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Technical Information
iTHERM ModuLine TM121

Thermometer with RTD or TC insert complete with thermowell manufactured from pipe or tube material

Metric version with basic technology for all standard applications. Insert replaceable without process interruption

Application

- For universal use
- For use in non-hazardous areas
- Measuring range: −50 to +650 °C (−58 to +2 012 °F)
- Pressure range up to 50 bar (725 psi)
- Degree of protection: up to IP 68

Head transmitters

Endress+Hauser transmitters are available with enhanced measurement accuracy and reliability compared to directly wired sensors. With a choice of the following outputs and communication protocols, they are easily customized to your measuring task:

- Analog output 4 to 20 mA, HART® protocol
- IO-Link®

Your benefits

- Economical, reliable measurement
- User-friendly from product selection to maintenance
- Wide range of process connections
- Bluetooth® connectivity (optional)

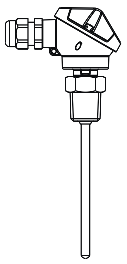
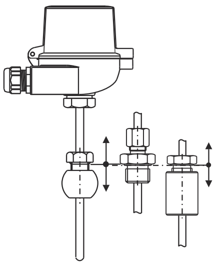
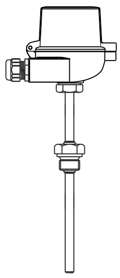
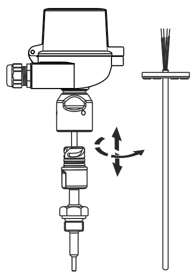
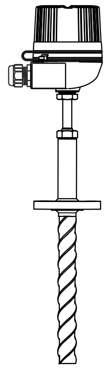
Endress+Hauser
People for Process Automation

Table of contents

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 ▪ QuickNeck ▪ Fast response times ▪ Dual-seal technology ▪ Dual-compartment housing	▪ iTHERM StrongSens and QuickSens inserts ▪ QuickNeck ▪ TwistWell ▪ Fast response times ▪ Dual-seal technology ▪ Dual-compartment housing
Hazardous area	-		-		

Measuring principle

Resistance thermometers (RTD)

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

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

The primary advantages of thin film temperature sensors over wire wound versions are their smaller sizes and better vibration resistance. A relatively low principle-based deviation of the resistance/temperature characteristic from the standard characteristic of IEC 60751 can frequently be observed among TF sensors at high temperatures. As a result, the tight limit values of tolerance class A as per IEC 60751 can only be observed with TF sensors at temperatures up to approx. 300 °C (572 °F).

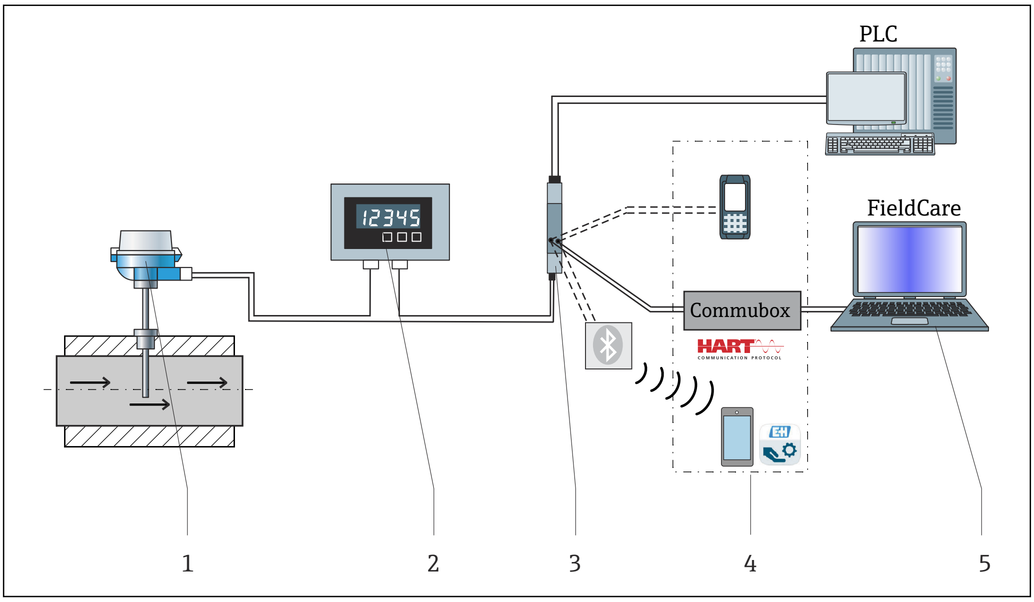
Thermocouples (TC)

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

Measuring system

Endress+Hauser offers a complete portfolio of optimized components for the temperature measuring point – everything you need for the seamless integration of the measuring point into the overall facility. These include:
- Power supply unit/barrier
- Display units
- Surge arrester

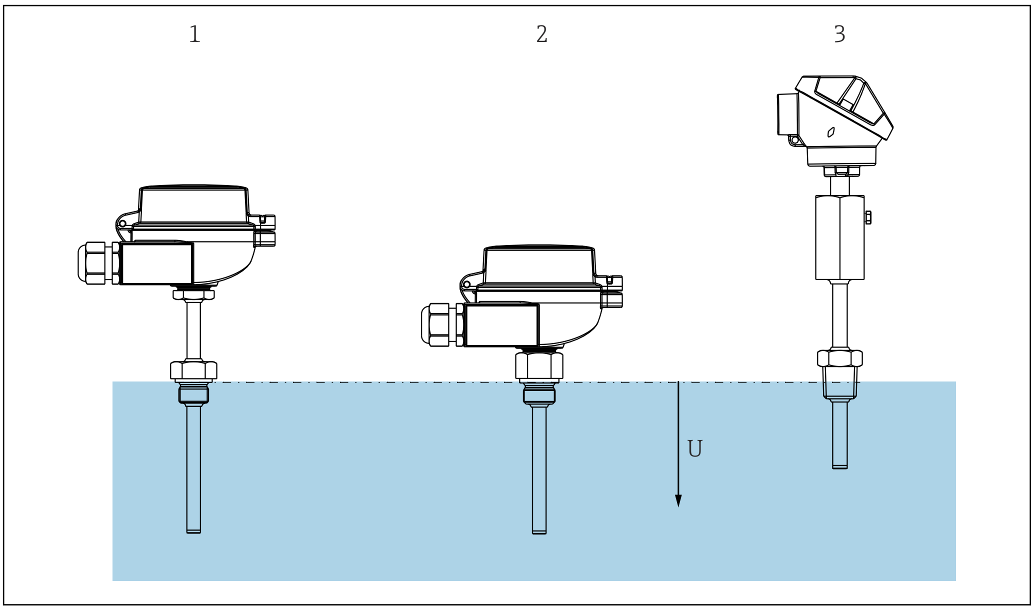
For more information, see the brochure "System Components - Solutions for a Complete Measuring Point" (FA00016K)



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

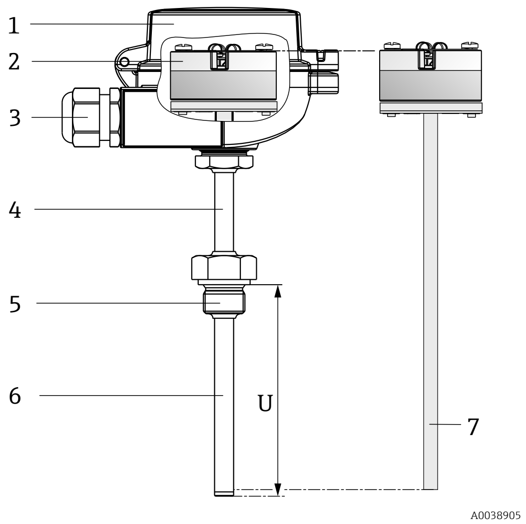
1 Installed iTHERM thermometer with HART® communication protocol
2 RIA15 loop-powered process indicator - The process indicator is incorporated into the current loop and displays the measuring signal or the HART® process variables in digital form. The process display unit does not require an external power supply. It is powered directly from the current loop.
3 Active barrier RN42 - The RN42 (17.5 V_{DC}, 20 mA) active barrier has a galvanically isolated output for supplying voltage to loop-powered transmitters. The universal power supply works with an input supply voltage of 24 to 230 V AC/DC, 0/50/60 Hz, which means that it can be used in all international power grids.
4 Communication examples: HART® Communicator (handheld terminal), FieldXpert, Commubox FXA195 for intrinsically safe HART® communication with FieldCare via the USB interface, Bluetooth® technology with SmartBlue App.
5 FieldCare is a FDT-based plant asset management tool from Endress+Hauser, for details see section "accessories".

