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Technical Information
iTHERM SurfaceLine TM691

Surface thermometer
Metric/imperial TC tube skin thermometer for harsh environments such as fired heaters, reformers, heat exchangers, boilers

Application

- International explosion protection approvals with extended temperature range
- Usage in the Oil & Gas, Chemical, and Power & Energy industries
- Typically for fired heaters, reformers, heat exchangers, boilers
- Specifically designed for harsh environments with high temperatures, corrosion and vibration

Benefits

- Increased plant and process safety: early detection of overheating and critical operating conditions of process pipes
- Improved energy efficiency: assessing and optimizing burner operation and heat distribution
- Improved product quality: stabilized process conditions due to accurate temperature measurement
- iTEMP temperature transmitter with all standard communication protocols and optional Bluetooth® connectivity

Endress+Hauser
People for Process Automation

Table of contents

About this document

Electrical symbols

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

Symbols for certain types of information

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

Symbols in graphics

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

Function and system design

Measuring principle

Thermocouples (TC)

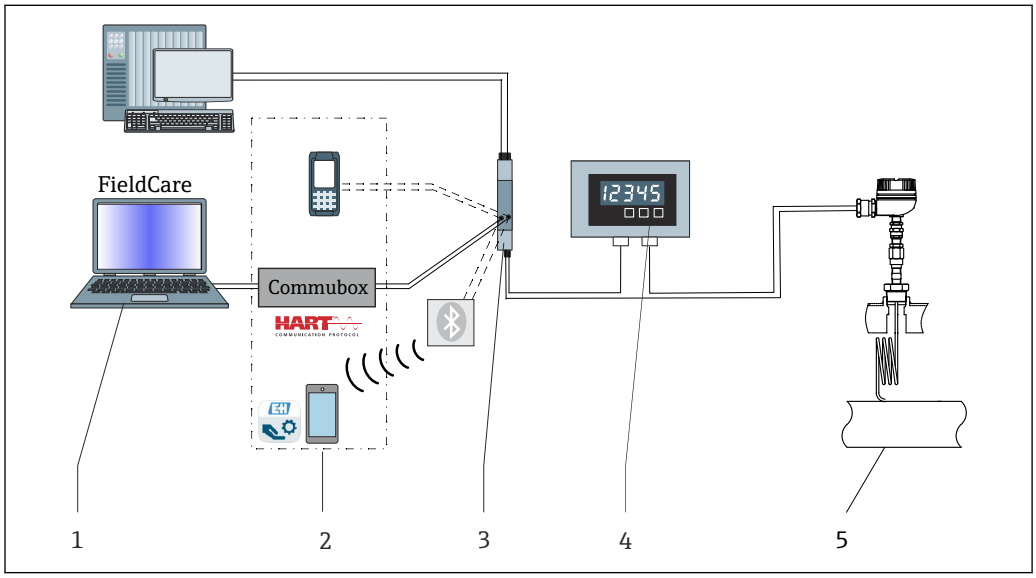
Thermocouples are comparatively simple, robust temperature sensors which use the Seebeck effect for temperature measurement: if two electrical conductors made of different materials are connected at a point, a weak electrical voltage can be measured between the two open conductor ends if the conductors 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

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



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

1 *FieldCare is a FDT-based plant asset management tool from Endress+Hauser, for details see section "accessories".*

2 *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.*

3 *RN series active barriers - The RN series active barriers (e.g. with 17.5 V_{DC}, 20 mA) have a galvanically isolated output for supplying voltage 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. More information on this can be found in the Technical Information under "Documentation".*

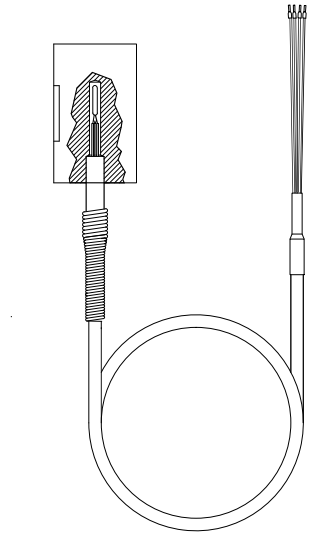
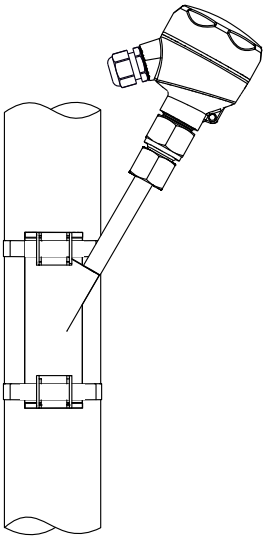
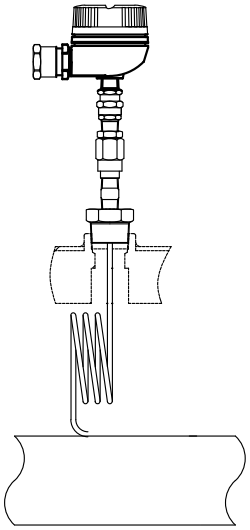
4 *2-wire process indicator from the RIA product range. The process indicator is integrated into the current loop and displays the measuring signal or HART® process variables in digital form. The process indicator does not require an external power supply. It is powered directly from the current loop. More information on this can be found in the technical documentation under "Documentation".*

5 *Installed iTHERM thermometer with HART® communication protocol.*

Equipment architecture

iTHERM SurfaceLine

This device is part of the surface thermometer product family.

Non-invasive thermometers			
Design	Metric, imperial		
Device	iTHERM SurfaceLine TST602  A0062723	iTHERM SurfaceLine TM611  A0062724	iTHERM SurfaceLine TM691  A0062725
FLEX segment	**L**	**E**	**X**
Properties	Non-invasive RTD measurement	Non-invasive RTD or TC measurement	Non-invasive TC measurement
Hazardous area	-	EX	EX
Application	Cost-effective medium measurement	High-performance medium measurement	Tube skin temperature measurement

Tube skin thermometer

Temperature measurements are critically important in the process industry to ensure product quality, safety, and process efficiency.

Tube skin measurement with iTHERM SurfaceLine TM691

Tube skin measurement is used for the early detection of overheating and critical operating conditions in process pipes. It therefore contributes to process safety and is used in particular in fired heaters, reformers, heat exchangers, and boilers. Monitoring tube skin temperatures also enables burner operation to be evaluated and optimized, thereby improving energy efficiency. Accurate temperature measurement ultimately helps improve product quality by ensuring stable process conditions.

Input

Measured variable

Temperature (temperature-linear transmission behavior)

Measuring range

Depends on the type of sensor used

Sensor type	Measuring range
Thermocouple (TC), type J	−40 to 750 °C (−40 to 1382 °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 ambient 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 ambient temperature range. All iTEMP transmitters are approved for use in all the main process control systems. Integration tests are carried out in the Endress+Hauser '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.

