISO 228 BSPP

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.

Thermometer connection	Version Ge1		L_1	L_2	Standard/Class
 *18 Female thread*	M	M14x1.5	17 mm (0.67 in)	20 mm (0.79 in)	ASME B1.13M/ISO 965-1 H6
		M20x1.5			
		M18x1.5			
	G [1]	G ½" DIN/BSP			ISO 228-1 A
	NPT	NPT ½"			ANSI B1.20.1
 *19 Adjustable male thread*					

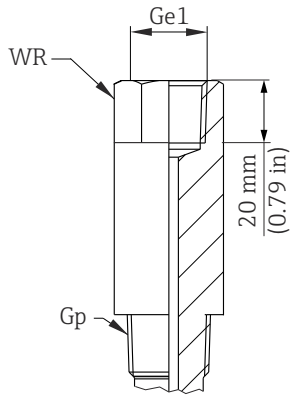
1) DIN ISO 228 BSPP

Process connections Thread

Threaded process connection	Type of fitting		Thread length L_Gp	Standard	Max. process pressure
 *20 Cylindrical (left side) and conical (right side) version*	M	M20x1.5	14 mm (0.55 in)	ASME B1.13M ISO 965-1 g6	Maximum static process pressure for threaded process connection: [1] 400 bar (5 802 psi) at +400 °C (+752 °F)
		M27x2	16 mm (0.63 in)		
		M33x2	18 mm (0.71 in)		
	G	G ½"	15 mm (0.6 in)	ISO 228-1 A	
	NPT	NPT ½"	20 mm (0.79 in) L_Gp_e: 8 mm (0.32 in)	ANSI B1.20.1	
		NPT ¾"	20 mm (0.79 in) L_Gp_e: 8 mm (0.32 in)		
		NPT 1"	25 mm (0.98 in) L_Gp_e: 10 mm (0.39 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

WR size matrix for threaded thermowells (with hexagonal lagging)



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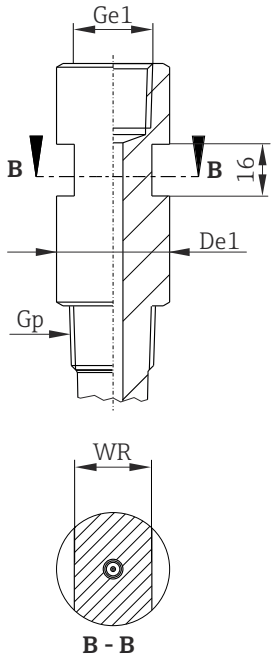
	Process connection size Gp (male thread)						
Wrench flats	M20x1.5	M27x2	M33x2	G ½"	NPT ½"	NPT ¾"	NPT 1"
	WR 27	WR 36	WR 41	WR 27	WR 24	WR 27	WR 36

WR size matrix for threaded thermowells with wrench flats

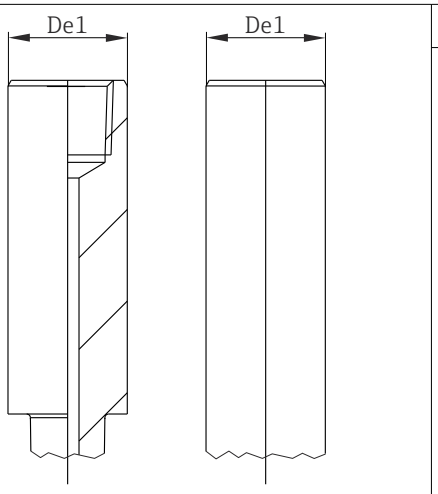


A0060280

	Process connection size Gp (male thread)						
Wrench flats	M20x1.5	M27x2	M33x2	G ½"	NPT ½"	NPT ¾"	NPT 1"
	WR 24	WR 27	WR 36	WR 24	WR 24	WR 24	WR 27

Weld-in, socket weld

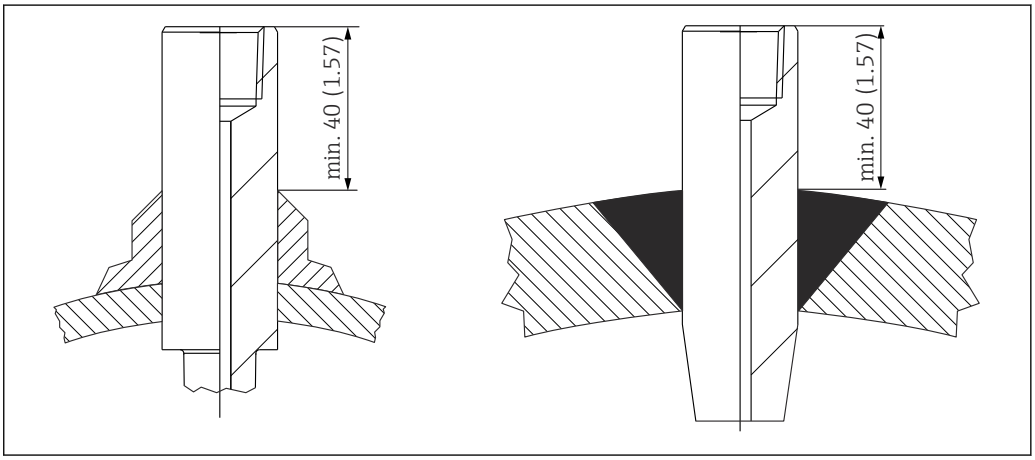
Weld-in version/socket weld



De1

- Φ 18 mm (0.71 in)
- Φ 24 mm (0.94 in)
- Φ 26 mm (1.02 in)
- Φ 26.7 mm (NPS ¾")
- Φ 33.4 mm (NPS 1")

Welding recommendation: The distance between the welding seam and the end of thermowell should be at least 40 mm (1.57 in). A dummy plug is recommended to prevent deformation of the thread.



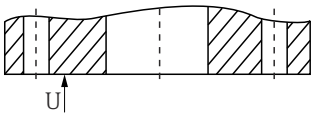
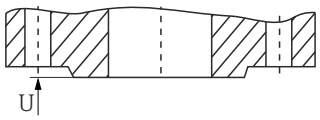
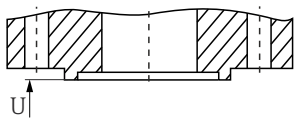
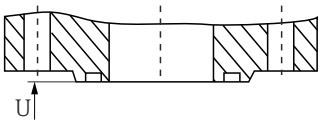
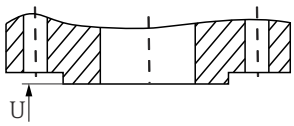
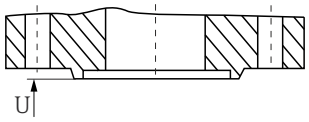
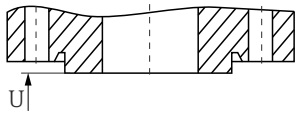
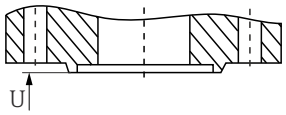
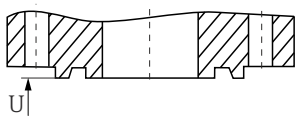
Flanges

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

- DIN flanges: German Standards Institute DIN 2527
- EN flanges: European standard DIN EN 1092-1:2002-06 and 2007
- ASME flanges: American Society of Mechanical Engineers ASME B16.5-2013
- JIS flanges: Japanese Industrial Standard B2220:2004
- HG/T flanges: Chinese Chemical Standard HG/T 20592-2009 and 20615-2009

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	 A0043514	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	 A0043516	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)	
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

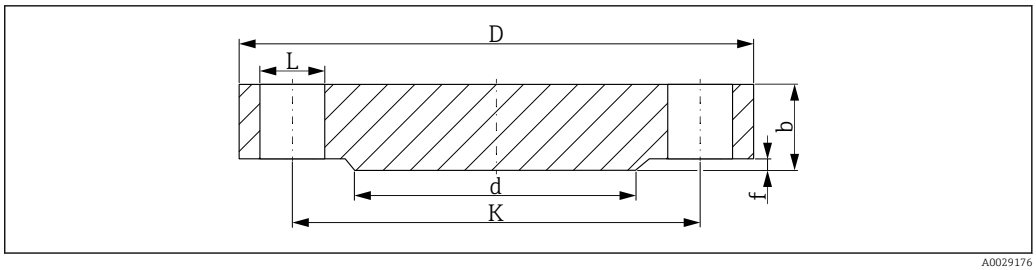
Flanges according to the old DIN standard are compatible with the new DIN EN 1092-1 standard.
Change in pressure ratings: Old DIN standards PN64 → DIN EN 1092-1 PN63.