Modular design



2 Various versions of the thermometer are available.

1 With thermowell and lagging - determined by the chosen design - and various process connections
2 With thermowell and threaded process connection - lagging determined by the chosen design
3 Special design with Mignon head
U Immersion length



Design	Options
1: Terminal head	▪ Aluminum, high or low head, with or without display window ▪ Mignon miniature head, offering no space for transmitter (for directly wired sensors) **Your benefits:** ▪ Cost effective small terminal heads ▪ Optional display: local process display for added reliability
2: Wiring, electrical connection, output signal	▪ Ceramic terminal block ▪ Flying leads ▪ Head transmitter: 4 to 20 mA, HART®, IO-Link® ▪ Attachable display, optional
3: Plug or cable gland	▪ Polyamide cable glands ▪ M12 plug, 4-pin: IO-Link®
4: Lagging	The lagging is part of the thermowell and not removable
5: Process connection	▪ Threaded process connection M-, NPT- or G-thread ▪ Compression fittings ▪ Flange according to DIN or ASME
6: Thermowell	▪ Diameter ⌀9 mm (0.35 in) or ⌀11 mm (0.43 in) ▪ Straight tip ▪ Special design for assembly with Mignon miniature terminal head It is possible to verify the mechanical loading capacity depending on the installation and process conditions using the online TW Sizing Module for thermowells in the Endress +Hauser Applicator software. This is valid for DIN thermowell calculations. See 'Accessories' section.
7: Insert	Diameter ⌀6 mm (0.24 in) ▪ RTD thin-film (TF) sensor for measuring range: −50 to +200 °C (−58 to +392 °F) ▪ Thermocouple type K for measuring range up to 650 °C (1 202 °F) **Your benefits:** Reliable, robust and cost effective temperature measurement

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 iTHERM QuickSens, fast response	−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 ≤ 60g	−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

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

- Directly-wired sensors - sensor measured values forwarded without a transmitter.
- Via all common protocols by selecting an appropriate Endress+Hauser iTEMP transmitter. All the transmitters listed below are mounted directly in the terminal head and wired with the sensory mechanism.

Family of temperature transmitters

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

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

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

Head transmitter with IO-Link ®
The temperature 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.

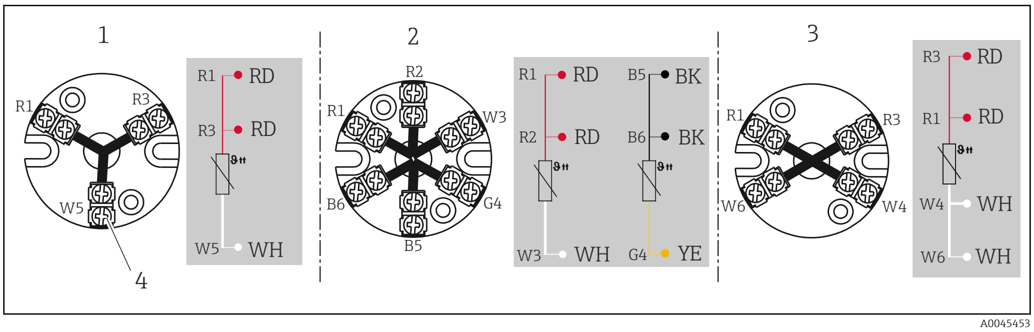
Advantages of the iTEMP transmitters:
- Dual or single sensor input (optionally for certain transmitters)
- Pluggable display (optionally for certain transmitters)
- Unsurpassed reliability, accuracy and long-term stability in critical processes
- Mathematical functions
- Monitoring of the thermometer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

Power supply

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

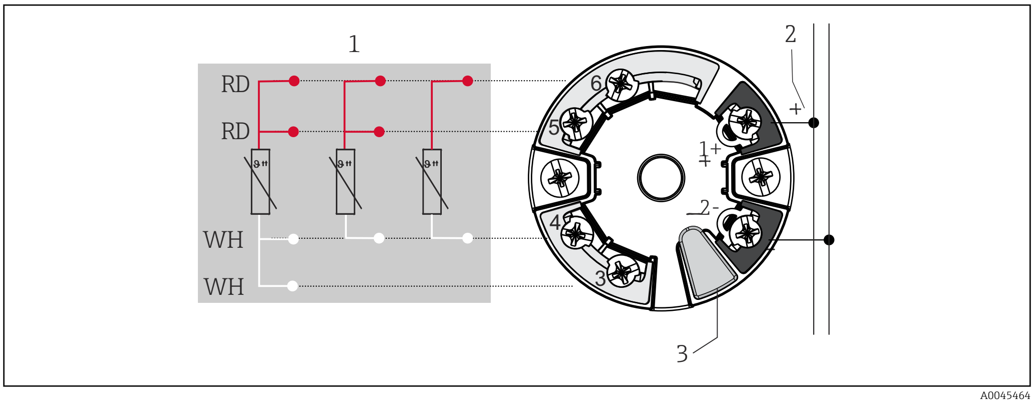
Terminal assignment

Type of sensor connection RTD



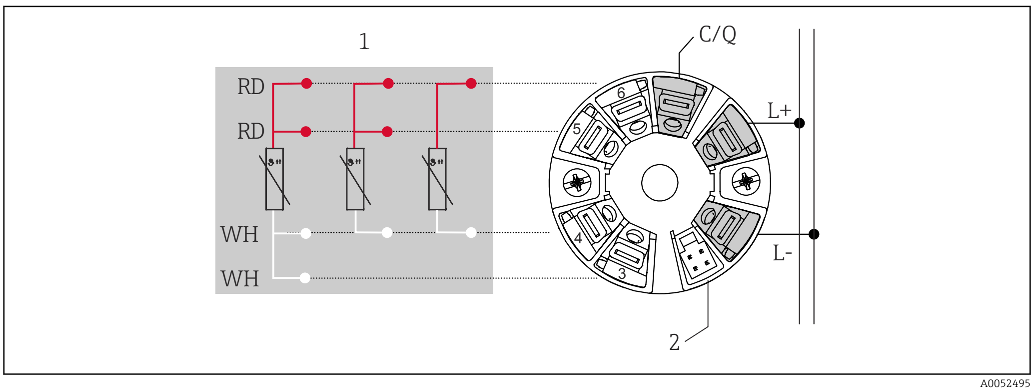
3 Mounted ceramic terminal block

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



4 Head mounted transmitter TMT7x or TMT31 (single input)

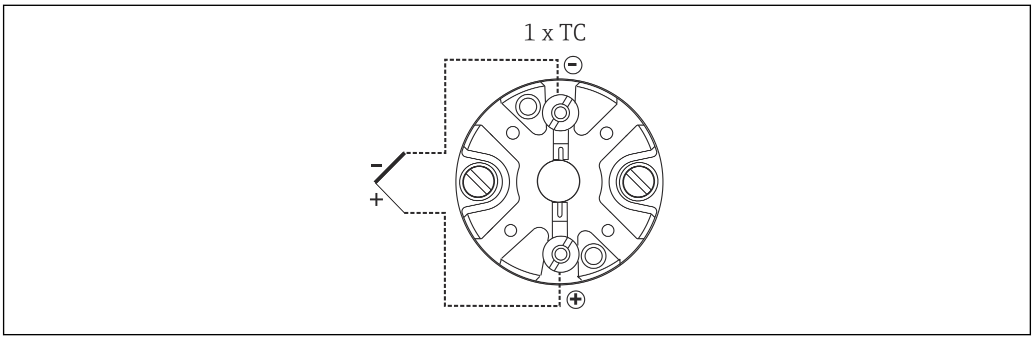
1 Sensor input, RTD, 4-, 3- and 2-wire
2 Power supply/bus connection
3 Display connection/CDI interface



5 Head-mounted transmitter TMT36 (single 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

Type of sensor connection thermocouple (TC)