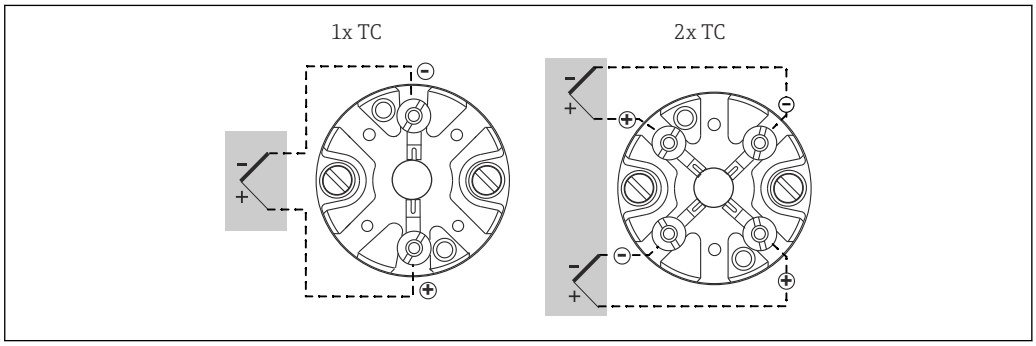
Advantages of the iTEMP transmitters:
- Dual or single sensor input (optional for certain transmitters)
- Attachable display (optional for certain transmitters)
- Unsurpassed reliability, accuracy and long-term stability in critical processes
- Mathematical functions (optional for certain transmitters)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

Electrical connection

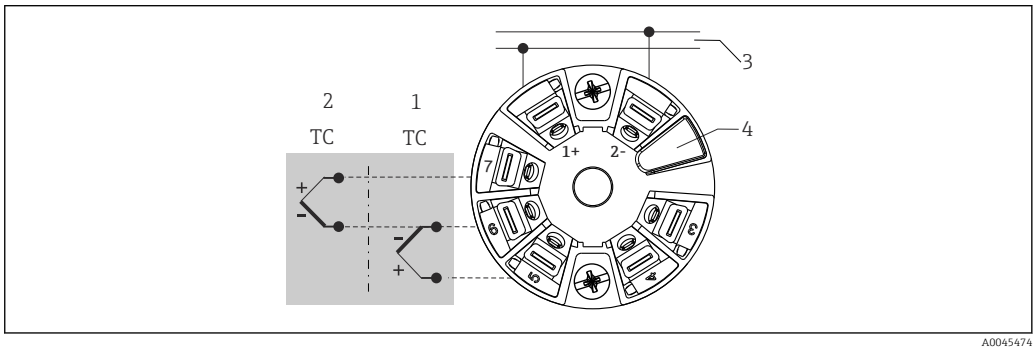
The sensor connection wires are equipped with terminal lugs. The nominal diameter of the terminal lugs is 1.3 mm (0.05 in).

Terminals

Sensor connection type: Thermocouple TC

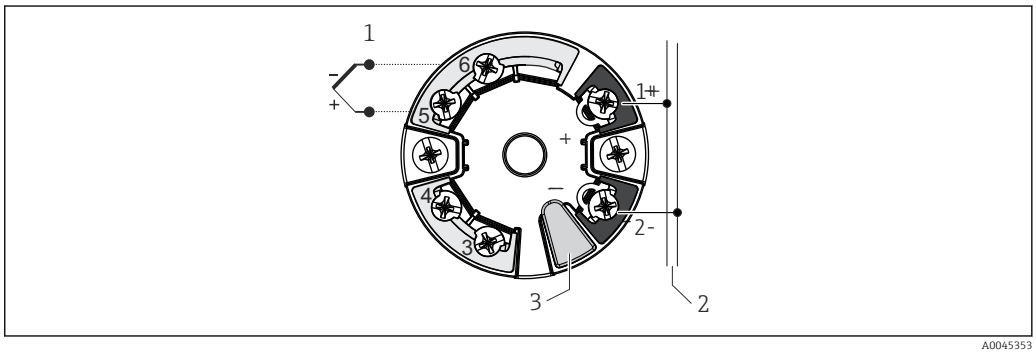


2 *Installed ceramic terminal block for thermocouples.*



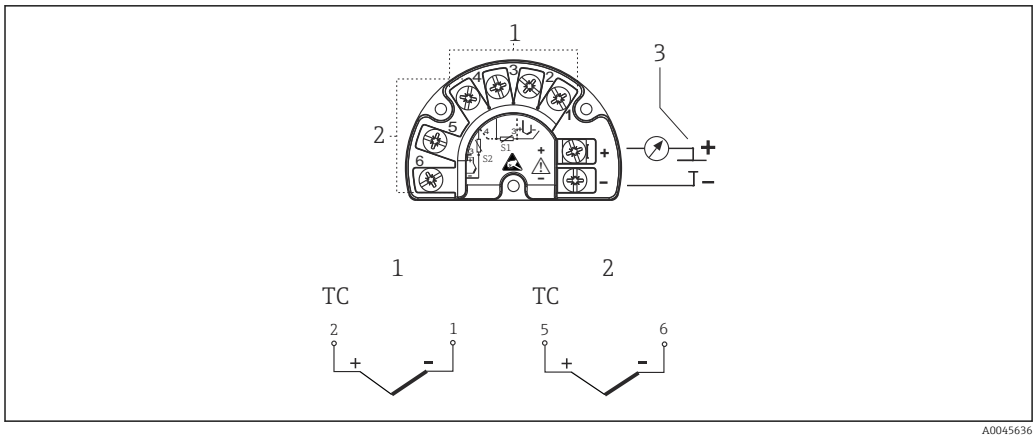
3 *Head-mounted iTEMP TMT8x transmitter (dual sensor input)*

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



4 *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*



5 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 (-)

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

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)	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). Class 3 tolerances cannot be met. A separate material must be selected for this temperature range. This cannot be handled via the standard product.

Standard	Type	Tolerance class: Standard	Tolerance class: Special
ASTM E230/ANSI MC96.1		Deviation; the larger value applies in each case.	

	J (Fe-CuNi)	±2.2 K or ±0.0075 |t| [1] (0 to 760 °C)	±1.1 K or ±0.004 |t| [1] (0 to 760 °C)
	K (NiCr-NiAl) N (NiCrSi-NiSi)	±2.2 K or ±0.02 |t| [1] (−200 to 0 °C) ±2.2 K or ±0.0075 |t| [1] (0 to 1 260 °C)	±1.1 K or ±0.004 |t| [1] (0 to 1 260 °C)

1) |t| = absolute value in °C

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

Influence of ambient temperature

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

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. Two different methods are used to calibrate inserts:

- Calibration at fixed points, such as the ice point, i.e. the freezing point of water at 0 °C
- Calibration by comparison with 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. For thermometer calibrations, temperature-controlled calibration baths with highly homogeneous thermal values or special calibration furnaces are typically used. 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 cannot be maintained exactly 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. Converting the measured sensor resistance values to temperatures in temperature transmitters or other measuring electronics is often associated with a significant error, as this conversion is generally based on the standard characteristic curve.