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	-
	> DN 20 to DN 50	2 (0.08) 0	
	> DN 50	3 (0.12) 0	

1) Dimensions in mm (in)

EN flanges (DIN EN 1092-1)



21 Raised face B1

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 (generally 2 mm (0.08 in)

PN16 [1)]

DN	D	b	K	d	L	approx. kg (lbs)
25	115 (4.53)	18 (0.71)	85 (3.35)	68 (2.68)	4xØ14 (0.55)	1.50 (3.31)
32	140 (5.51)	18 (0.71)	100 (3.94)	78 (3.07)	4xØ18 (0.71)	2.00 (4.41)
40	150 (5.91)	18 (0.71)	110 (4.33)	88 (3.46)	4xØ18 (0.71)	2.50 (5.51)
50	165 (6.5)	18 (0.71)	125 (4.92)	102 (4.02)	4xØ18 (0.71)	2.90 (6.39)
65	185 (7.28)	18 (0.71)	145 (5.71)	122 (4.80)	8xØ18 (0.71)	3.50 (7.72)
80	200 (7.87)	20 (0.79)	160 (6.30)	138 (5.43)	8xØ18 (0.71)	4.50 (9.92)
100	220 (8.66)	20 (0.79)	180 (7.09)	158 (6.22)	8xØ18 (0.71)	5.50 (12.13)
125	250 (9.84)	22 (0.87)	210 (8.27)	188 (7.40)	8xØ18 (0.71)	8.00 (17.64)
150	285 (11.2)	22 (0.87)	240 (9.45)	212 (8.35)	8xØ22 (0.87)	10.5 (23.15)
200	340 (13.4)	24 (0.94)	295 (11.6)	268 (10.6)	12xØ22 (0.87)	16.5 (36.38)

DN	D	b	K	d	L	approx. kg (lbs)
250	405 (15.9)	26 (1.02)	355 (14.0)	320 (12.6)	12xØ26 (1.02)	25.0 (55.13)
300	460 (18.1)	28 (1.10)	410 (16.1)	378 (14.9)	12xØ26 (1.02)	35.0 (77.18)

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

PN25

DN	D	b	K	d	L	approx. kg (lbs)
25	115 (4.53)	18 (0.71)	85 (3.35)	68 (2.68)	4xØ14 (0.55)	1.50 (3.31)
32	140 (5.51)	18 (0.71)	100 (3.94)	78 (3.07)	4xØ18 (0.71)	2.00 (4.41)
40	150 (5.91)	18 (0.71)	110 (4.33)	88 (3.46)	4xØ18 (0.71)	2.50 (5.51)
50	165 (6.5)	20 (0.79)	125 (4.92)	102 (4.02)	4xØ18 (0.71)	3.00 (6.62)
65	185 (7.28)	22 (0.87)	145 (5.71)	122 (4.80)	8xØ18 (0.71)	4.50 (9.92)
80	200 (7.87)	24 (0.94)	160 (6.30)	138 (5.43)	8xØ18 (0.71)	5.50 (12.13)
100	235 (9.25)	24 (0.94)	190 (7.48)	162 (6.38)	8xØ22 (0.87)	7.50 (16.54)
125	270 (10.6)	26 (1.02)	220 (8.66)	188 (7.40)	8xØ26 (1.02)	11.0 (24.26)
150	300 (11.8)	28 (1.10)	250 (9.84)	218 (8.58)	8xØ26 (1.02)	14.5 (31.97)
200	360 (14.2)	30 (1.18)	310 (12.2)	278 (10.9)	12xØ26 (1.02)	22.5 (49.61)
250	425 (16.7)	32 (1.26)	370 (14.6)	335 (13.2)	12xØ30 (1.18)	33.5 (73.9)
300	485 (19.1)	34 (1.34)	430 (16.9)	395 (15.6)	16xØ30 (1.18)	46.5 (102.5)

PN40

DN	D	b	K	d	L	approx. kg (lbs)
15	95 (3.74)	16 (0.55)	65 (2.56)	45 (1.77)	4xØ14 (0.55)	0.81 (1.8)
25	115 (4.53)	18 (0.71)	85 (3.35)	68 (2.68)	4xØ14 (0.55)	1.50 (3.31)
32	140 (5.51)	18 (0.71)	100 (3.94)	78 (3.07)	4xØ18 (0.71)	2.00 (4.41)
40	150 (5.91)	18 (0.71)	110 (4.33)	88 (3.46)	4xØ18 (0.71)	2.50 (5.51)
50	165 (6.5)	20 (0.79)	125 (4.92)	102 (4.02)	4xØ18 (0.71)	3.00 (6.62)
65	185 (7.28)	22 (0.87)	145 (5.71)	122 (4.80)	8xØ18 (0.71)	4.50 (9.92)
80	200 (7.87)	24 (0.94)	160 (6.30)	138 (5.43)	8xØ18 (0.71)	5.50 (12.13)
100	235 (9.25)	24 (0.94)	190 (7.48)	162 (6.38)	8xØ22 (0.87)	7.50 (16.54)
125	270 (10.6)	26 (1.02)	220 (8.66)	188 (7.40)	8xØ26 (1.02)	11.0 (24.26)
150	300 (11.8)	28 (1.10)	250 (9.84)	218 (8.58)	8xØ26 (1.02)	14.5 (31.97)
200	375 (14.8)	36 (1.42)	320 (12.6)	285 (11.2)	12xØ30 (1.18)	29.0 (63.95)
250	450 (17.7)	38 (1.50)	385 (15.2)	345 (13.6)	12xØ33 (1.30)	44.5 (98.12)
300	515 (20.3)	42 (1.65)	450 (17.7)	410 (16.1)	16xØ33 (1.30)	64.0 (141.1)

PN63

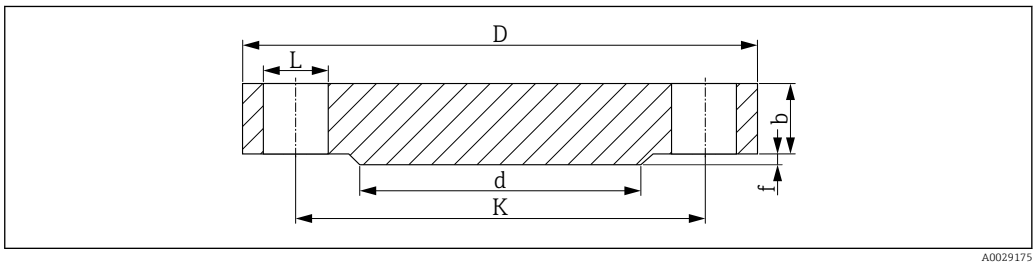
DN	D	b	K	d	L	approx. kg (lbs)
25	140 (5.51)	24 (0.94)	100 (3.94)	68 (2.68)	4xØ18 (0.71)	2.50 (5.51)
32	155 (6.10)	24 (0.94)	110 (4.33)	78 (3.07)	4xØ22 (0.87)	3.50 (7.72)
40	170 (6.69)	26 (1.02)	125 (4.92)	88 (3.46)	4xØ22 (0.87)	4.50 (9.92)
50	180 (7.09)	26 (1.02)	135 (5.31)	102 (4.02)	4xØ22 (0.87)	5.00 (11.03)
65	205 (8.07)	26 (1.02)	160 (6.30)	122 (4.80)	8xØ22 (0.87)	6.00 (13.23)

DN	D	b	K	d	L	approx. kg (lbs)
80	215 (8.46)	28 (1.10)	170 (6.69)	138 (5.43)	8xØ22 (0.87)	7.50 (16.54)
100	250 (9.84)	30 (1.18)	200 (7.87)	162 (6.38)	8xØ26 (1.02)	10.5 (23.15)
125	295 (11.6)	34 (1.34)	240 (9.45)	188 (7.40)	8xØ30 (1.18)	16.5 (36.38)
150	345 (13.6)	36 (1.42)	280 (11.0)	218 (8.58)	8xØ33 (1.30)	24.5 (54.02)
200	415 (16.3)	42 (1.65)	345 (13.6)	285 (11.2)	12xØ36 (1.42)	40.5 (89.3)
250	470 (18.5)	46 (1.81)	400 (15.7)	345 (13.6)	12xØ36 (1.42)	58.0 (127.9)
300	530 (20.9)	52 (2.05)	460 (18.1)	410 (16.1)	16xØ36 (1.42)	83.5 (184.1)

PN100

DN	D	b	K	d	L	approx. kg (lbs)
25	140 (5.51)	24 (0.94)	100 (3.94)	68 (2.68)	4xØ18 (0.71)	2.50 (5.51)
32	155 (6.10)	24 (0.94)	110 (4.33)	78 (3.07)	4xØ22 (0.87)	3.50 (7.72)
40	170 (6.69)	26 (1.02)	125 (4.92)	88 (3.46)	4xØ22 (0.87)	4.50 (9.92)
50	195 (7.68)	28 (1.10)	145 (5.71)	102 (4.02)	4xØ26 (1.02)	6.00 (13.23)
65	220 (8.66)	30 (1.18)	170 (6.69)	122 (4.80)	8xØ26 (1.02)	8.00 (17.64)
80	230 (9.06)	32 (1.26)	180 (7.09)	138 (5.43)	8xØ26 (1.02)	9.50 (20.95)
100	265 (10.4)	36 (1.42)	210 (8.27)	162 (6.38)	8xØ30 (1.18)	14.0 (30.87)
125	315 (12.4)	40 (1.57)	250 (9.84)	188 (7.40)	8xØ33 (1.30)	22.5 (49.61)
150	355 (14.0)	44 (1.73)	290 (11.4)	218 (8.58)	12xØ33 (1.30)	30.5 (67.25)
200	430 (16.9)	52 (2.05)	360 (14.2)	285 (11.2)	12xØ36 (1.42)	54.5 (120.2)
250	505 (19.9)	60 (2.36)	430 (16.9)	345 (13.6)	12xØ39 (1.54)	87.5 (192.9)
300	585 (23.0)	68 (2.68)	500 (19.7)	410 (16.1)	16xØ42 (1.65)	131.5 (289.9)