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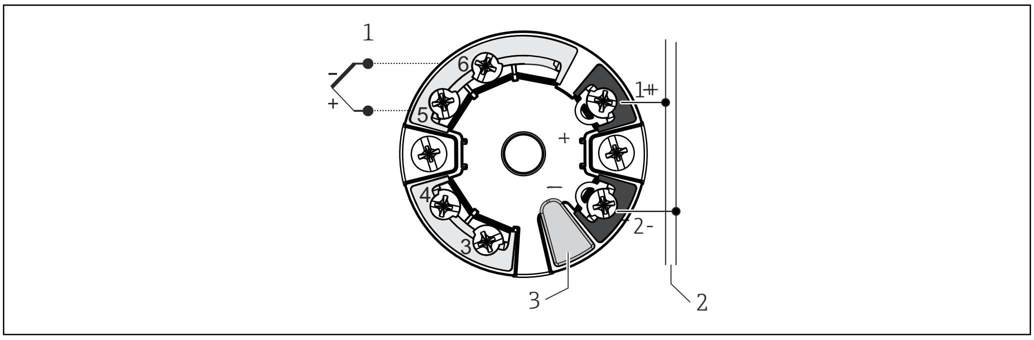
6 *Mounted ceramic terminal block*



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7 *Head-mounted transmitter TMT7x (single input)*

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

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 (-)

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.

Cable entries

See "Terminal heads" section → 30

The cable entries must be selected during the configuration of the device.

Connectors

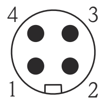
Endress+Hauser offers a wide variety of connectors for the simple and fast integration of the thermometer into a process control system. The following tables show the PIN assignments of the various plug connector combinations.

Abbreviations

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

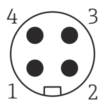
BU	Blue	GN	Green
GY	Gray	BK	Black

Terminal head with one cable entry

Plug				
Plug thread	M12			
PIN number	1	2	3	4
Electrical connection (terminal head)				
Flying leads, thermocouples are not connected	Not connected (not insulated)			
3-wire terminal block (1x Pt100)	RD	RD	WH	
4-wire terminal block (1x Pt100)			WH	WH
6-wire terminal block (2x Pt100)	RD (#1) 1)	RD (#1) 1)	WH (#1) 1)	
1x TMT 4 to 20 mA or HART®	+	i	-	i
2x TMT 4 to 20 mA or HART® in the terminal head with a high cover	+(#1)	+(#2)	-(#1)	-(#2)
PIN position and color code	 1 BN 2 GNYE 3 BU 4 GY A0018929			

1) Second Pt100 is not connected

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

Connection combination: insert - transmitter

<table>
<tr><th rowspan="2">Insert</th><th>Transmitter connection</th></tr>
<tr><th>1x 1-channel</th></tr>
<tr><td>1x Pt100 or 1x TC, flying leads</td><td>Pt100 or TC (#1): Transmitter</td></tr>
<tr><td>2x Pt100 or 1x TC, flying leads</td><td>Pt100 (# 1): Transmitter
Pt100 (#2) insulated</td></tr>
</table>

Surge arrester

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

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

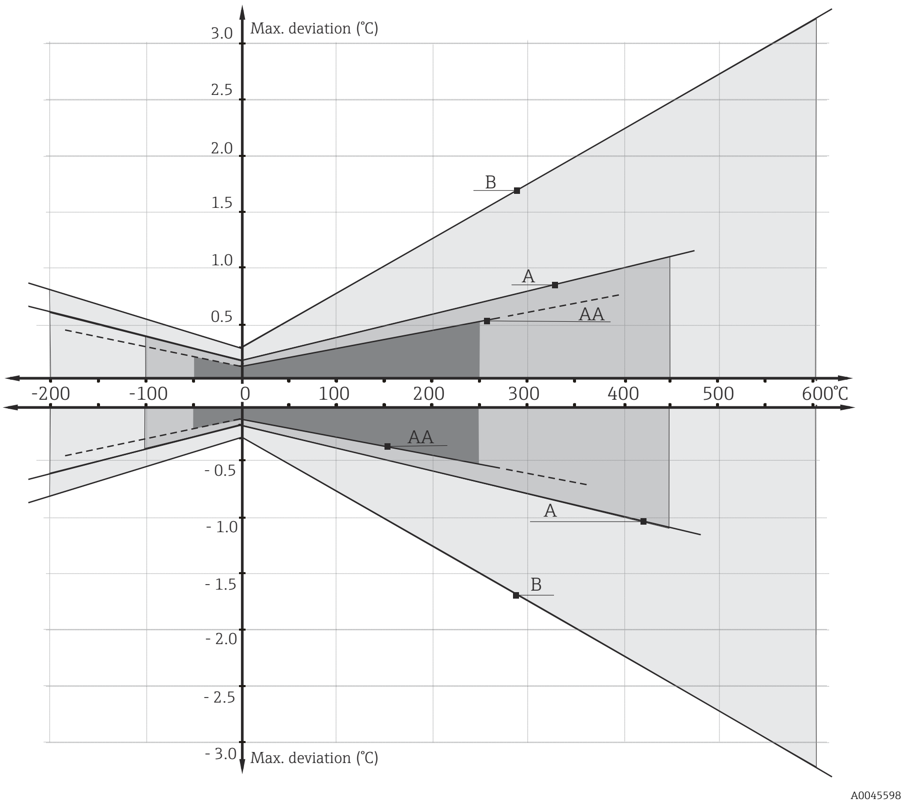
Performance characteristics

Reference conditions

These data are relevant for determining the measurement accuracy of the transmitters used. For details, see the relevant Technical Information.

Maximum measurement error

RTD resistance thermometer assembly as per IEC 60751

<table>
<tr><th>Class</th><th>Max. tolerances (°C)</th><th>Characteristics</th></tr>
<tr><th colspan="3">RTD maximum sensor error</th></tr>
<tr><td>Cl. A</td><td>± (0.15 + 0.002 · |t| [1])</td><td rowspan="3">
</td></tr>
<tr><td>Cl. AA, formerly 1/3 Cl. B</td><td>± (0.1 + 0.0017 · |t|) [1]</td></tr>
<tr><td>Cl. B</td><td>± (0.3 + 0.005 · |t| [1])</td></tr>
</table>

1) |t| = absolute temperature value in °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 (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)
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)

1) Selection depending 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
	K (NiCr-NiAl)	2	±2.5 °C (−40 to +333 °C) ±0.0075 |t| (333 to 1 200 °C)	1	±1.5 °C (−40 to +375 °C) ±0.004 |t| (375 to 1 000 °C)

Standard	Type	Standard tolerance	Special tolerance
ASTM E230/ANSI MC96.1		Deviation; the larger value applies in each case	
	K (NiCr-NiAl)	±2.2 K or ±0.02 |t| (−200 to 0 °C) ±2.2 K or ±0.0075 |t| (0 to 1 260 °C)	±1.1 K or ±0.004 |t| (0 to 1 260 °C)

Influence of ambient temperature

Depends on the head transmitter used. For details, see the 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 temperature transmitter (very small measurement current) is connected.

Response time

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

Typical values

Thermowell diameter: 9 mm (0.35 in)	t_{50}	t_{90}
RTD insert	30 s	90 s
Thermocouple (TC) insert	20 s	60 s

Typical values

Thermowell diameter: 11 mm (0.43 in)	t_{50}	t_{90}
RTD insert	40 s	100 s
Thermocouple (TC) insert	30 s	90 s

Calibration

Calibration of thermometers

Calibration involves comparing the measured values of a unit under test (UUT) with those of a more precise calibration standard using a defined and reproducible measurement method. The aim is to determine the deviation of the UUT's measured values from the true value of the measured variable. Two different methods are used for thermometers:
- Calibration at fixed-point temperatures, e.g. at the freezing point of water at 0 °C,
- Calibration compared against a precise reference thermometer.

The thermometer to be calibrated must display the fixed point temperature or the temperature of the reference thermometer as accurately as possible. Temperature-controlled calibration baths with very homogeneous thermal values, or special calibration furnaces 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 ISO17025, 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.