When 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 stated on all calibration certificates where possible, e.g. for at least three calibration points, so that users can also configure suitable temperature transmitters themselves accordingly.

For the device, the manufacturer 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 the manufacturer's sales organization 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 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) required
2) With iTEMP head transmitter, at a temperature of 80 to 250 °C (176 to 482 °F), min. 50 mm (1.97 in) required.

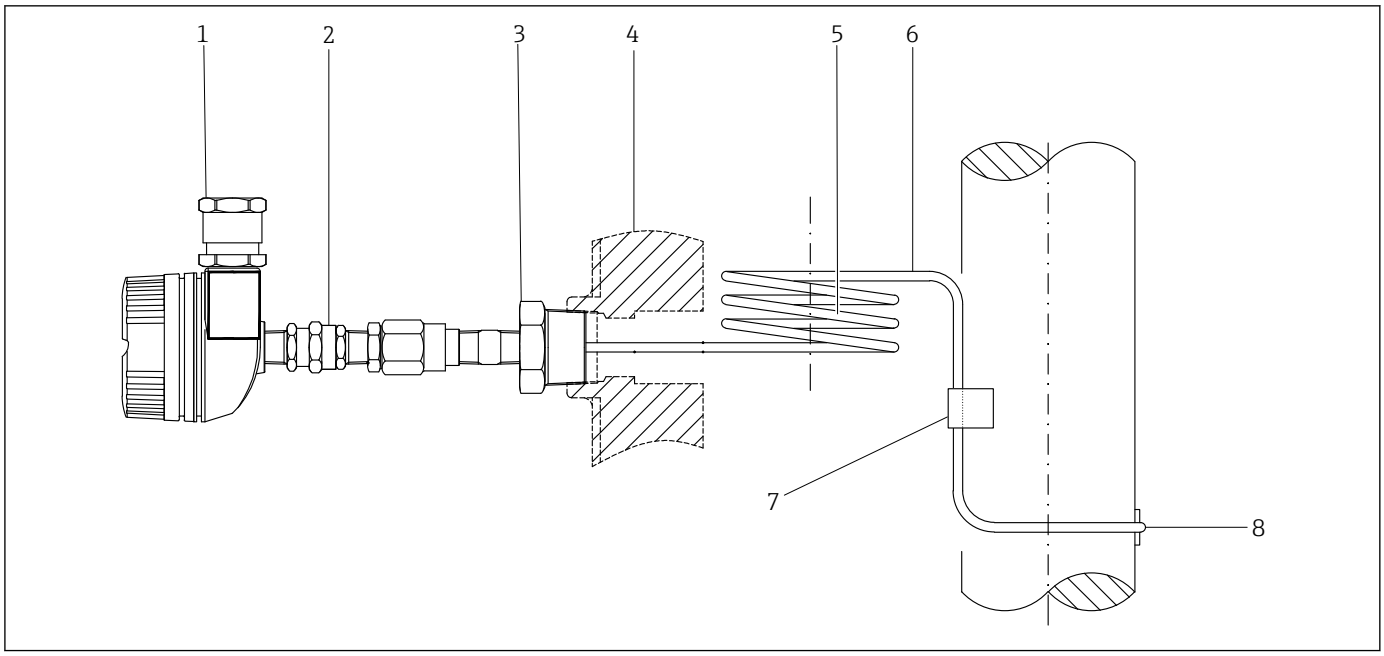
Insulation resistance

Thermocouples:
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

The orientation of the device can influence the measurement accuracy. Measurement accuracy is significantly influenced by the position and welded connection of the sensor tip on the process pipe, as well as by shielding from direct burner exposure. The precise geometry and installation position are specified during the quotation phase.



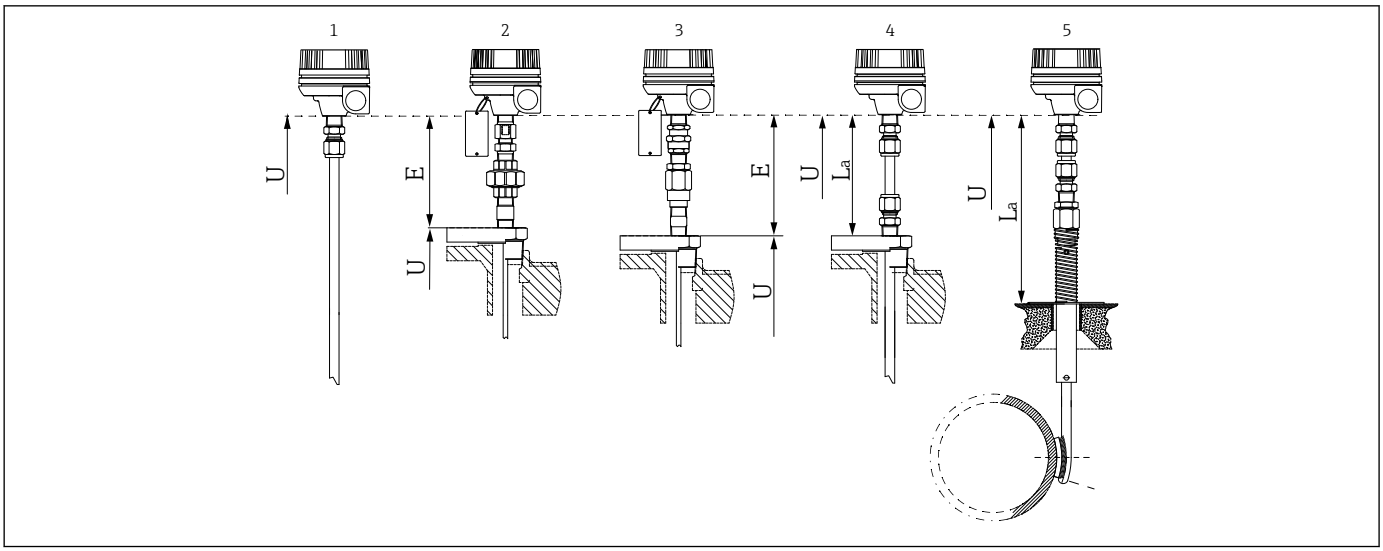
6 *Example configuration of iTHERM SurfaceLine TM691*

1 *Terminal head*
2 *Extension neck*
3 *Threaded process connection*
4 *Vessel or housing outer wall*
5 *Sheathed cable with coils*
6 *Sheathed cable*
7 *Clips for securing the sheathed cable*
8 *Sensor tip on process pipe*

The sensor tip of the tube skin thermometer is attached to the process pipe, and the sheathed cable is routed to the outside through the vessel or housing wall. The terminal head with the extension and the process connection is mounted there.