ASME flanges (ASME B16.5-2013)



22 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)

DN	D	b	K	d	L	approx. kg (lbs)
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)
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)

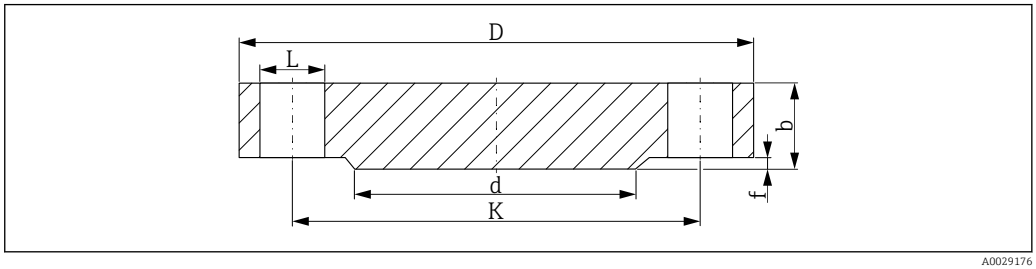
Class 900

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)
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)

HG/T flanges (HG/T 20592-2009)



23 Raised face

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 (generally 2 mm (0.08 in)

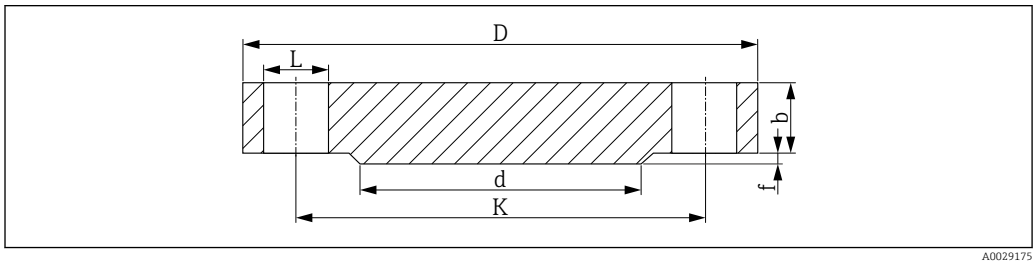
PN40

DN	D	b	K	d	L	approx. kg (lbs)
25	115 (4.53)	16 (0.63)	85 (3.35)	68 (2.68)	4xØ14 (0.55)	1.50 (3.31)
40	150 (5.91)	16 (0.63)	110 (4.33)	88 (3.46)	4xØ18 (0.71)	2.50 (5.51)
50	165 (6.5)	18 (0.71)	125 (4.92)	102 (4.02)	4xØ18 (0.71)	3.00 (6.62)

PN63

DN	D	b	K	d	L	approx. kg (lbs)
50	180 (7.09)	24 (0.95)	135 (5.31)	102 (4.02)	4xØ22 (0.87)	5.00 (11.03)

HG/T flanges (HG/T 20615-2009)



24 Raised face

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: 2 mm (0.08 in) or from Class 600: 7 mm (0.28 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"	110.0 (4.33)	12.7 (0.5)	79.4 (3.13)	50.8 (2.00)	4xØ16 (0.63)	0.86 (1.9)
1½"	125.0 (4.92)	15.9 (0.63)	98.4 (3.87)	73.0 (2.87)	4xØ16 (0.63)	1.53 (3.37)
2"	150 (5.91)	17.5 (0.69)	120.7 (4.75)	92.1 (3.63)	4xØ18 (0.71)	2.42 (5.34)

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

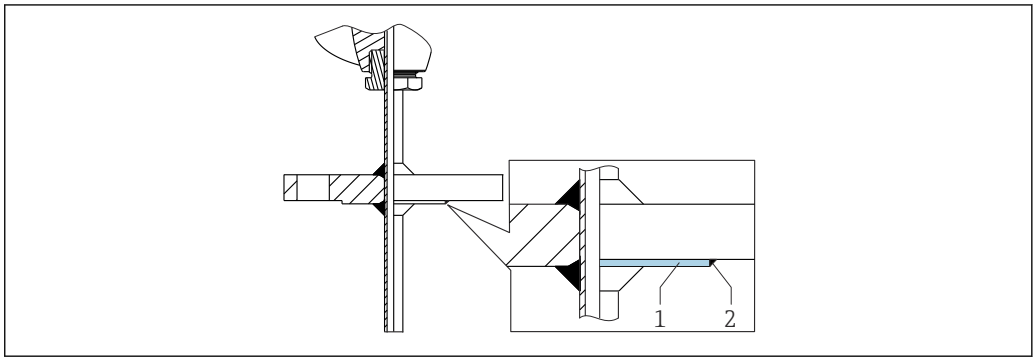
Class 300

DN	D	b	K	d	L	approx. kg (lbs)
1"	125.0 (4.92)	15.9 (0.63)	88.9 (3.50)	50.8 (2.00)	4xØ18 (0.71)	1.39 (3.06)
1½"	155 (6.10)	19.1 (0.75)	114.3 (4.50)	73 (2.87)	4xØ22 (0.87)	2.66 (5.87)
2"	165 (6.50)	20.7 (0.82)	127.0 (5.00)	92.1 (3.63)	8xØ18 (0.71)	3.18 (7.01)

Class 600

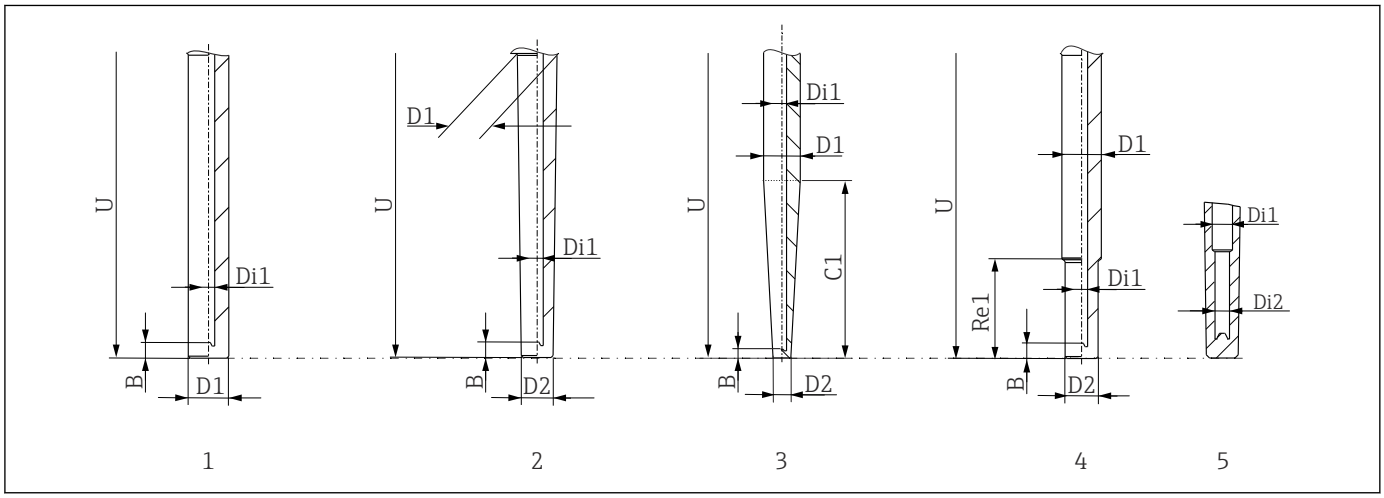
DN	D	b	K	d	L	approx. kg (lbs)
2"	165 (6.50)	25.4 (1.00)	127.0 (5.00)	92.1 (3.63)	8xØ18 (0.71)	4.15 (9.15)

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

Geometry of parts in contact with medium



1 Straight (complete length U)
2 Tapered (complete length U)
3 Tapered (over length C1)
4 Stepped, Re1 = 63.5 mm (2.5 in)
5 Stepped bore diameter (Di1/Di2)

Measuring inserts

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

RTD sensor type [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 measuring insert tip	≤ 3 g	≤ 4 g	Increased vibration resistance 60 g	▪ ø3 mm (0.12 in) ≤ 3 g ▪ ø6 mm (0.24 in) ≤ 60 g	≤ 3 g
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)

TC sensor type [1]	**Type K**	**Type J**	**Type N**
Sensor design	Mineral-insulated, with Alloy600 sheathed cable	Mineral-insulated, with stainless steel sheathed cable	
Vibration resistance of the measuring insert tip	≤ 3 g		
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	Measuring 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 iTHERM TS111 and TS211 measuring inserts used with enhanced vibration resistance and fast-response sensor, see the technical information (TI01014T and TI01411T).