Evaluation of thermometers

If a calibration with an acceptable measurement uncertainty and transferable measurement results is not possible, Endress+Hauser offers customers a thermometer evaluation measurement service, if technically feasible. This is the case when:
- The process connections/flanges are too big or the immersion length (IL) is too short to allow the UUT to be immersed sufficiently in the calibration bath or furnace (see the following table), or
- Due to heat conduction along the thermometer tube, the resulting sensor temperature generally deviates significantly from the actual bath/furnace temperature.

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

Sensor-transmitter-matching

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

When Endress +Hauser 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 your Endress+Hauser sales center on request. Calibrations are traceable to national and international standards. The calibration certificate is referenced to the serial number of the device. Only the insert is calibrated.

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

Due to the limitations of furnace geometries, the minimum insertion 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 1022 °F)	300 mm (11.81 in)
551 to 600 °C (1023.8 to 1112 °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

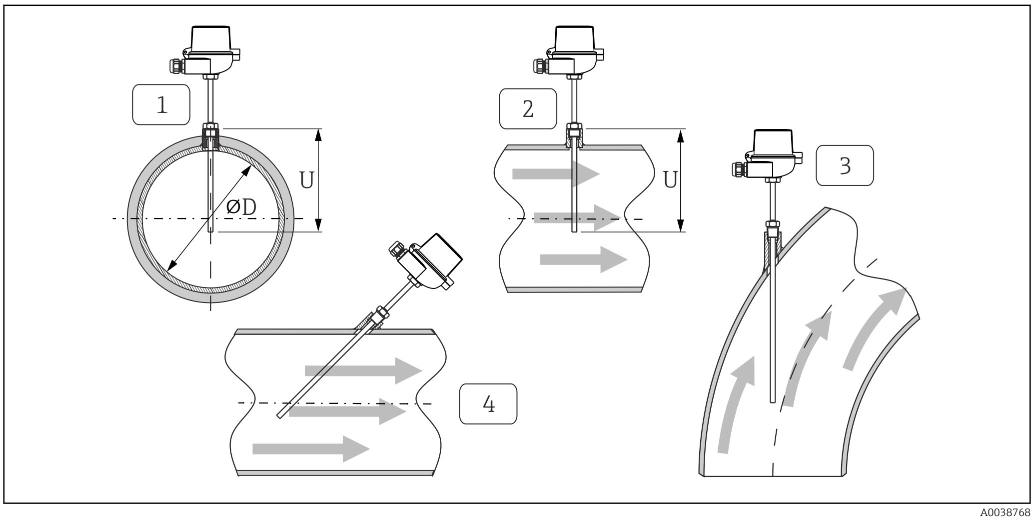
- RTD:
  Insulation resistance according to IEC 60751 > 100 MΩ at 25 °C between terminals and sheath material measured with a minimum test voltage of 100 V DC
- TC:
  Insulation resistance according to IEC 1515 between terminals and sheath material with a test voltage of 500 V DC:
  - > 1 GΩ at 20 °C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

Installation

Orientation

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

Installation instructions



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

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

Ambient conditions

Ambient temperature range

Terminal head	Temperature in °C (°F)
Without mounted head transmitter	Depends on the terminal head used and the cable gland or fieldbus connector; see "Terminal heads" section.
With mounted head transmitter	−40 to +85 °C (−40 to +185 °F)
With mounted head transmitter and display	−20 to +70 °C (−4 to +158 °F)

Storage temperature

For information, see the ambient temperature above.

Humidity

Depends on the transmitter used If Endress+Hauser iTEMP head transmitters are used:
- Condensation permitted as per IEC 60 068-2-33
- Max. rel. humidity: 95% as per IEC 60068-2-30

Climate class

As per EN 60654-1, Class C

Degree of protection

Max. IP 66 (NEMA Type 4x encl.)	Depending on the design (terminal head, connector, etc.).
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 the sensor type and design. Refer to the following table:

Sensor type	Vibration resistance for the sensor tip
Pt100 (WW)	≤ 30 m/s² (3g)
Pt100 (TF), basic	
Pt100 (TF), standard	≤ 40 m/s² (4g)
iTHERM StrongSens Pt100 (TF)	≤ 600 m/s² (60g)
iTHERM QuickSens Pt100 (TF), version: Ø6 mm (0.24 in) iTHERM QuickSens Pt100 (TF), version: Ø3 mm (0.12 in)	≤ 600 m/s² (60g) ≤ 30 m/s² (3g)
Thermocouple inserts	≤ 30 m/s² (3g)

Electromagnetic compatibility (EMC)

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

Process

Process temperature range

Depends on the sensor type and the material used,

max. −200 to +650 °C (−328 to +1 202 °F),

Process pressure range

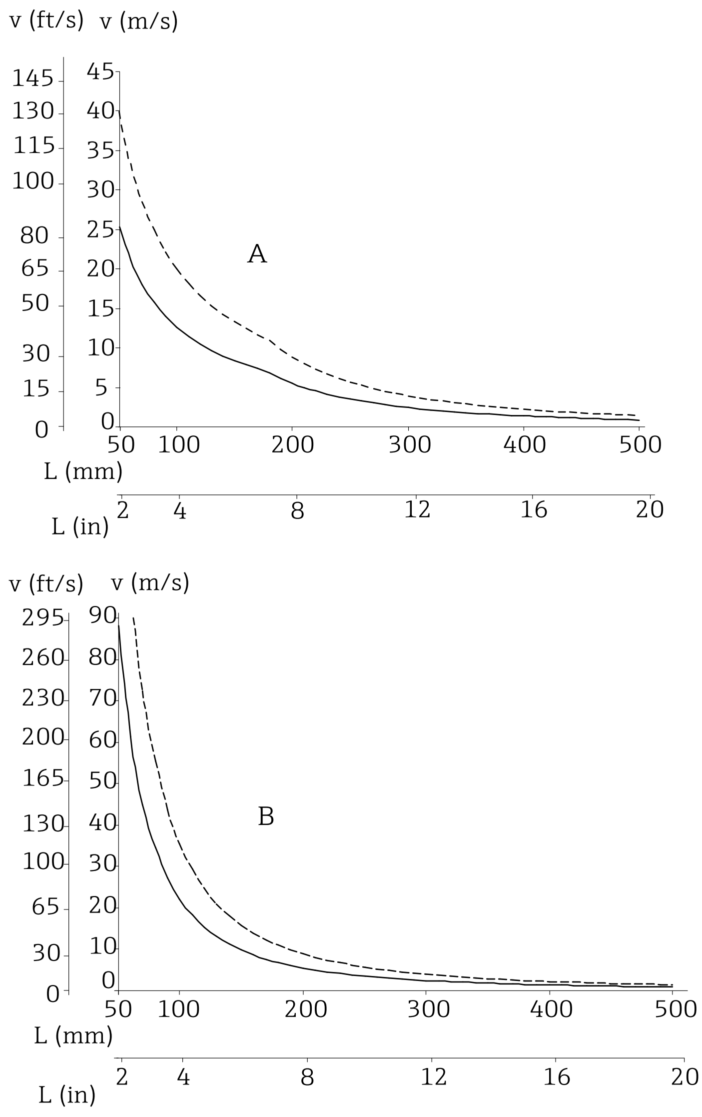
$P_{max.}$ = 50 bar (725 psi)

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

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

Permitted flow velocity depending on the immersion length and process medium

The highest flow velocity tolerated by the thermometer diminishes with increasing insert immersion length exposed to the flowing fluid. The flow velocity is also dependent on the diameter of the thermometer tip, the type of medium being measured, the process temperature and the process pressure. The following figures exemplify the maximum permitted flow velocities in water and superheated steam at a process pressure of 50 bar (725 psi).