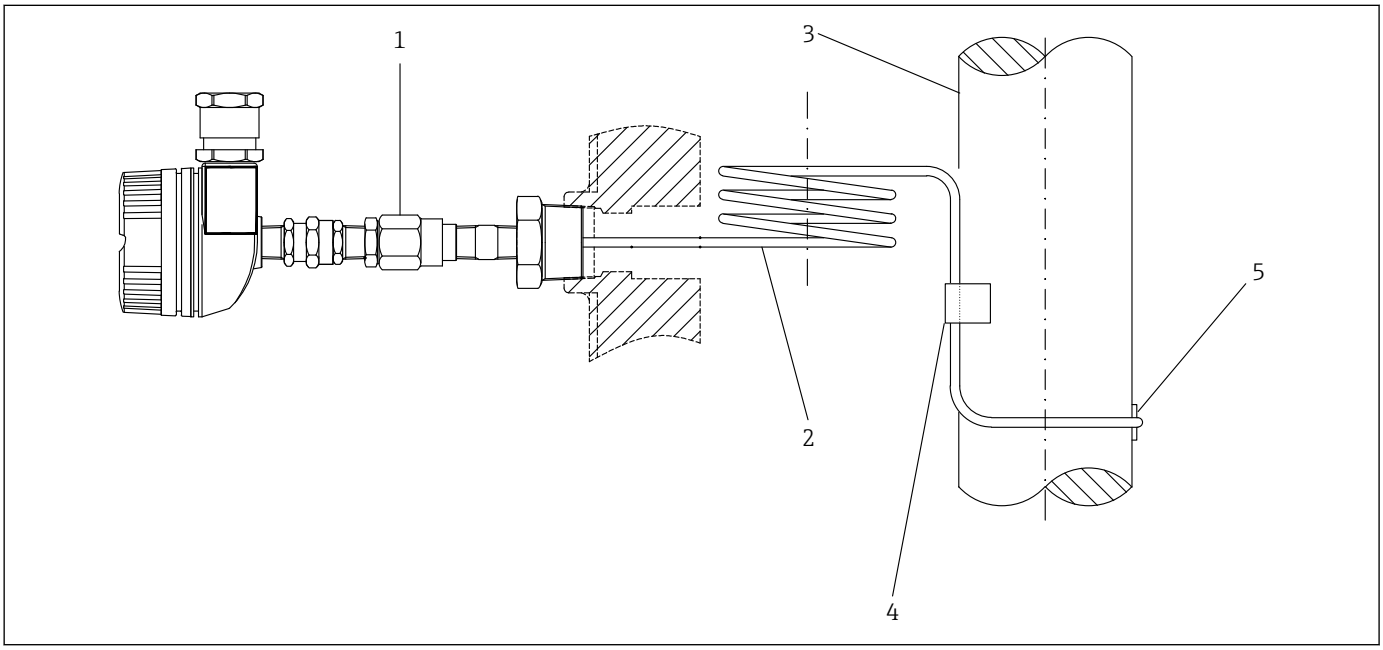
Installation instructions

When welding the sensor tip in place, ensure that the process pipe is free from rust and dirt. The geometry of the sensor tip must be flush with the process pipe. There must be no air gap between the sensor tip geometry and the process pipe. Do not weld the clips to the sheathed cable, since the cable must remain sufficiently flexible to accommodate thermal movement. Weld the clips to the process pipe only.



7 Installation examples for iTHERM SurfaceLine TM691

1 Version without process connection, non-hazardous area
2 Fixed extension with flange/thread, non-hazardous area
3 Fixed extension with flange/thread, hazardous area
4 Adjustable extension, with flange/thread, non-hazardous area
5 Version with spring-loaded disk, non-hazardous area
E Fixed extension
La Adjustable extension
U Linear length



8 Typical installation in a fired heater

1 Terminal head with extension neck
2 Sheathed cable with coils
3 Process pipe
4 Clips for securing the sheathed cable
5 Welded-on sensor tip

For installation in a fired heater, the sheathed cable with coils is removed together with the terminal head and extension. The sheathed cable is welded to the process pipe inside the furnace. The sheathed cable is then routed from the inside of the furnace to the outside. The terminal head and extension are subsequently installed. Clips welded to the process pipe secure the sheathed cable.

Environment

Ambient temperature range

Terminal head	Temperature in °C (°F)
Without mounted head transmitter	Depends on the terminal head used and the cable gland and 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 60564-1, 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

Vibration resistance

The manufacturer's inserts exceed the requirements of IEC 60751 for shock and vibration resistance of 3g over a frequency 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
Thermocouple TC, type J, K, N	≤ 30 m/s² (≤ 3g)

1) Selection depends 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 sensor type and the material used, max. −200 to 1 100 °C (−328 to 2 012 °F).

Process pressure range

In some applications, the atmospheric pressure may also be in the vacuum range.

Pressure range:
Max. 50 bar (725 psi) up to 400 °C (752 °F)

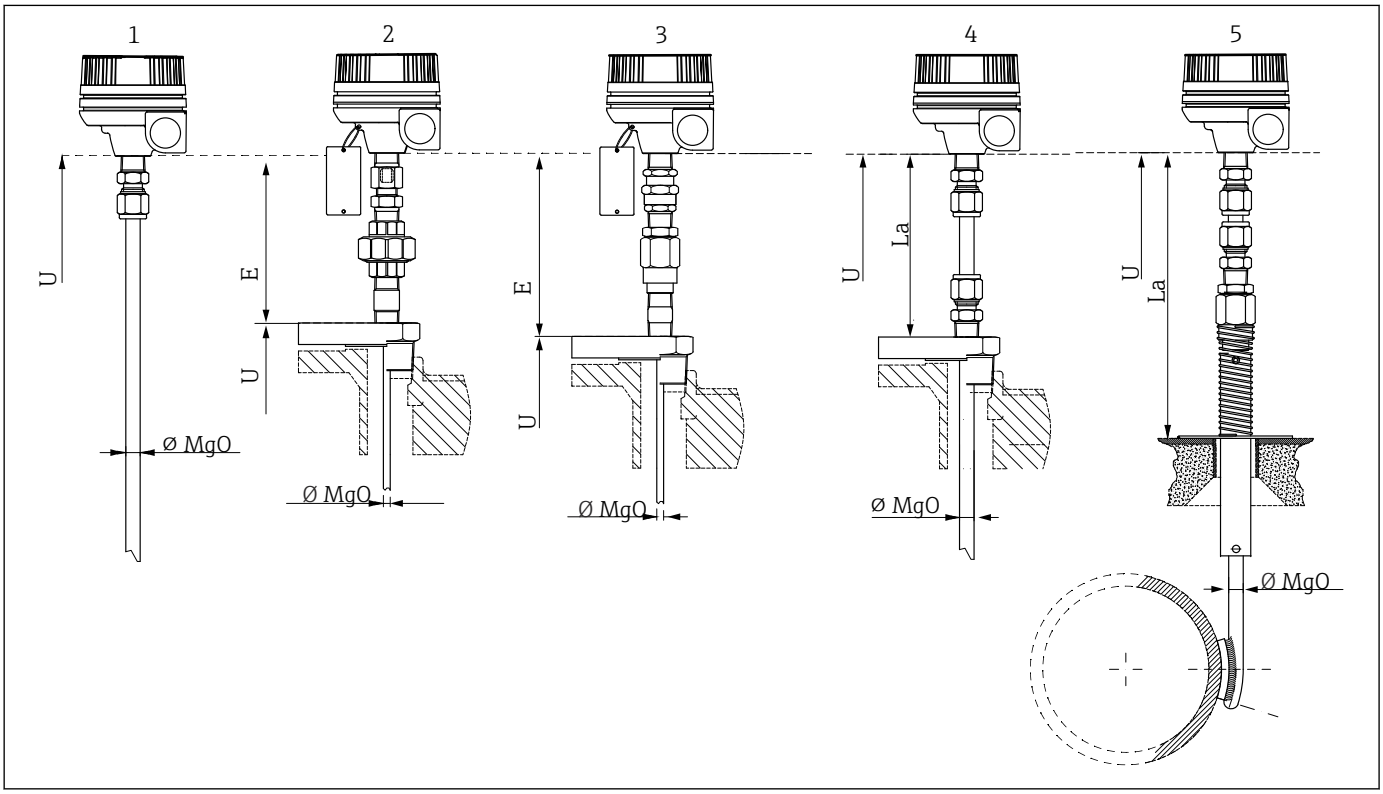
The maximum possible process pressure depends on various influencing factors, such as the design, process connection and process temperature. For information on the maximum possible process pressures for the individual process connections, see the "Process connection" section.