Spare parts for the product 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.

iTHERM QuickSleeve

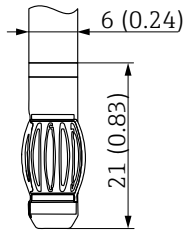
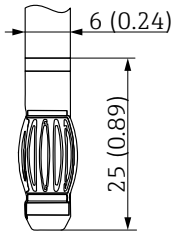
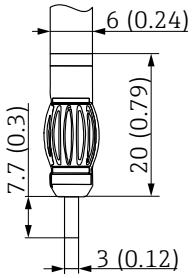
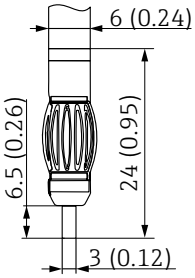
Reducing the air gap between the thermowell and the measuring insert has the greatest impact on improving the response time of the thermometer. Optimizing the bore in the barstock thermowell is the best solution, e.g. a bore diameter of 6.1 mm (0.24 in) when using a 6 mm (0.24 in) measuring insert.

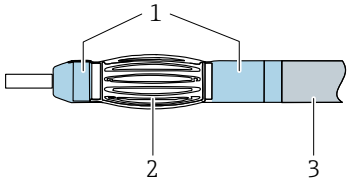
If it is not possible to adapt the bore accordingly, e.g. when using existing thermowells or specifications for using standard bores, the iTHERM QuickSleeve from Endress+Hauser can be used.

iTHERM QuickSleeve is a mechanical spring component at the tip of a measuring insert. This spring component improves heat transfer and shortens the response time from a barstock thermowell to the measuring insert and ultimately to the sensor.

iTHERM QuickSleeve is available in two designs for use in barstock thermowells:
- For bore diameter 6.5 mm (0.256 in)
- For bore diameter 7 mm (0.28 in)

Mechanical construction

Type of fitting	Bore diameter 6.5 mm (0.256 in)	Bore diameter 7 mm (0.28 in)
Pt100 iTHERM QuickSens, 3 mm (0.12 in)		
Pt100, WW and TF, 3 mm (0.12 in)		



Materials
- Bushing (1) and reinforcing tube (3): Stainless steel
- Spring (2): Copper-plated

Surface roughness

Specifications for surfaces in contact with medium

Standard surface	$R_a \leq 1.6$ µm (63 µin)
Finely honed surface, buffed	$R_a \leq 0.76$ µm (30 µin)

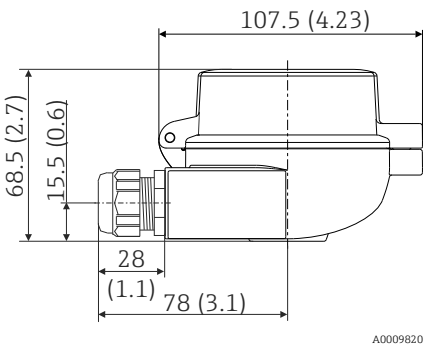
Terminal heads

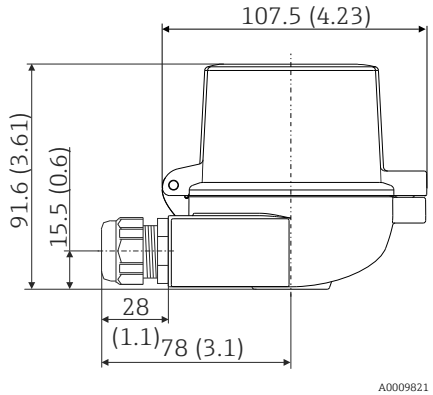
All terminal heads have an internal geometry in accordance with DIN EN 50446 Form B and a thermometer connection with an M24x1.5 or NPT ½" thread. All dimensions in mm (in). The example cable glands in the diagrams correspond to M20x1.5 connections with non-Ex polyamide cable glands. Specifications without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

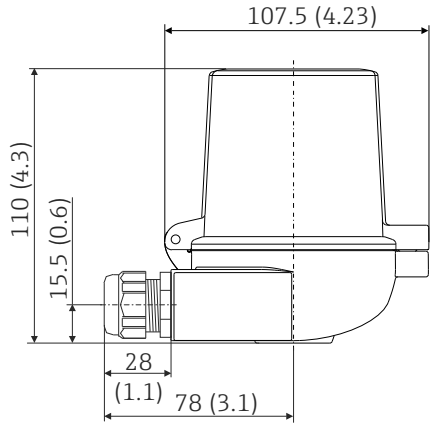
As a special feature, Endress+Hauser offers terminal heads with optimum access to the terminals for easy installation and maintenance.

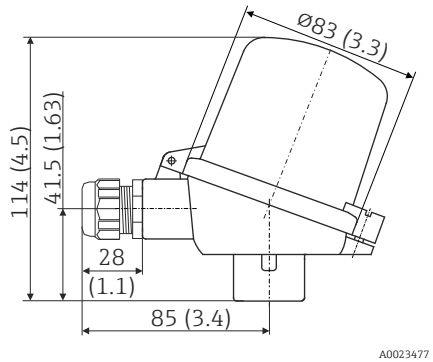
IP 68 = 1.83 m (6 ft), 24 h, with cable gland without cable (with plug), type 6P as per NEMA 250-2003

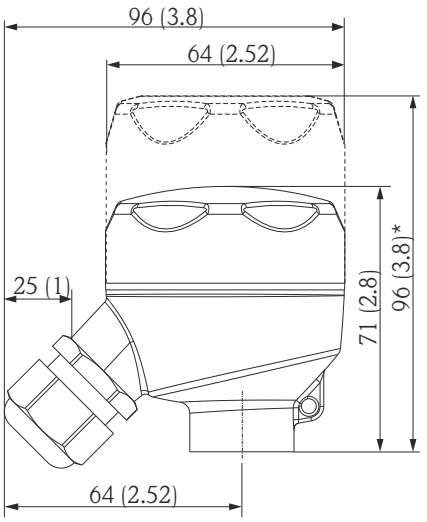
TA30A	Specification

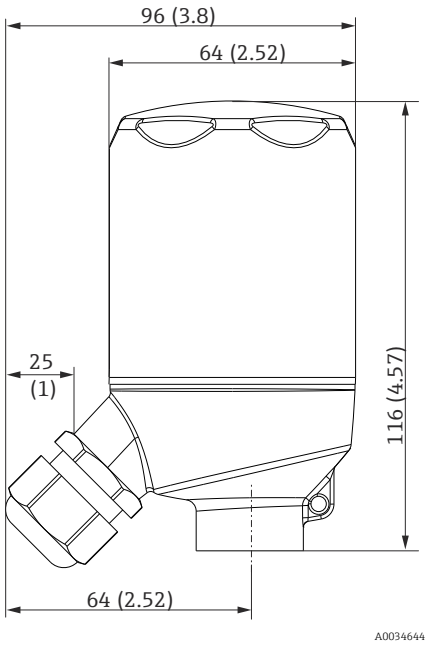
	• Protection degree:
	  ▪ IP66/68 (NEMA Type 4x encl.)
	  ▪ For ATEX: IP66/67
	• Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland
	• Material: aluminum, polyester powder coated
	Seals: silicone
	• Threaded cable entry: G ½", NPT ½" and M20x1.5;
	• Head color: blue, RAL 5012
	• Cap color: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

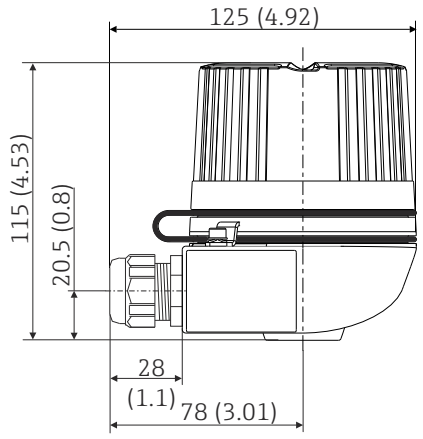
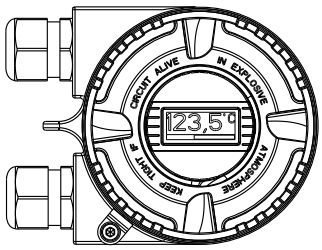
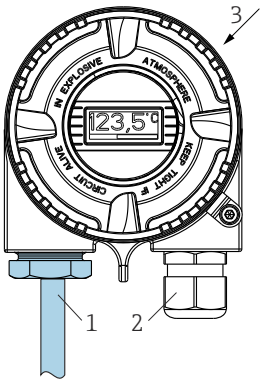
TA30A with display window in cover	Specification
	▪ Protection degree: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", NPT ½" and M20x1.5 ▪ 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

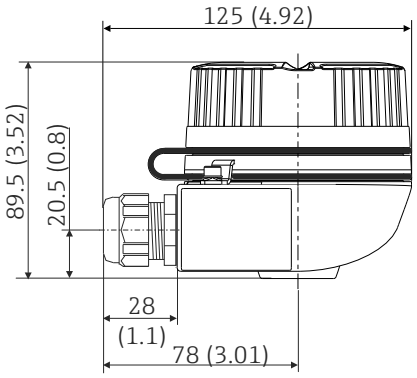
TA30D	Specification
	▪ Protection degree: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", NPT ½" and M20x1.5 ▪ Two head transmitters can be 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