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

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

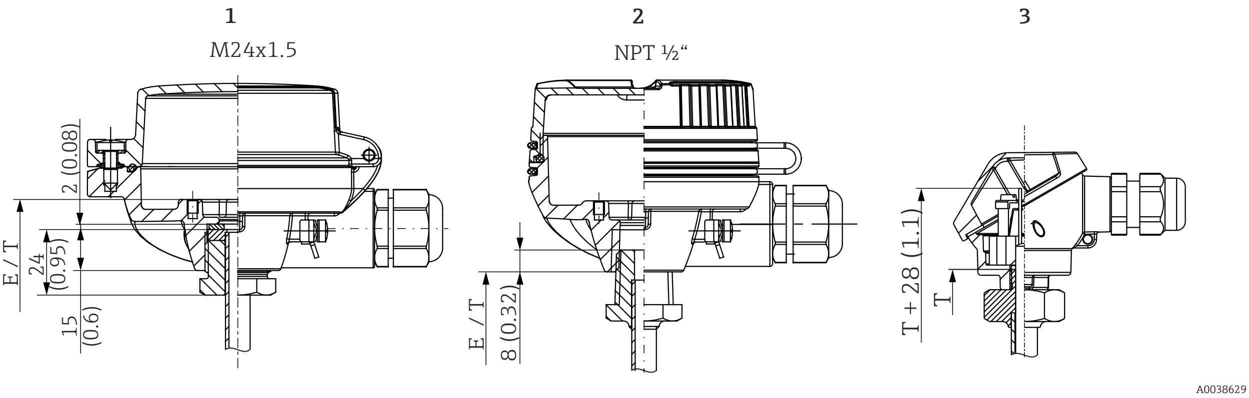
Mechanical construction

Design, dimensions

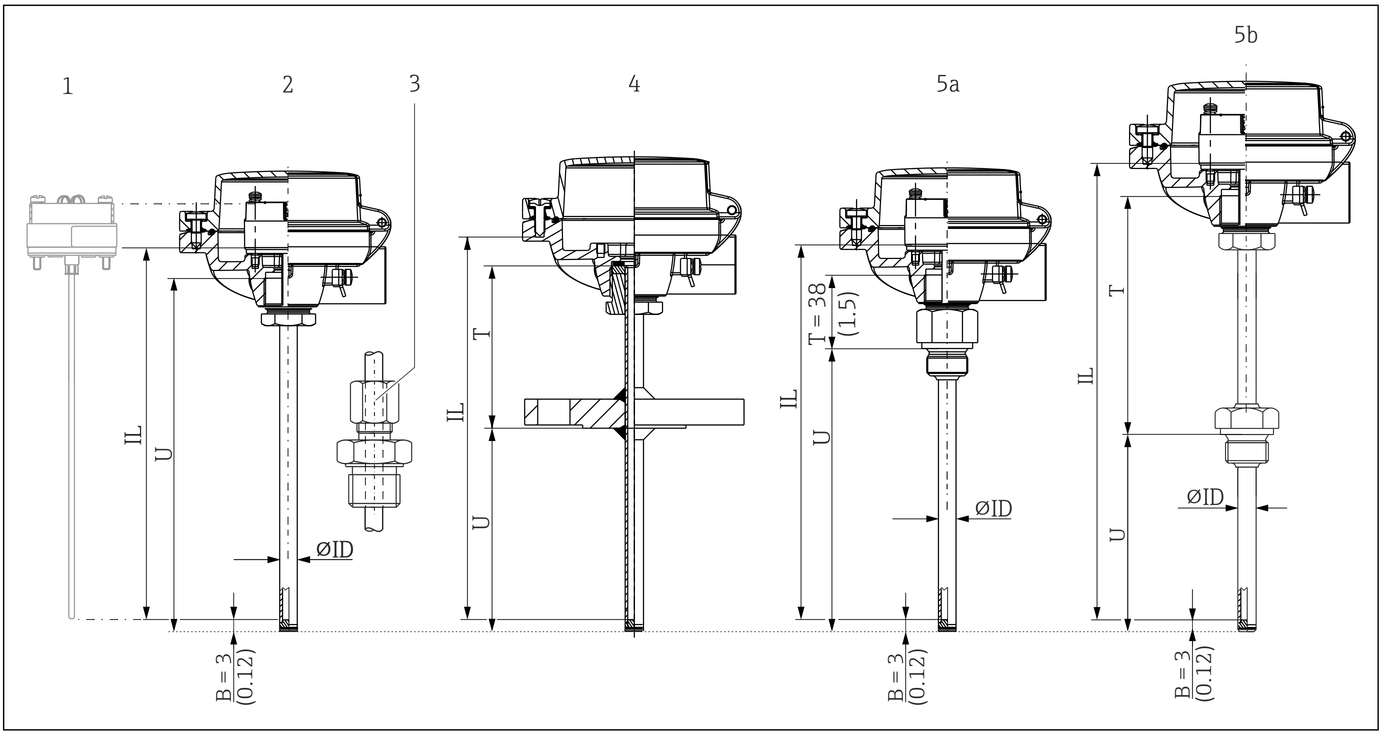
All dimensions in mm (in). The design of the thermometer depends on the general design version used:
- Thermometer without lagging DIN43772 Form 2
- Lagging DIN 43772 Form 2G, 2F, 3G, 3F
- Design with Mignon head

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

Variable dimensions:

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>IL</td><td>Insertion length of insert</td></tr>
<tr><td>B</td><td>Thermowell bottom thickness: predefined, depends on thermowell version (see also the individual table data)</td></tr>
<tr><td>T</td><td>Length of lagging: variable or predefined, depends on thermowell version (see also the individual table data)</td></tr>
<tr><td>U</td><td>Immersion length: variable, depending on the configuration</td></tr>
<tr><td></td><td>Variable for calculating the insertion length of the insert, depending on different screw-in lengths in terminal head thread M24x1.5 or ½" NPT, see insert length calculation (IL).


10 Different screw-in lengths in terminal head thread for M24x1.5 and ½" NPT
1 Metric thread M24x1.5
2 Conical thread NPT ½"
3 M10x1 adapter for Mignon terminal head</td></tr>
<tr><td>ØID</td><td>Thermowell diameter = 9x1.25 mm or 11x2 mm</td></tr>
<tr><td></td><td>Diameter tolerances
▪ Lower tolerance limit: 0.0 mm
▪ Upper tolerance limit: +0.1 mm</td></tr>
</table>