Mechanical construction

Design and dimensions

All dimensions in mm (inches).

Dimensions such as the immersion length U and the extension neck length E are variable values and are therefore indicated as items in the following dimensional drawings.

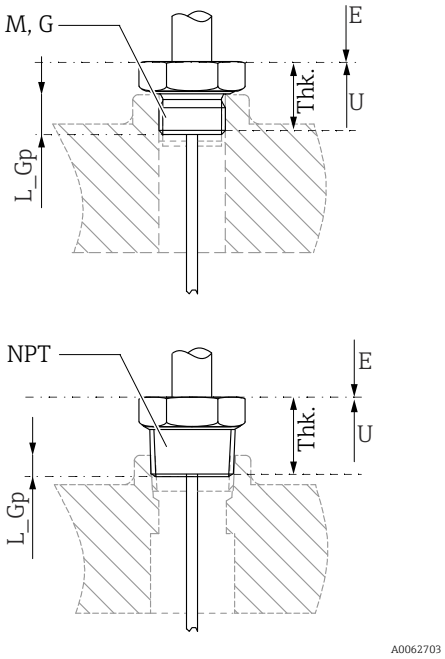


A Version without process connection, non-hazardous area
B Fixed extension with flange/thread, non-hazardous area
C Fixed extension with flange/thread, hazardous area
D Adjustable extension, with flange/thread, non-hazardous area
E Version with spring-loaded disk, non-hazardous area

Version	**Ø Diameter MgO**
1	12.7 mm (5 in)
2	6 mm (0.23 in) 8 mm (0.31 in)
3	6 mm (0.23 in) 8 mm (0.31 in) 12.7 mm (5 in)
4	12.7 mm (5 in)
5	12.7 mm (5 in)

Process connections

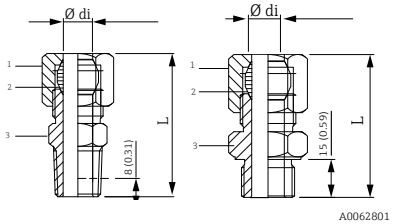
Threaded process connection

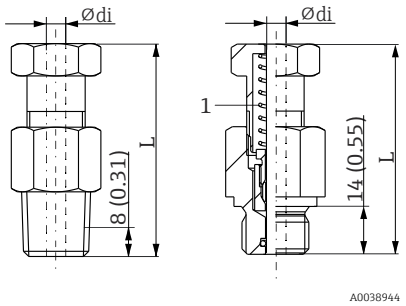
Threaded process connection	Version		Thread length L_Gp	Standard	Connection thickness	Max. process pressure
	M	M20x1.5	14 mm (0.55 in)	ASME B1.13M ISO 965-1 g6	30 mm (1.18 in)	Maximum static process pressure for threaded process connection: [1] 400 bar (5 802 psi) at 400 °C (752 °F)
		M25x1.5	15 mm (0.6 in)		30 mm (1.18 in)	
		M27x1.5	16 mm (0.63 in)		30 mm (1.18 in)	
		M32x1.5	18 mm (0.71 in)		35 mm (1.37 in)	
		M40x1.5	20 mm (0.79 in)		35 mm (1.37 in)	
	G	G ½"	15 mm (0.6 in)	ISO 228-1 A	30 mm (1.18 in)	
		G ¾"	15 mm (0.6 in)		30 mm (1.18 in)	
		G 1"	18 mm (0.71 in)		35 mm (1.37 in)	
		G 1¼"	18 mm (0.71 in)		35 mm (1.37 in)	
		G1½"	20 mm (0.79 in)		35 mm (1.37 in)	
	NPT	NPT ½"	8 mm (0.32 in)	ANSI B1.20.1	30 mm (1.18 in)	
		NPT ¾"	8 mm (0.32 in)		30 mm (1.18 in)	
		NPT 1"	10 mm (0.39 in)		35 mm (1.37 in)	
		NPT1¼"	10.5 mm (0.41 in)		35 mm (1.37 in)	
		NPT1½"	10.5 mm (0.41 in)		35 mm (1.37 in)	

9 Cylindrical (left side) and conical (right side) version

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

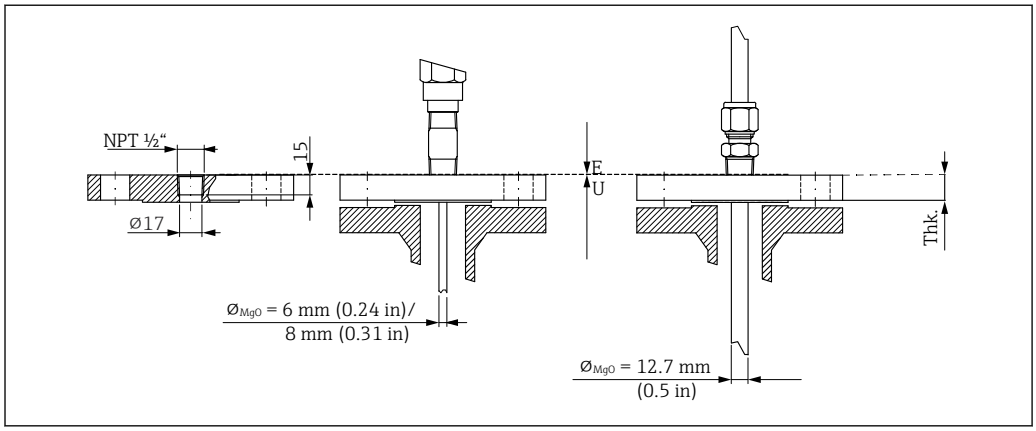
Compression fitting

Type TK40	Version	Dimensions		Technical properties
		ø di	Width across flats	
 *1 Nut* *2 Ferrule* *3 Process connection*	NPT ½", L = approx. 62 mm (2.44 in) G ½", L = approx. 56 mm (2.20 in) Ferrule material 316L Tightening torque 25 Nm (316L)	12.7 mm (0.5 in)	G½": 27 mm (1.06 in) NPT ½": 24 mm (0.95 in)	▪ $P_{max.}$ = 40 bar (104 psi) at T = 200 °C (392 °F) for 316L material ▪ $P_{max.}$ = 25 bar (77 psi) at T = 400 °C (752 °F) for 316L material