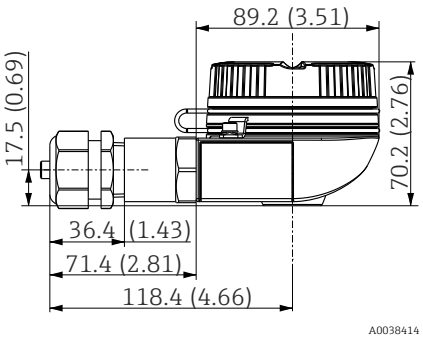
TA30P	Specification
	▪ Degree of protection: IP65 ▪ Max. temperature: −40 to +120 °C (−40 to +248 °F) ▪ Material: polyamide (PA12), antistatic Seals: silicone ▪ Threaded cable entry: M20x1.5 ▪ Two head transmitters can be mounted. In the standard version, one transmitter is mounted in the terminal head 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

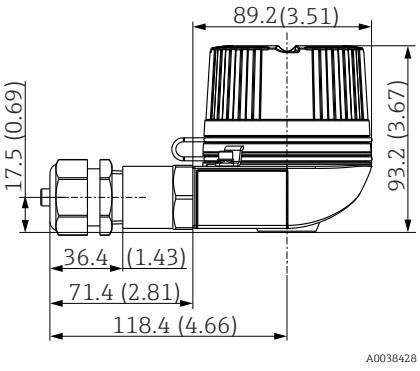
TA30R (optionally with display window in cover)	Specification
 * Dimensions of version with display window in cover	▪ Degree of protection - standard version: IP69K (NEMA Type 4x encl.) Degree of protection - version with display window: IP66/68 (NEMA Type 4x encl.) ▪ Temperature: −50 to +130 °C (−58 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

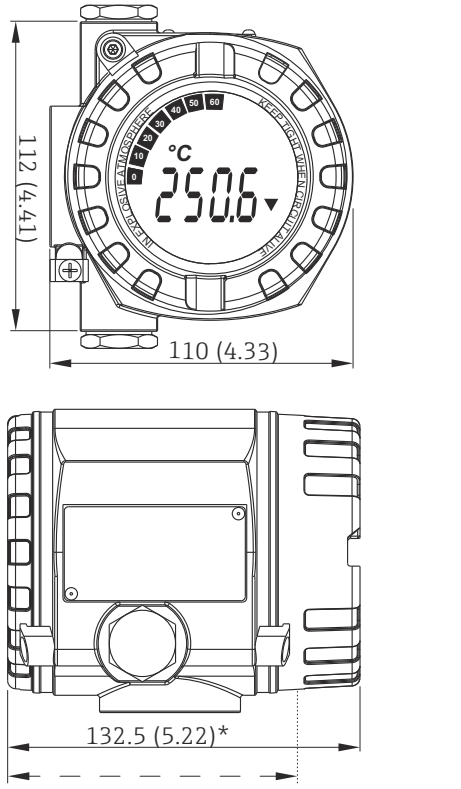
TA30R (high version for two transmitters)	Specification
	▪ Degree of protection: IP69K (NEMA Type 4x encl.) ▪ Temperature: −50 to +130 °C (−58 to +266 °F) without cable gland ▪ Material: stainless steel 316L, abrasive-blasted or polished Seals: EPDM ▪ Cable entry thread NPT ½" and M20x1.5 ▪ Weight: 460 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

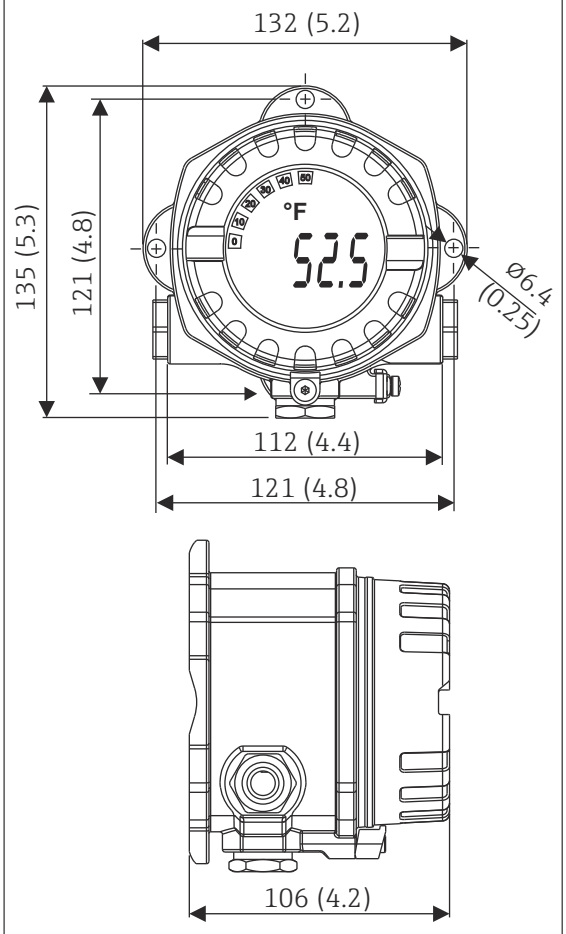
TA30H with display window in cover	Specification
  A0009831  A0044217 *25 Terminal head used as field housing with display frontal mounted* *1 One cable input serves as a sensor input channel with a measuring insert* *2 Cable entry used for wiring* *3 The bottom entry into the housing is not available 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
 * 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

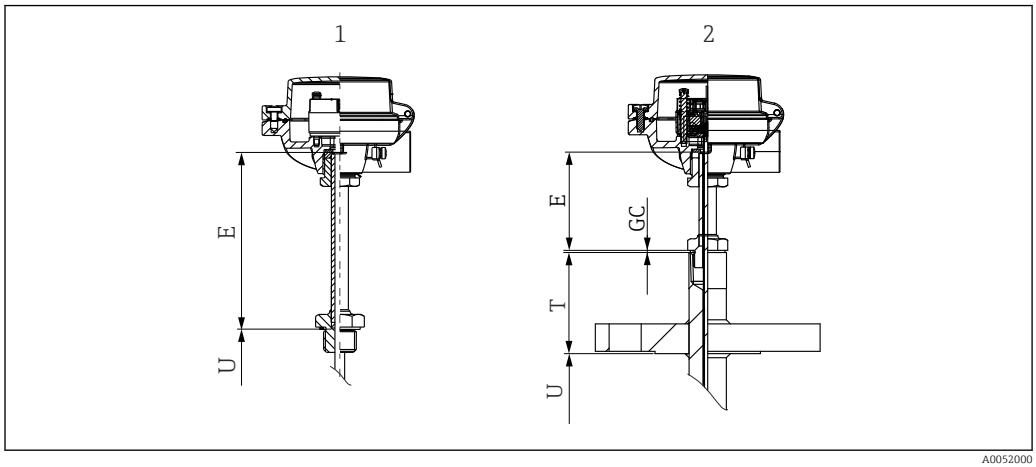
Cable glands are not available for encapsulated, flameproof thermometers.

Extension neck

The extension neck is the component between the thermowell and the terminal head. The term E is used to describe the length of the removable extension neck.

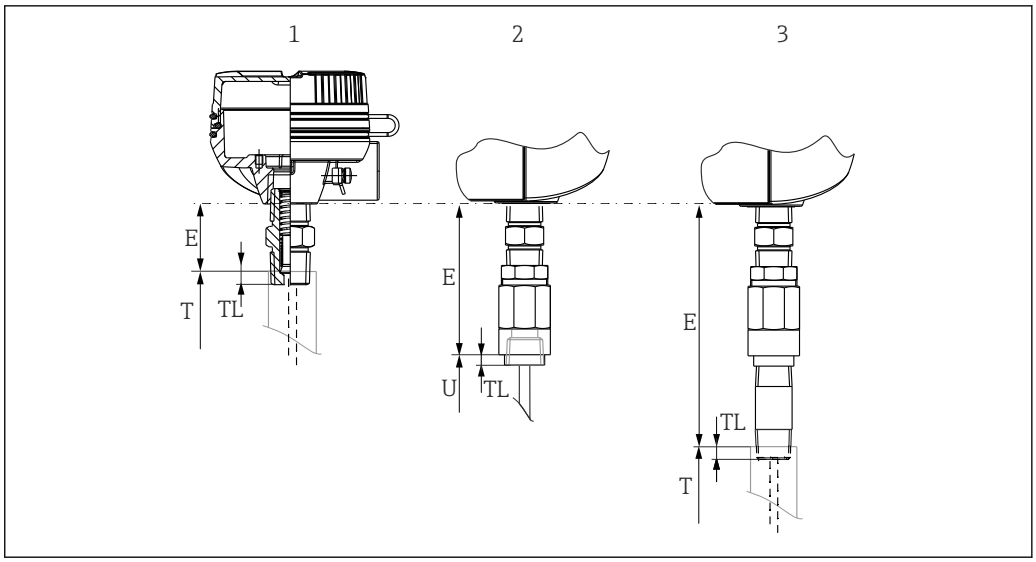
Different versions of the removable extension neck are possible.