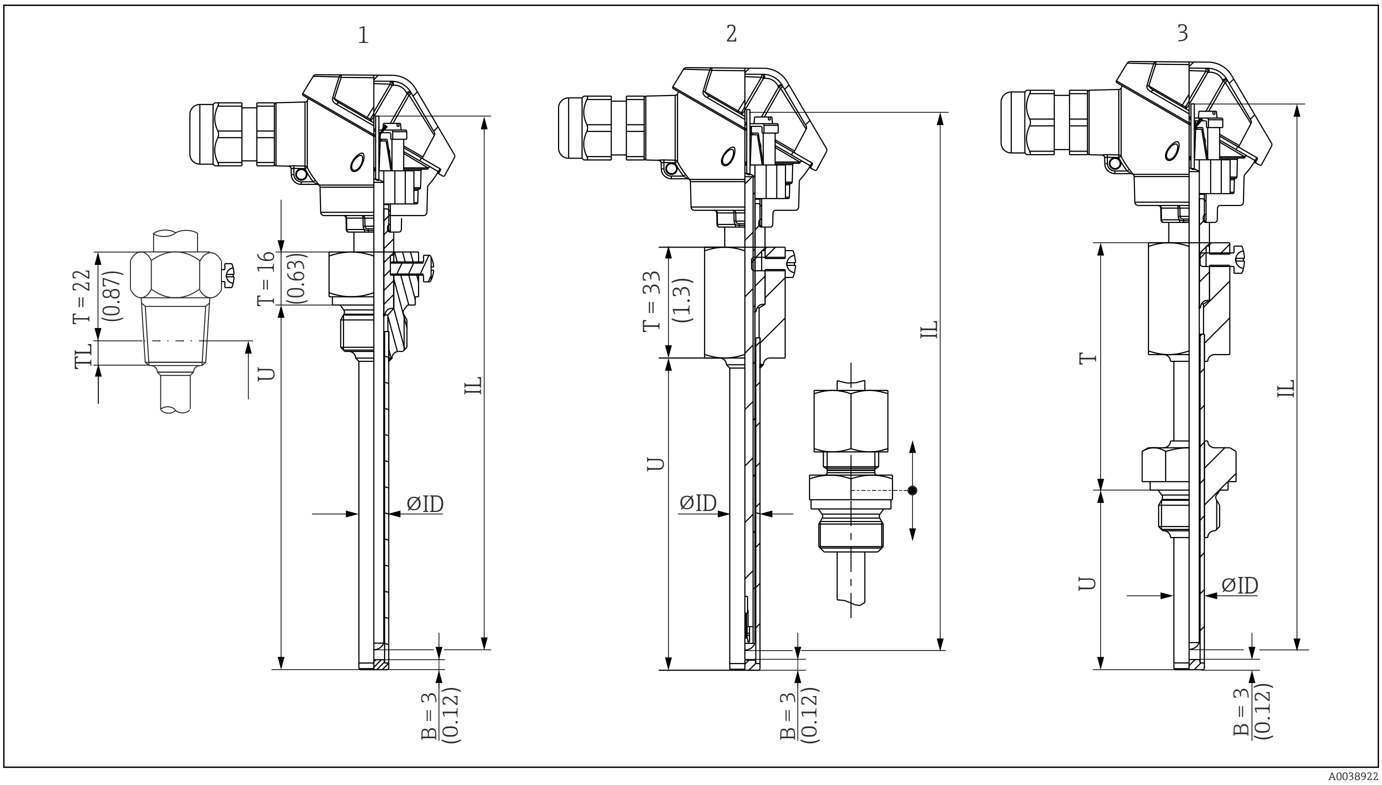


1 Measuring insert with mounted transmitter
2 Without process connection, without lagging
3 With compression fitting, without lagging
4 With flanged process connection, with lagging
5a With threaded process connection, lagging determined by the chosen design
5b With threaded process connection, with lagging

Calculation of insert length IL [1)]

Version 2 and 3:	For connection head with M24 thread (with head TA30A, TA20AB): **IL = U + 11 mm (28 in)** For connection head with ½" NPT thread (with head TA30EB): **IL = U + 26 mm (66 in)**
Version 4 and 5 (a + b):	For connection head with M24 thread (with head TA30A, TA20AB): **IL = U + T + 11 mm (28 in)** For connection head with ½" NPT thread (with head TA30EB): **IL = U + T + 26 mm (66 in)** Length of lagging T determined by design.

1) A replaceable TS111 is used as the insert



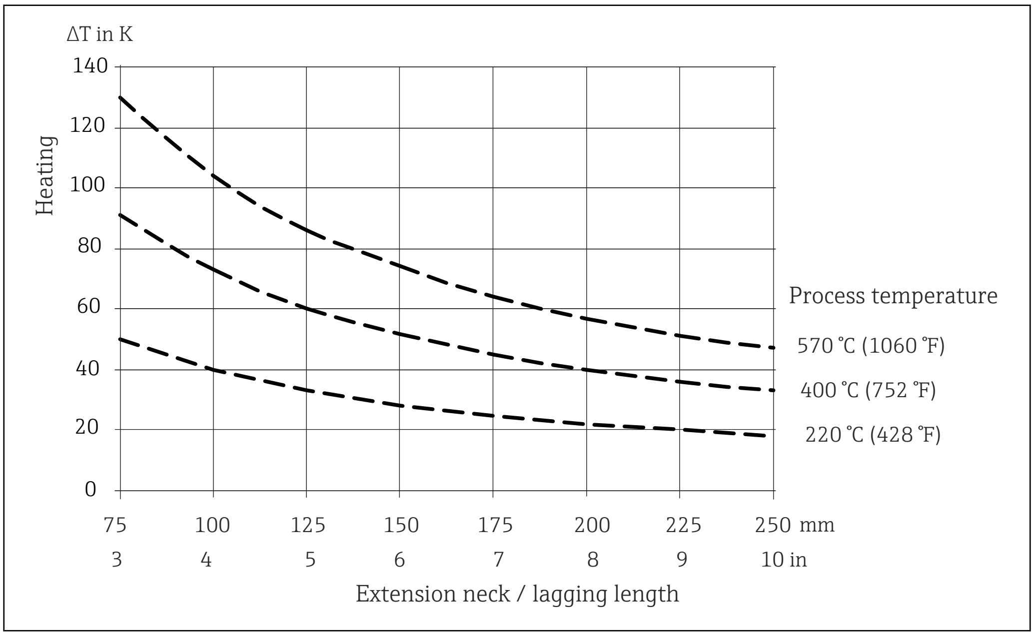
11 Thermometer design with Mignon head

1. *With threaded process connection, cylindrical or conical, without lagging*
2. *Without process connection, alternatively with compression fitting*
3. *With process connection, thread or flange, with lagging*

Calculation of insert length: IL = U + T + 38 mm (96.5 in) [1)]

As illustrated in the following figure, the length of the lagging may influence the temperature in the terminal head. This temperature must remain within the limit values defined in the "Operating conditions" section.

1) The insert cannot be replaced in this version.



12 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 lagging length of 100 mm (3.94 in), the heat conduction is 40 K (72 °F). The transmitter temperature is therefore 40 K (72 °F) plus the ambient temperature, e.g. 25 °C (77 °F): 40 K (72 °F) + 25 °C (77 °F) = 65 °C (149 °F).

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

Weight

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

Material

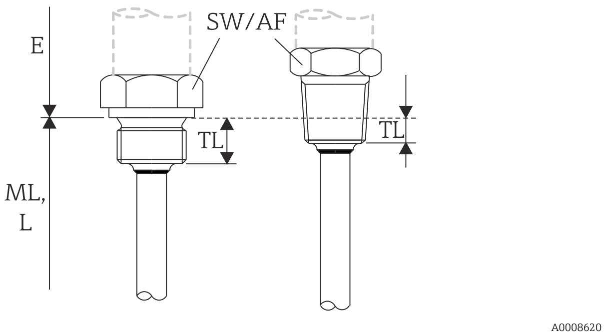
The temperatures for continuous operation specified in the following table are only intended as reference values for use of the various materials in air and without any significant mechanical load. The maximum operating temperatures can be reduced considerably in cases where abnormal conditions such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

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

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316L/1.4404 1.4435	X2CrNiMo17-12-2 X2CrNiMo18-14-3	650 °C (1 202 °F)	▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion-resistance in chlorinated and acidic, non-oxidizing atmospheres by adding molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with low concentration) ▪ Increased resistance to intergranular corrosion and pitting ▪ Compared to 1.4404, 1.4435 has even higher corrosion resistance and a lower delta ferrite content
Alloy600/2.4816	NiCr15Fe	1 100 °C (2 012 °F)	▪ A nickel/chromium alloy with very good resistance to aggressive, oxidizing and reducing atmospheres, even at high temperatures ▪ Resistance to corrosion caused by chlorine gases and chlorinated media as well as many oxidizing mineral and organic acids, sea water etc. ▪ Corrosion from ultrapure water ▪ Not to be used in sulfur-containing atmospheres

Process connections

Thread

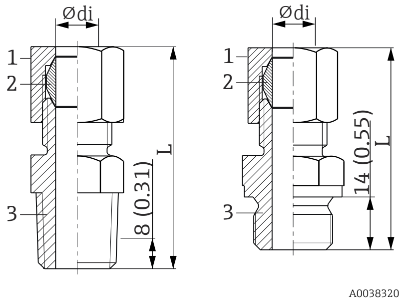
Threaded process connection	Version		Dimensions		Technical properties
			Thread length TL in mm (in)	Width across flats AF (mm)	
 13 *Cylindrical (left side) and conical (right side) version*	M	M20x1.5	14 mm (0.55 in)	27	Maximum static process pressure for threaded process connection: 1) 400 bar (5 802 psi) at +400 °C (+752 °F)
		M27x2	16 mm (0.63 in)	32	
		M33x2	18 mm (0.71 in)	41	
	G	G ½" DIN / BSP	15 mm (0.6 in)	27	
	NPT	NPT ½"	8 mm (0.32 in)	22	

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)

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

SWAGELOCK or similar fittings are strongly recommended for higher requirements.