Spring-loaded version as option				
Type TK40	**Version**	**Dimensions**		**Technical properties**
		Ø di	**Width across flats**	
 *1 Spring*	NPT 3/4", L = approx. 105 mm (4.13 in) G 3/4", L = approx. 100 mm (3.93 in)	12.7 mm (5 in)	G½" : 32 mm (1.25 in), NPT½": 36 mm (1.41 in)	It is not pressure tight. Use only in combination with a thermowell or in air as the process medium. Tightening torque ▪ G½": 40 Nm ▪ NPT½": 55 Nm

Flanges

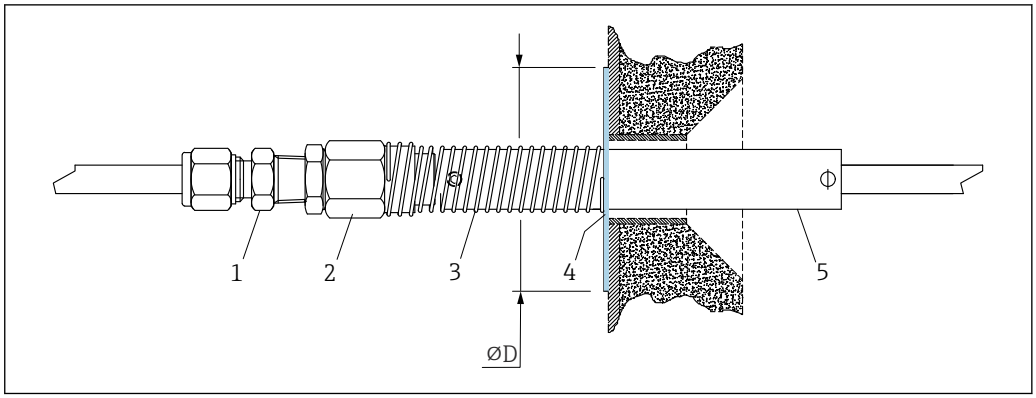
Types
- EN flanges: European standard DIN EN 1092-1:2002-06 and 2007
- ASME flanges: American Society of Mechanical Engineers ASME B16.5-2013



Thk. = Connection thickness

Flange size and pressure rating	Connection thickness
Flange ANSI 1", 150 RF B16.5	14.3 mm (0.56 in)
Flange ANSI 1", 300 RF B16.5	17.5 mm (0.68 in)
Flange ANSI 1", 600 RF B16.5	23.9 mm (0.94 in)
Flange ANSI 1-1/2", 150 RF B16.5	17.5 mm (0.68 in)
Flange ANSI 1-1/2", 300 RF B16.5	20.6 mm (0.81 in)
Flange ANSI 1-1/2", 600 RF B16.5	28.6 mm (1.12 in)
Flange ANSI 2", 150 RF B16.5	19 mm (0.74 in)
Flange ANSI 2", 300 RF B16.5	22.2 mm (0.87 in)
Flange ANSI 2", 600 RF B16.5	31.8 mm (1.25 in)
Flange DN25 PN40 B1 EN 1092-1	18 mm (0.70 in)
Flange DN40 PN40 B1 EN 1092-1	18 mm (0.70 in)
Flange DN50 PN40 B1 EN 1092-1	20 mm (0.78 in)

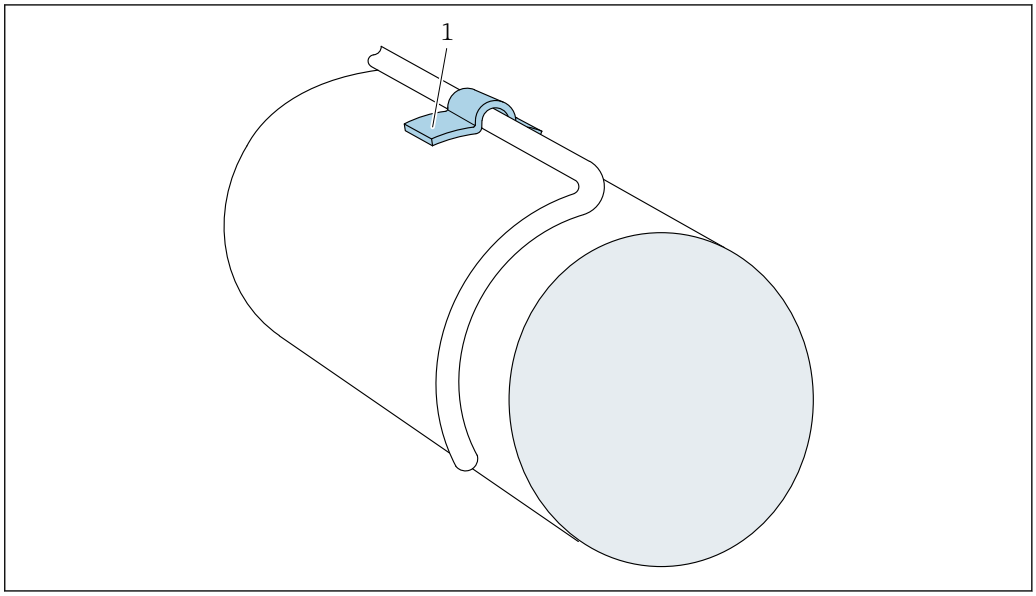
Spring-loaded disk



1 Compression fitting
2 Union
3 Spring
4 Disk, material AISI 304
ØD disk diameter: 100 mm (3.94 in) or 200 mm (7.87 in)
5 ¾" pipe, Alloy600 material

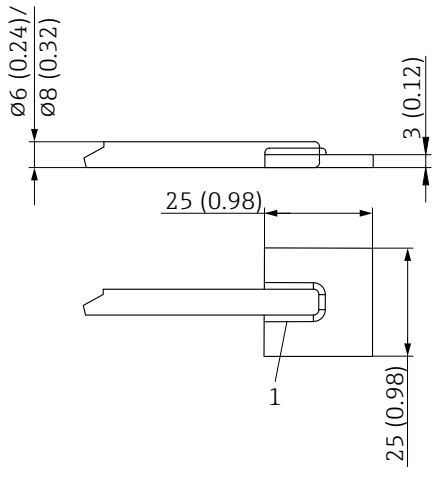
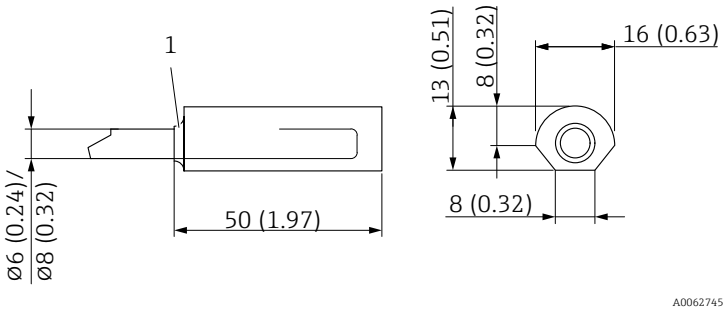
Clips