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 connection is designed according to the "Predefined versions" section. 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)*



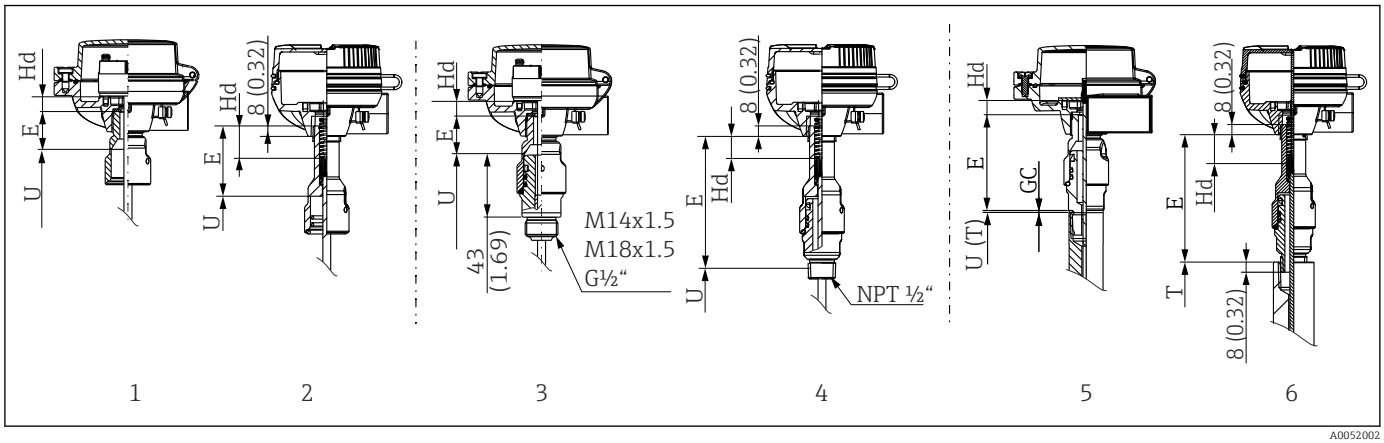
1 Removable extension neck – thermometer without thermowell, measuring insert TS111
2 Removable extension neck – thermometer with thermowell, measuring insert TS111

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 measuring 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 measuring 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 measuring 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.



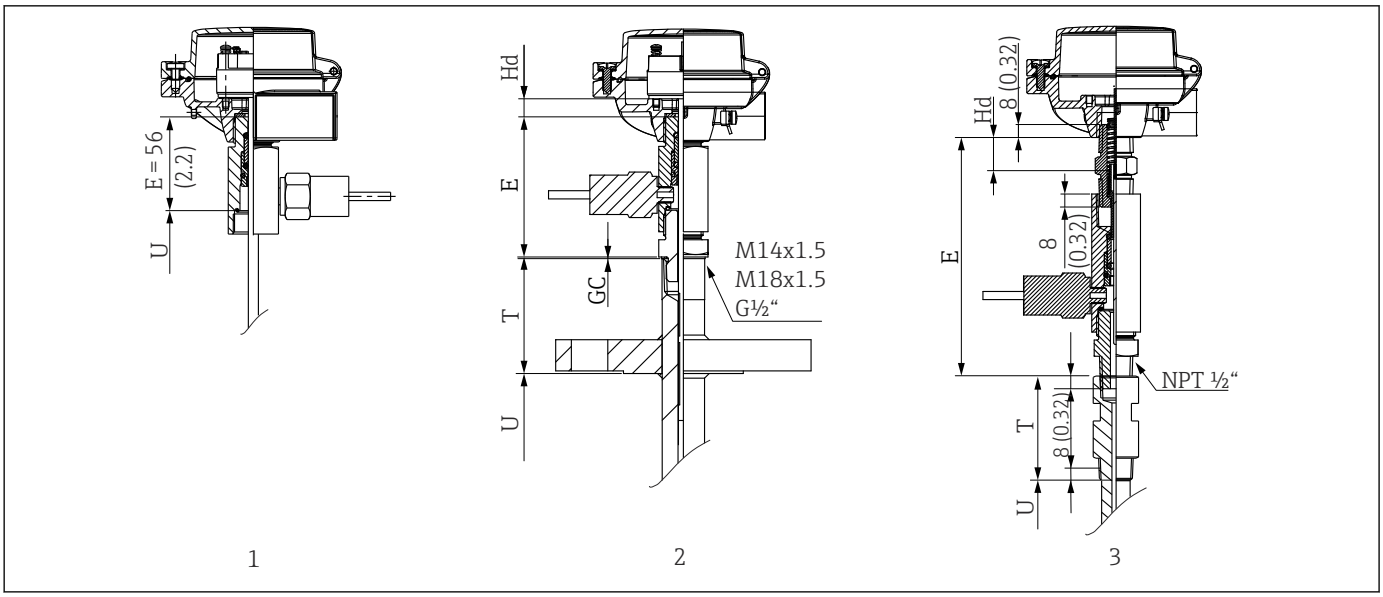
1 Extension neck type N NPT ½"
2 Extension neck type NU NPT ½" female thread
3 Extension neck type NUN NPT ½", the length of the lower nipple can be configured

Removable extension neck as QuickNeck
If the thermometer does not have a thermowell, select the QuickNeck (upper half) or QuickNeck option *(feature 30: Thermometer structure)*. The length of the removable extension neck is predetermined by the chosen design here.



1 iTHERM QuickNeck – upper half – for installation in an existing thermowell with iTHERM QuickNeck according to DIN standard
2 iTHERM QuickNeck – upper half – for installation in an existing thermowell with iTHERM QuickNeck according to ASME standard
3 iTHERM QuickNeck complete, for installation in an existing thermowell according to DIN standard
4 iTHERM QuickNeck complete, for installation in an existing thermowell according to ASME standard
5 iTHERM QuickNeck installed in thermowell according to DIN standard
6 iTHERM QuickNeck installed in thermowell according to ASME standard

Removable extension neck as "second process seal"
The removable extension neck can be designed as a second process seal. The length of the removable extension neck is predetermined by the chosen design here.

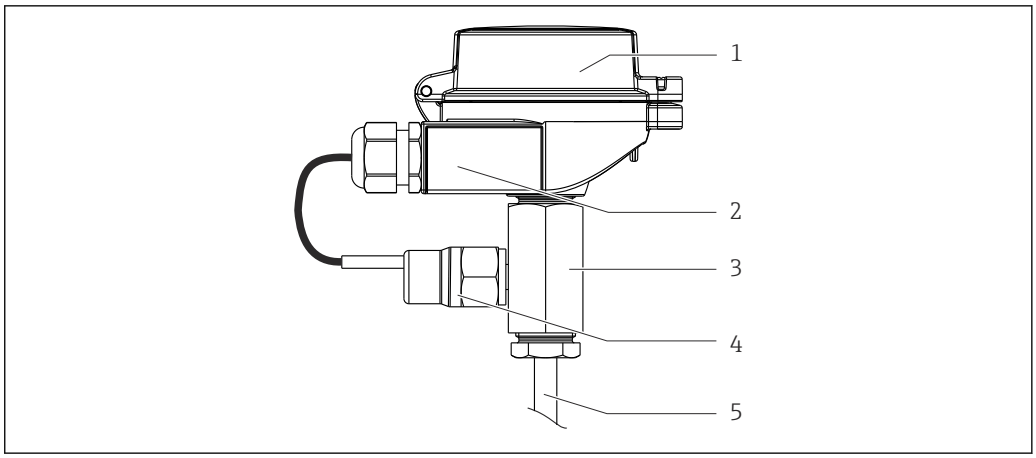


1 Extension neck with second process seal without a thermowell
2 Extension neck with second process seal with a thermowell according to DIN standard
3 Extension neck with second process seal with a thermowell according to ASME standard

Extension neck with second process seal

A special version of the extension neck is available in the form of 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 iTEMP 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.
- 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 the second process seal and transmits the failure information via PROFINET® protocol if the pressure switch is activated.



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 extension neck length 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.

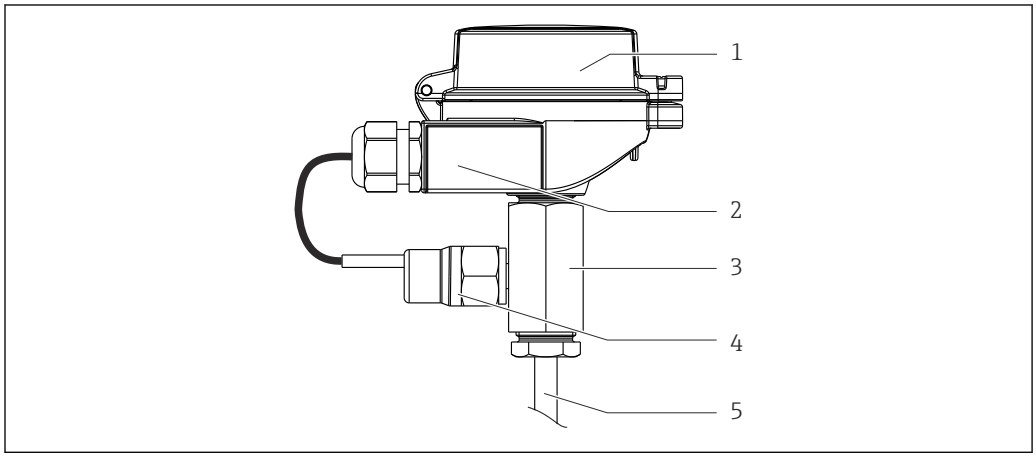
The primary thermowell, whose material can be selected from various stainless steels or nickel-based materials, represents the first process seal. The resistance of the thermowell material to the process conditions must be guaranteed. The extension neck represents the second process seal. The process 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

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 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.
- 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.