Compression fitting

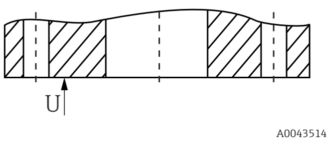
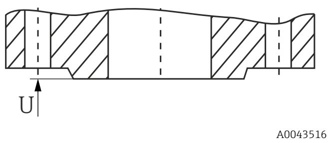
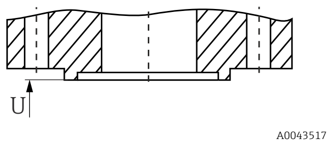
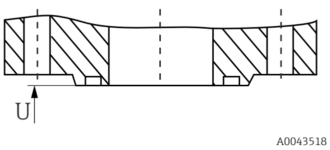
Type TK40	Version	Dimensions			Technical properties
		Ødi	L	Width across flats AF	
 *1 Nut* *2 Ferrule* *3 Process connection*	NPT ½" , ferrule material 316L G ½" , ferrule material 316L G 1", ferrule material 316L	9 mm (0.35 in) 11 mm (0.43 in)	NPT ½": 52 mm (2.05 in) G ½": 47 mm (1.85 in) G 1": 66 mm (2.6 in)	NPT ½": 24 mm (0.95 in) G½": 27 mm (1.06 in) G1": 41 mm (1.61 in)	▪ $P_{max.}$: 40 bar (580 psi) at +200 °C (+392 °F) ▪ $P_{max.}$: 25 bar (363 psi) at +400 °C (+752 °F) Min. tightening torque: 70 Nm

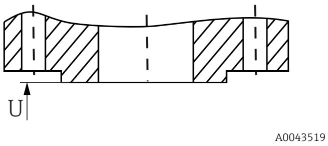
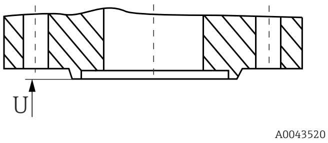
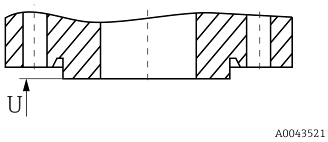
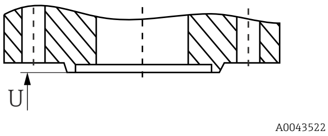
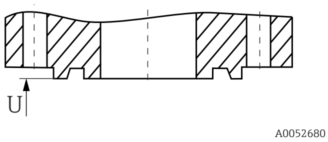
Flange

The flanges are supplied in stainless steel AISI 316L with material number 1.4404 or 1.4435. With regard to their stability-temperature property, the materials 1.4404 and 1.4435 are grouped together under 13E0 in DIN EN 1092-1 Tab.18 and under 023b in JIS B2220:2004 Tab. 5. 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 2.54. 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		A B	- 40 to 160	A [2]	12.5 to 50	3.2 to 12.5	Flat face (FF)	3.2 to 6.3 (AARH 125 to 250 µin)
with raised face		C D E	40 to 160 40 16	B1 [3] B2	12.5 to 50 3.2 to 12.5	3.2 to 12.5 0.8 to 3.2	Raised face (RF)	
Tongue		F	-	C	3.2 to 12.5	0.8 to 3.2	Tongue (T)	3.2
Groove		N		D			Groove (G)	

Flanges	Sealing surface	DIN 2526 [1]		DIN EN 1092-1			ASME B16.5	
		Form	Rz (µm)	Form	Rz (µm)	Ra (µm)	Form	Ra (µm)
Projection		V 13	-	E	12.5 to 50	3.2 to 12.5	Male (M)	3.2
Recess		R 13		F			Female (F)	
Projection		V 14	for O-rings	H	3.2 to 12.5	3.2 to 12.5	-	-
Recess		R 14		G			-	-
With ring-type joint		-	-	-	-	-	Ring-type joint (RTJ)	1.6

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

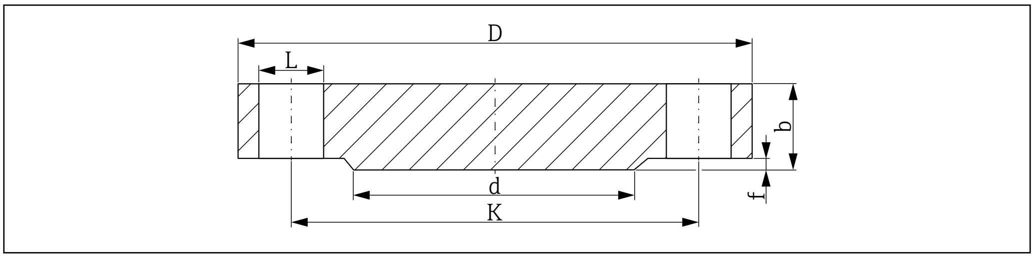
Flanges according to the old DIN standard are compatible with the new DIN EN 1092-1 standard. Change in pressure ratings: Old DIN standards PN64 → DIN EN 1092-1 PN63.

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)



14 *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)
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

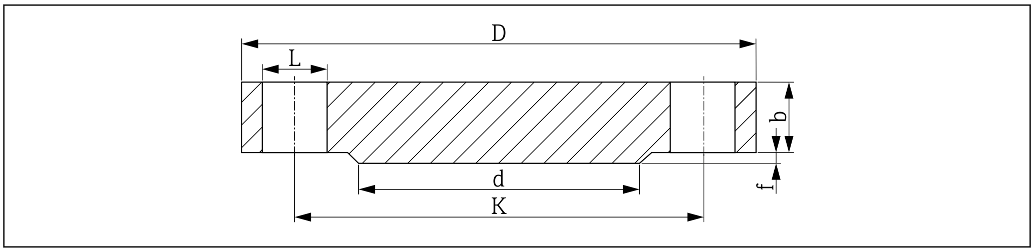
DN	D	b	K	d	L	approx. kg (lbs)
25	140 (5.51)	24 (0.94)	100 (3.94)	68 (2.68)	4xØ18 (0.71)	2.50 (5.51)
32	155 (6.10)	24 (0.94)	110 (4.33)	78 (3.07)	4xØ22 (0.87)	3.50 (7.72)
40	170 (6.69)	26 (1.02)	125 (4.92)	88 (3.46)	4xØ22 (0.87)	4.50 (9.92)
50	180 (7.09)	26 (1.02)	135 (5.31)	102 (4.02)	4xØ22 (0.87)	5.00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

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



15 Raised face RF

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

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

Class 150 [1)]

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

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

Class 300

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

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

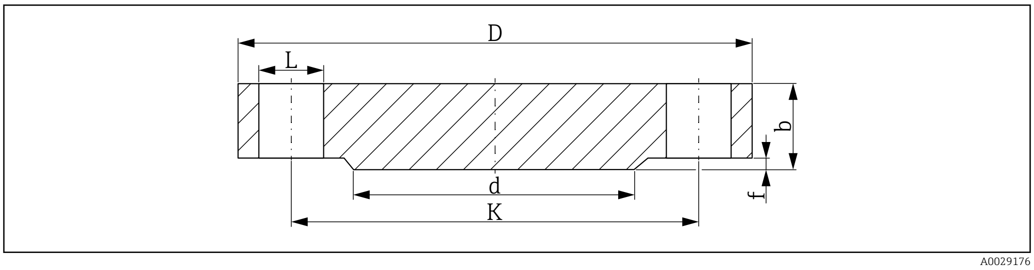
DN	D	b	K	d	L	approx. kg (lbs)
1"	149.4 (5.88)	28.4 (1.12)	101.6 (4.0)	50.8 (2.00)	4xØ25.4 (1.00)	3.57 (7.87)
1¼"	158.8 (6.25)	28.4 (1.12)	111.3 (4.38)	63.5 (2.50)	4xØ25.4 (1.00)	4.14 (9.13)
1½"	177.8 (7.0)	31.8 (1.25)	124.0 (4.88)	73.2 (2.88)	4xØ28.4 (1.12)	5.75 (12.68)
2"	215.9 (8.50)	38.1 (1.50)	165.1 (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)

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



16 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)

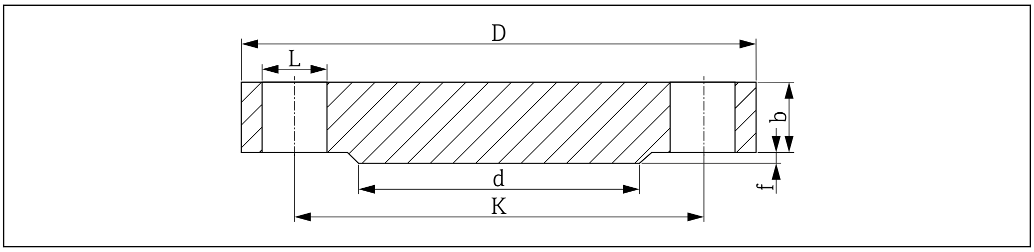
PN40

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)