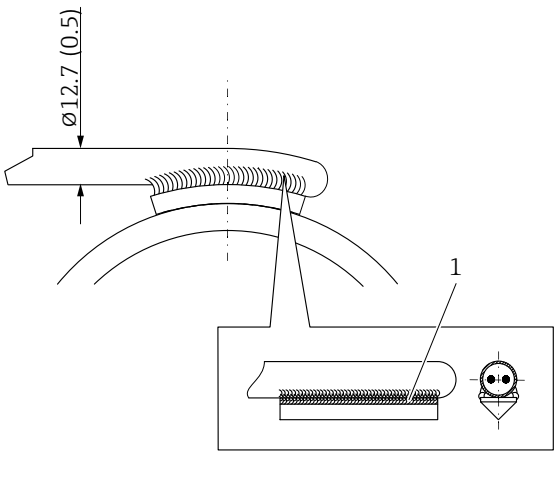
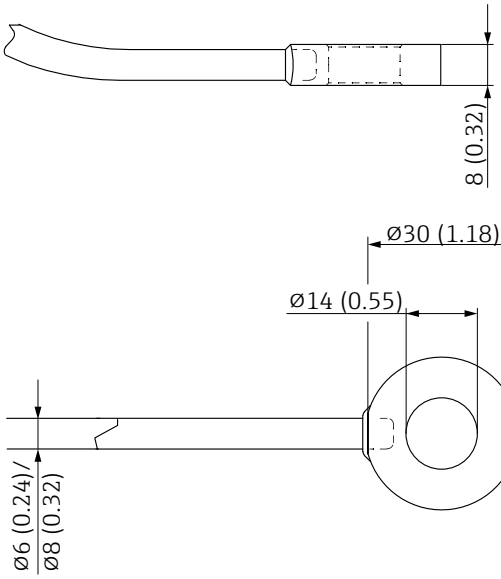
Clips are used to additionally secure the sheathed cable to the pipe surface. The exact dimensions are adapted to the sheathed cable.



1 Clip welded on site

Connection to the sensor tip

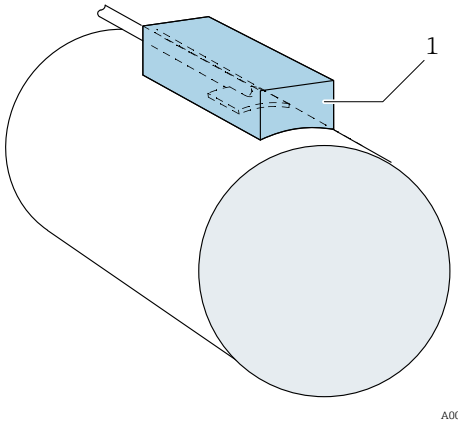
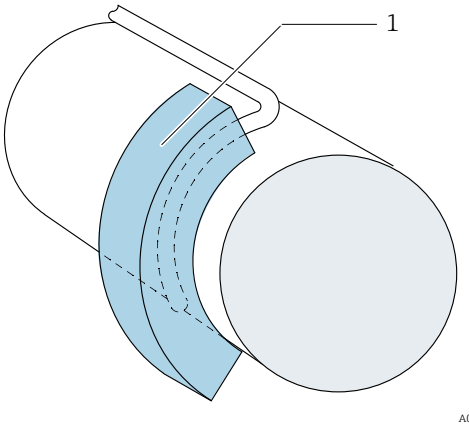
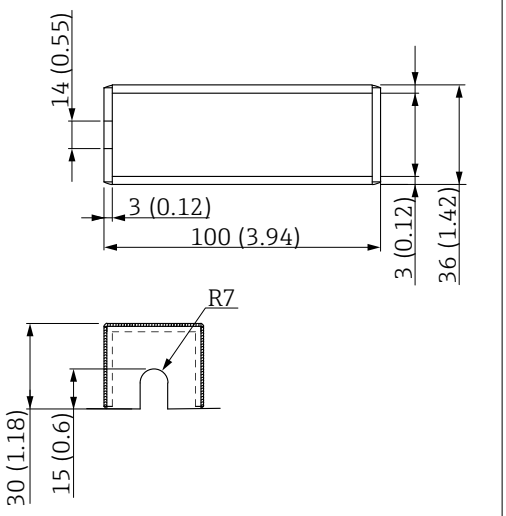
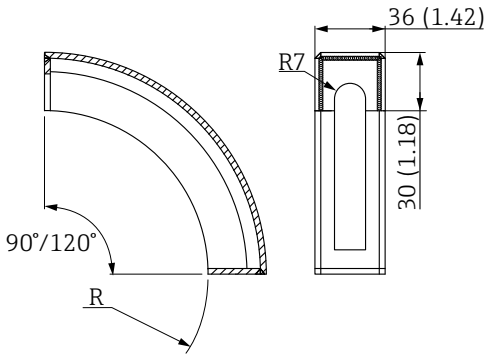
WeldPad	 *1 TIG welding*
FanType	 *1 TIG welding*

KnifeEdge	 *1 TIG welding*
Washer	

Sensor tip protection

The sensor tip protection reduces the thermal load on the sensor tip in installation situations in the immediate vicinity of the burner. It also improves measurement of the tube skin temperature.

Versions [1)]

Straight version	Radial version
	
1 Welded on site	*1 Welded on site*
Dimensions in mm (inches)	Dimensions in mm (inches)
	

1) Depends on the orientation.

The protection is available in the following materials: AISI 310, Alloy 600, AISI 446. Optionally, the protection can be filled with ceramic insulation.

Inserts

TC sensor type [1)]	Type K	Type J	Type N
Sensor design	Mineral-insulated sheathed cable		
Vibration resistance of the 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		

1) Options depend on product and configuration

Sheathed cable

The overview shows the combinations of thermocouple and sheathed cable material available as standard. All other combinations are available on request as a Technical Special Product (TSP).