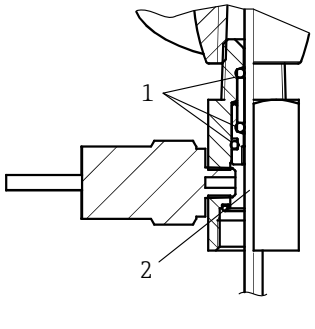


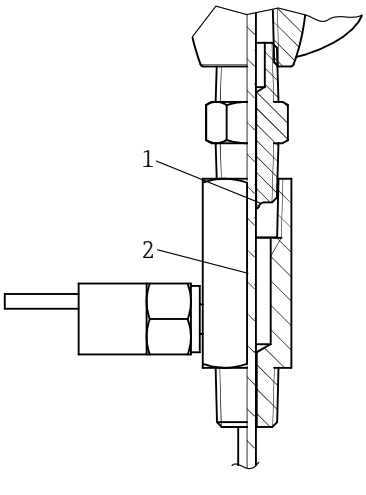
27 Extension neck with Dual Seal

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 measuring insert	
 *1 Gaskets* *2 Replaceable measuring insert*	This version enables replacement of the measuring insert. When installed, the measuring insert is spring-loaded, ensuring constant contact with the bottom of the thermowell for an 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

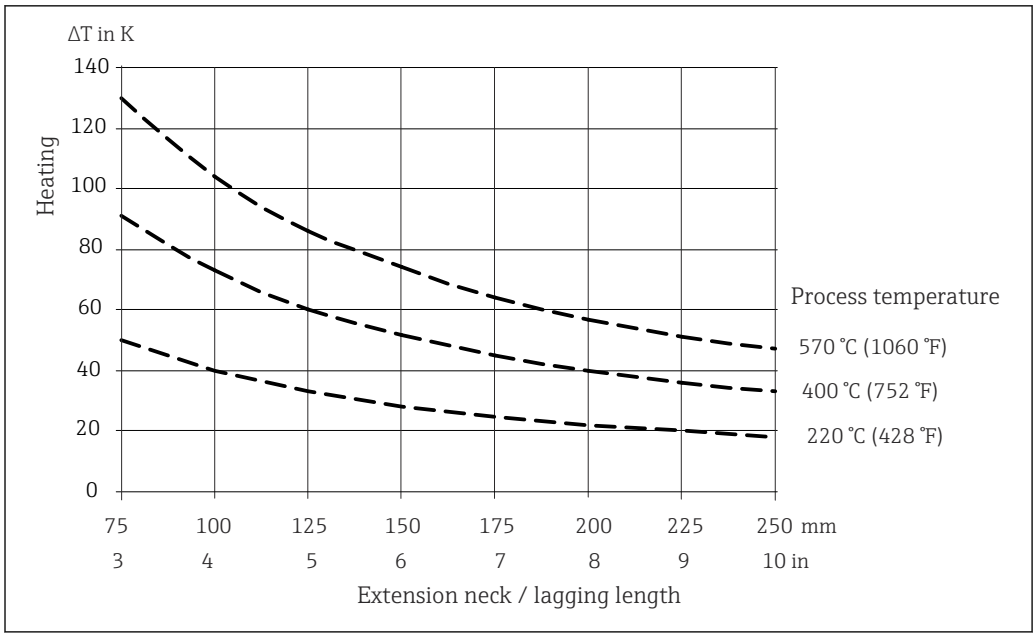
Dual Seal with metal seal and fixed measuring insert	
 *1 Metal seal* *2 Fixed measuring insert*	In this design, the measuring insert is welded to the thermometer, forming a metal seal. No additional seals are used, and the system does not have any moving parts.

Pressure switch

The switch point of the pressure switch can be selected from two predefined 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.

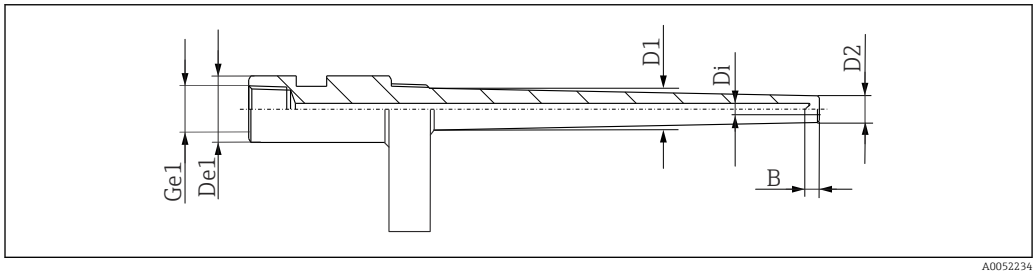
Example: At a process temperature of 220 °C (428 °F) and with a total lagging and extension neck length (T + E) of 100 mm (3.94 in), the heat conduction is 40 K (72 °F). The determined transmitter temperature is less than 85 °C(maximum ambient temperature for iTEMP temperature transmitter).

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

Predefined versions

Predefined standard geometries apply if no other options for special geometries are selected in the optional configuration section.

Thermometer with thermowell according to ASME standard



The predefined geometries are the result of combining the thermowell standard, the process connection and the geometry of the wetted parts:

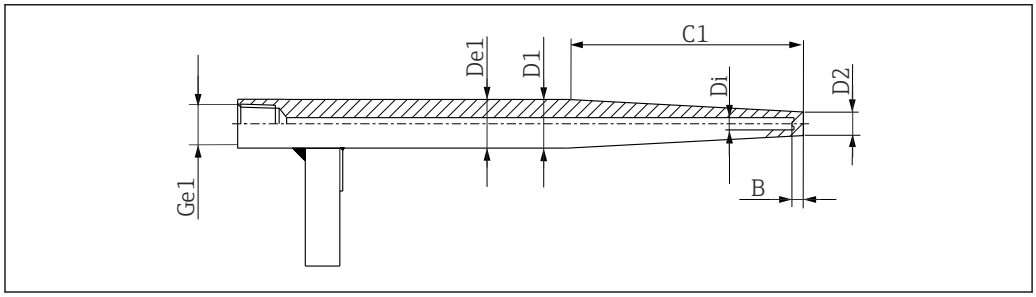
Thermowell standard	Process connection	Geometry of wetted parts	Root Ø D1	Tip Ø D2	Bore Ø Di	Bottom thickness B	Flange face	Thermometer connection Ge1	Lagging Ø De1
Metric ASME with flange	Flange 1"/ DN25	Straight	19 mm (0.75 in)	19 mm (0.75 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	RF	NPT ½"	32 mm (1.26 in)
		Tapered	22.2 mm (0.87 in)	15 mm (0.6 in)					
		Stepped	19 mm (0.75 in)	12.7 mm (0.5 in)					

Thermowell standard	Process connection	Geometry of wetted parts	Root Ø D1	Tip Ø D2	Bore Ø Di	Bottom thickness B	Flange face	Thermometer connection Ge1	Lagging Ø De1
	Flange 1½"/ DN40	Straight	19 mm (0.75 in)	19 mm (0.75 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	RF [1]	NPT ½"	32 mm (1.26 in)
		Tapered	27 mm (1.06 in)	17 mm (0.67 in)					
		Stepped	19 mm (0.75 in)	12.7 mm (0.5 in)					
	Flange 2"/ DN50	Straight	19 mm (0.75 in)	19 mm (0.75 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	RF [1]	NPT ½"	32 mm (1.26 in)
		Tapered	27 mm (1.06 in)	17 mm (0.67 in)					
		Stepped	19 mm (0.75 in)	12.7 mm (0.5 in)					
Metric ASME with thread	NPT ½", G ½", M20 male thread	Straight	16 mm (0.63 in)	16 mm (0.63 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	-	NPT ½"	30 mm (1.18 in) [2]
		Tapered		15 mm (0.6 in)					
		Stepped		12.7 mm (0.5 in)					
	NPT ¾" male thread	Straight	19 mm (0.75 in)	19 mm (0.75 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	-	NPT ½"	30 mm (1.18 in) [2]
		Tapered	19.5 mm (0.77 in)	15 mm (0.6 in)					
		Stepped	19 mm (0.75 in)	12.7 mm (0.5 in)					
	NPT 1" male thread	Straight	22.2 mm (0.87 in)	22.2 mm (0.87 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	-	NPT ½"	35 mm (1.38 in)
		Tapered	27 mm (1.06 in)	17 mm (0.67 in)					
		Stepped	22.2 mm (0.87 in)	12.7 mm (0.5 in)					
	M27x2	Straight	19 mm (0.75 in)	19 mm (0.75 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	-	NPT ½"	35 mm (1.38 in)
		Tapered	19.5 mm (0.77 in)	15 mm (0.6 in)					
		Stepped	19 mm (0.75 in)	12.7 mm (0.5 in)					
	M33x2	Straight	22.2 mm (0.87 in)	22.2 mm (0.87 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	-	NPT ½"	40 mm (1.57 in) [3]
		Tapered	27 mm (1.06 in)	17 mm (0.67 in)					
		Stepped	22.2 mm (0.87 in)	12.7 mm (0.5 in)					
Metric ASME for weld-in	NPS ¾" , 26.7 mm	Tapered	26.7 mm (1.05 in)	17 mm (0.67 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	-	NPT ½"	26.7 mm
	NPS 1" , 33.4 mm	Tapered	33.4 mm (1.31 in)	20 mm (0.79 in)					33.4 mm
Metric ASME with socket weld	NPS ¾", 26.7 mm	Straight	19 mm (0.75 in)	19 mm (0.75 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	-	NPT ½"	26.7 mm
		Tapered	22.2 mm (0.87 in)	15 mm (0.6 in)					