17 *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

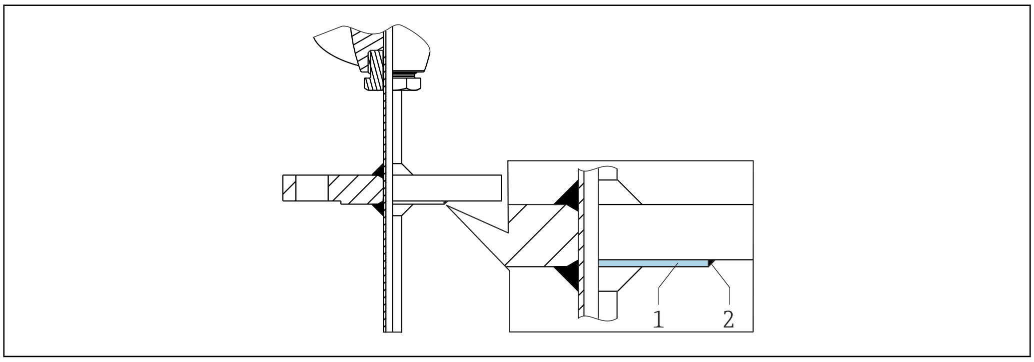
Class 300

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 Alloy600 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 Alloy600 > 316L or Alloy C276 > 316L.



A0043523

1 Raised face
2 Weld

Inserts

Depending on the configuration, the device can be fitted with a replaceable insert. [2)]

Sensor	Standard thin-film
Sensor design; connection method	1x or 2x Pt100, 3- or 4-wire, basic version, stainless steel sheath
Vibration resistance of the insert tip	Up to 3g
Measuring range; accuracy class	−50 to +200 °C (−58 to +392 °F), Class A or B
Diameter	6 mm (0.24 in)

TC thermocouples	Type K
Sensor design	Mineral insulated, alloy 600 sheathed TC cable
Vibration resistance of the insert tip	Up to 3g
Measuring range	−270 to +1 100 °C (−454 to +2 012 °F)
Connection type	Ungrounded hot junction
Temperature-sensitive length	Insert length
Diameter	6 mm (0.24 in)

The iTHERM inserts are available as a spare part. The insertion length (IL) depends on the immersion length of the thermowell (U), the thickness of the base (B), and the length of the thermowell lagging (L) for example. The insertion length (IL) must be taken into consideration when replacing the unit. Formulas for calculating IL → 17

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

Spare parts currently available for your product can be found online at: http://www.products.endress.com/spareparts_consumables. Choose the corresponding product root. Always quote the serial number of the device when ordering spare parts! The insertion length IL is automatically calculated using the serial number.

Surface roughness

Values for wetted surfaces:

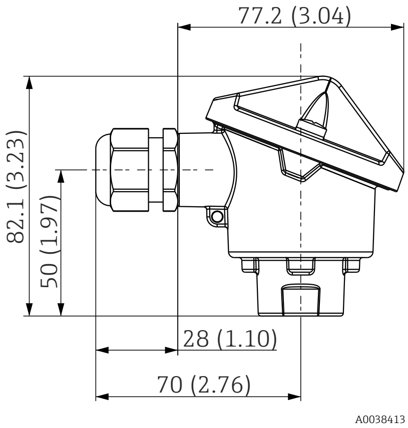
Standard surface	$R_a \leq$ 0.76 µm (0.03 µin)

Terminal heads

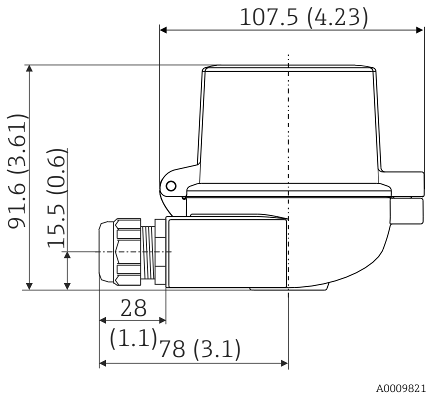
All terminal heads have an internal shape and size in accordance with DIN EN 50446, flat face and a thermometer connection with a M24x1.5 or ½" NPT thread. All dimensions in mm (in). The sample cable glands in the diagrams correspond to M20x1.5 connections with non-Ex polyamide cable glands. Specifications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

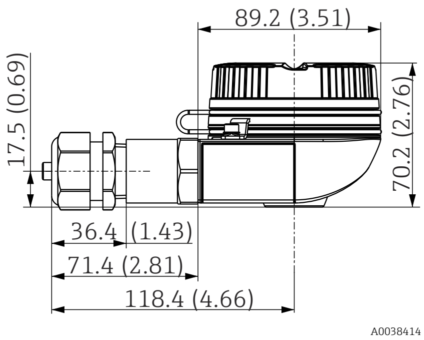
2) Not with Mignon terminal head TA20L

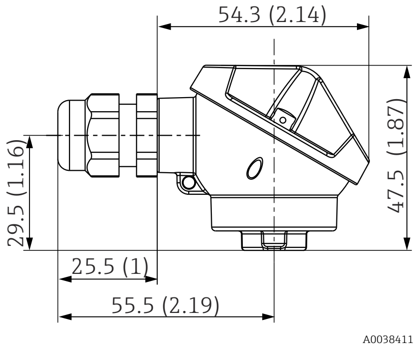
As a special feature, Endress+Hauser offers terminal heads with optimized terminal accessibility for easy installation and maintenance.

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

TA30A with display window in cover	Specification

	▪ Degree of protection:
	  ▪ 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
	▪ Cable entry thread: G ½", ½" NPT and M20x1.5
	▪ Protective fitting connection: M24x1.5
	▪ Color of head: blue, RAL 5012
	Color of cap: 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

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 ▪ Extension neck/thermowell connection: NPT ½" ▪ Color of head: blue, RAL 5012 ▪ Color of cap: gray, RAL 7035 ▪ Weight: approx. 400 g (14.11 oz) ▪ Ground terminal: internal and external If the housing cover is unscrewed: Before tightening, clean the thread in the cover and housing base and lubricate if necessary (Recommended lubricant: Klüber Syntheso Glep 1)

TA20L Mignon	Specification
	▪ Protection class: IP66 ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: M16x1.5 ▪ Protection armature connection: M10x1 ▪ Head color: blue, RAL 5012 Cap color: gray, RAL 7035 ▪ Weight: 420 g (14.81 oz) ▪ No ground terminal

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, 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)	-
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

For explosion proof thermometers no cable glands are assembled.

Certificates and approvals

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

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

Ordering information

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

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

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

Accessories

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

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Spare parts & Accessories**.

Service-specific accessories

Applicator
Software for selecting and sizing Endress+Hauser measuring devices:
- Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections.
- Graphic illustration of the calculation results

Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.

Applicator is available:
https://portal.endress.com/webapp/applicator

Configurator
Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
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The Configurator is available on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and the search field -> Open the product page -> The "Configure" button to the right of the product image opens the Product Configurator.

DeviceCare SFE100
Configuration tool for HART, PROFIBUS and FOUNDATION Fieldbus field devices
DeviceCare is available for download at www.software-products.endress.com. You need to register in the Endress+Hauser software portal to download the application.

Technical Information TI01134S

FieldCare SFE500
FDT-based plant asset management tool
It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.

Technical Information TI00028S

Netilion
IIoT ecosystem: Unlock knowledge
With the Netilion IIoT ecosystem, Endress+Hauser enables you to optimize plant performance, digitize workflows, share knowledge, and enhance collaboration. Drawing on decades of experience in process automation, Endress+Hauser provides the process industry with an IIoT ecosystem that unlocks valuable insights from data. These insights allow process optimization, leading to increased plant availability, efficiency, and reliability - ultimately resulting in a more profitable plant.

www.netilion.endress.com

Supplementary documentation

The following types of documentation are available on the product pages and in the Download Area of the Endress+Hauser website (www.endress.com/downloads) (depending on the selected device version):

Document	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 (XA) are supplied with the device. The Safety Instructions are an integral part of the Operating Instructions. Information on the Safety Instructions (XA) that are relevant for the device is provided on the nameplate.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the device documentation.

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