Thermowell standard	Process connection	Geometry of wetted parts	Root Ø D1	Tip Ø D2	Bore Ø Di	Bottom thickness B	Flange face	Thermometer connection Ge1	Lagging Ø De1
		Stepped	19 mm (0.75 in)	12.7 mm (0.5 in)					
	NPS 1", 33.4 mm	Straight	25.4 mm (1.0 in)	25.4 mm (1.0 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	-	NPT ½"	33.4 mm
		Tapered	25.4 mm (1.0 in)	15 mm (0.6 in)					
		Stepped	22.2 mm (0.87 in)	12.7 mm (0.5 in)					

1) For flanges with a pressure rating of 2500, RTJ is the flange face.
2) 27 mm (1.06 in) for material: Carbon steel and CrMo steel/Mo steel
3) 50 mm (1.97 in) for material: Carbon steel and alloy

Thermometer with thermowell according to DIN standard



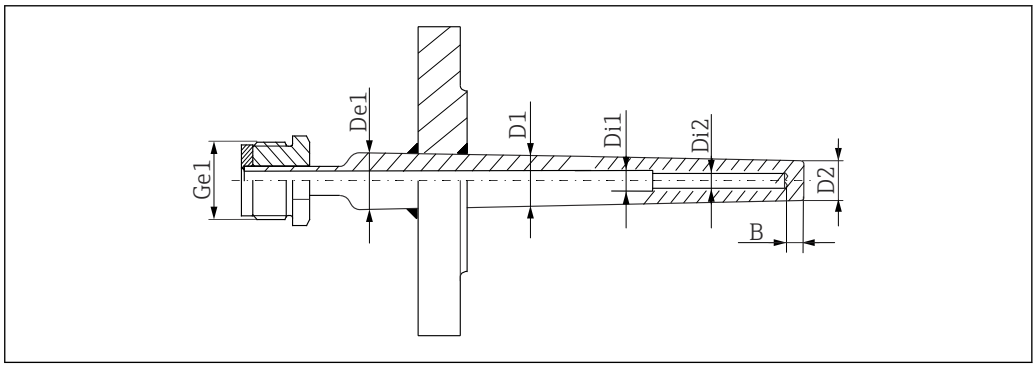
The predefined geometries result from the thermowell standard and the selected extension neck including thermometer connection:

Thermowell standard	Extension neck	Geometry of wetted parts	Root Ø D1	Tip Ø D2	Bore Ø Di	Bottom thickness B	Flange face	Thermometer connection Ge1	Lagging Ø De1
DIN 43772 Form 4F, flanged	Standard	Tapered	18 mm (0.71 in)	9 mm (0.35 in)	3.5 mm (0.14 in) [1]	6 mm (0.24 in)	B1	M14x1.5	18 mm (0.71 in)
			24 mm (0.95 in)	12.5 mm (0.5 in)	6.5 mm (0.26 in)			M18x1.5	24 mm (0.95 in)
			26 mm (1.02 in)	12.5 mm (0.5 in)	6.5 mm (0.26 in)			G ½"	26 mm (1.02 in)
	QuickNeck or with second process seal		24 mm (0.95 in)	12.5 mm (0.5 in)	6.5 mm (0.26 in)			M18x1.5	24 mm (0.95 in)
DIN 43772 Form 4, weld-in	Standard		18 mm (0.71 in)	9 mm (0.35 in)	3.5 mm (0.14 in) [1]		-	M14x1.5	18 mm (0.71 in)
			24 mm (0.95 in)	12.5 mm (0.5 in)	6.5 mm (0.26 in)			M18x1.5	24 mm (0.95 in)
			26 mm (1.02 in)	12.5 mm (0.5 in)	6.5 mm (0.26 in)			G ½"	26 mm (1.02 in)
	QuickNeck or with second process seal		24 mm (0.95 in)	12.5 mm (0.5 in)	6.5 mm (0.26 in)			M18x1.5	24 mm (0.95 in)

1) For L > 110 mm (4.33 in), a stepped bore is used: 6.5 mm (0.26 in) > 3.5 mm (0.14 in)

Length combination according to DIN 43772	
Form 4, welded in	Form 4F, flanged, standard extension neck
L = 110 mm (4.3 in), C1 = 65 mm (2.56 in)	L = 200 mm (7.87 in), U = 130 mm (5.12 in), C1 = 65 mm (2.56 in)
L = 110 mm (4.3 in), C1 = 73 mm (2.87 in)	L = 260 mm (10.24 in), U = 190 mm (7.5 in), C1 = 125 mm (4.92 in)
L = 140 mm (5.51 in), C1 = 65 mm (2.56 in)	L = 410 mm (16.14 in), U = 340 mm (13.39 in), C1 = 275 mm (10.83 in)
L = 170 mm (6.7 in), C1 = 133 mm (5.24 in)	
L = 200 mm (7.87 in), C1 = 125 mm (4.92 in)	

Thermometer with thermowell according to NAMUR standard



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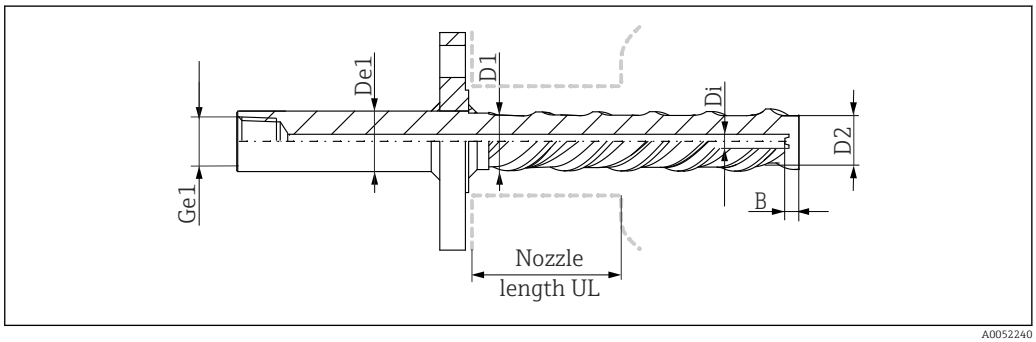
The predefined geometries result from the thermowell standard::

Thermowell standard	Process connection size	Geometry of wetted parts	Root Ø D1	Tip Ø D2	Bore Ø Di (Di1 > Di2)	Bottom thickness B	Flange face	Thermometer connection Ge1
Metric, based on NAMUR NE 170, flanged	Flange DN25–DN80	Tapered	20 mm (0.79 in)	13 mm (0.51 in)	Stepped, 7 mm (0.28 in)> 6.1 mm (0.24 in)	7 mm (0.28 in)	B1	Male thread M24x1.5, adjustable

Thermometer with iTHERM TwistWell thermowell



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The predefined geometry results from the iTHERM TwistWell (version: D1 = 30 mm (1.18 in)):

Thermowell type	Process connection size	Geometry of wetted parts	Root Ø D1	Tip Ø D2	Bore Ø Di	Bottom thickness B	Flange face	Thermometer connection Ge1	Lagging Ø De1
iTHERM TwistWell, flanged	Every selectable flange size	Length without flow	30 mm (1.18 in)	22 mm (0.87 in)	6.5 mm (0.26 in)	6 mm (0.24 in)	B1/RF	NPT ½" [1)]	30 mm (1.18 in)

1) In accordance with feature 030, or NPT 1/2" if not defined

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**.

MID

Test certificate (only in SIL mode). In compliance with:
- WELMEC 8.8: "Guide on the general and administrative aspects of the voluntary system of modular evaluation of measuring instruments"
- OIML R117-1, Edition 2007 (E), "Dynamic measuring system for liquids other than water"
- EN 12405-1/A2, Edition 2010, "Gas meters - Converters - Part 1: Volume conversion"
- OIML R140-1, Edition 2007 (E), "Measuring systems for gaseous fuels"

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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

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

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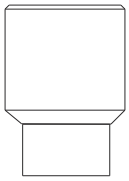
3. Select **Spare parts & Accessories**.

Device-specific accessories

Accessories	Description
 A0054624 29 Welding nipple TA115	Welding socket for barstock thermowell, according to DIN 43772 Form 4. Manufactured from barstock with diameter D = 50 mm, L = 50 mm. Order number: TA115-

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

30 QR code for free Endress+Hauser SmartBlue app

Online tools

Product information about the entire life cycle of the device is available at:
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 4-20mA values, 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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