Material	Diameter		
	øD 6 mm (0.23 in)	**øD 8 mm (0.31 in)**	**øD 12.7 mm (5 in)**
Alloy600	Type K, N	Type K, N	Type K
AlloyC276	--	Type K	--
AlloyX	--	Type K	Type K
446	--	--	Type K
310	Type K	Type K	Type K
316	Type J, K	--	--
Pyrosil	Type N	--	--
HR160	--	Type K	--

Wall thickness

ø D	Standard wall thickness		Heavy wall	
	1x TC	**2x TC**	**1x TC**	**2x TC**
6 mm (0.24 in)	--	--	0.90 mm (0.35 in)	0.84 mm (0.33 in)
8 mm (0.31 in)	0.80 mm (0.31 in)	0.72 mm (0.28 in)	1.20 mm (0.47 in)	1.12 mm (0.44 in)
9.5 mm (0.37 in)	0.95 mm (0.37 in)	0.86 mm (0.33 in)	1.42 mm (0.55 in)	1.33 mm (0.52 in)
10.8 mm (0.43 in)	1.08 mm (0.42 in)	0.97 mm (0.38 in)	1.62 mm (0.63 in)	1.51 mm (0.59 in)
12.7 mm (0.50 in)	1.27 mm (0.50 in)	1.14 mm (0.44 in)	1.90 mm (0.74 in)	1.78 mm (0.70 in)

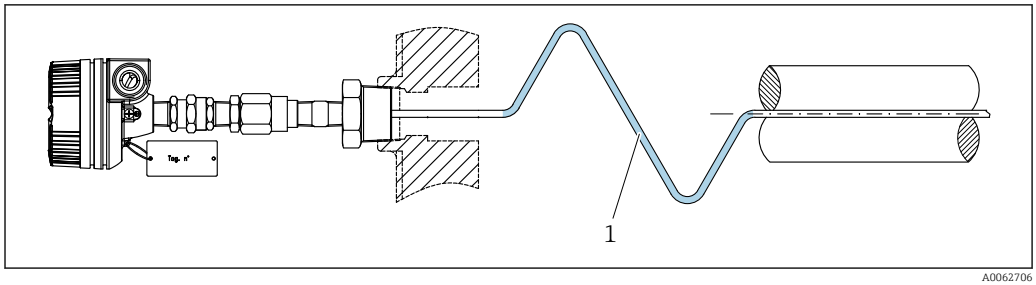
Maximum process temperature for sheathed cable

Material	Max. process temperature
Alloy600	1 130 °C
AlloyC276	1 080 °C
AlloyX	1 180 °C
446	1 130 °C
310	1 130 °C
316	850 °C
Pyrosil	1 230 °C
316L	850 °C
HR160	1 190 °C

Expansion compensation

Various types of expansion compensations are used to accommodate pipe movement resulting from thermal expansion, particularly during start-up until operating temperature is reached. The design depends on the installation position and space available.

S-shape



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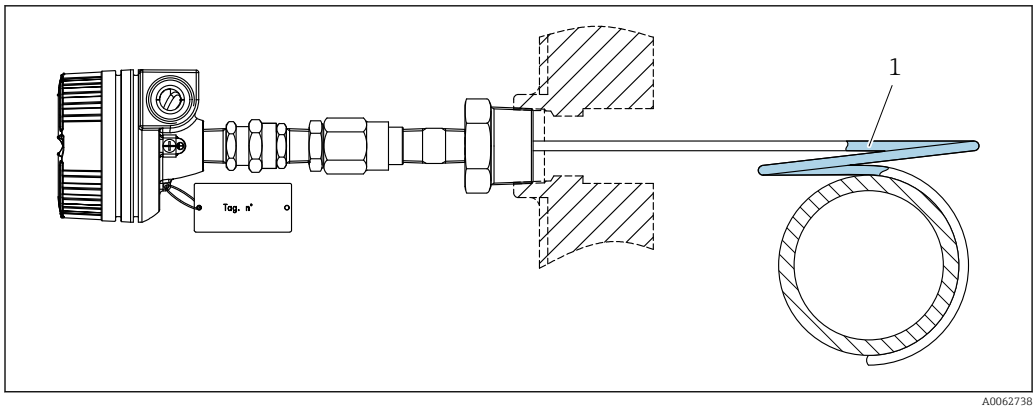
1 S-shaped expansion compensation

Single coil



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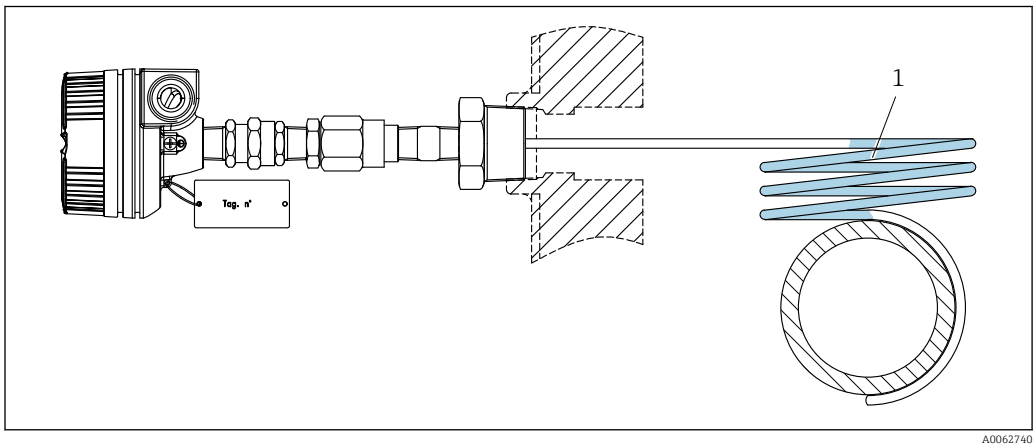
1 Single coil as expansion compensation

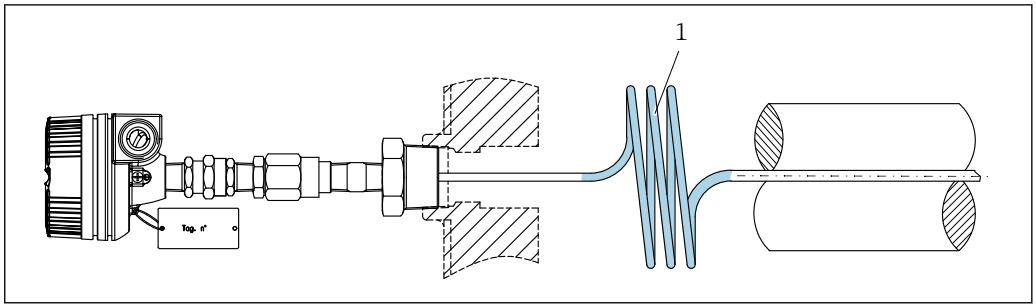
Multiple coils



A0062740

1 Multiple coils as expansion compensation

Spiral coils

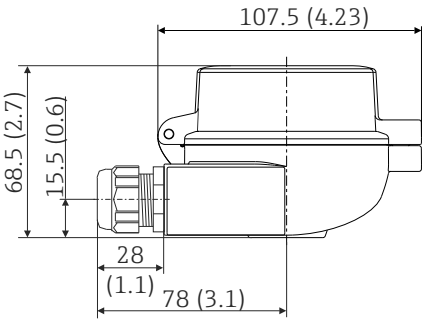


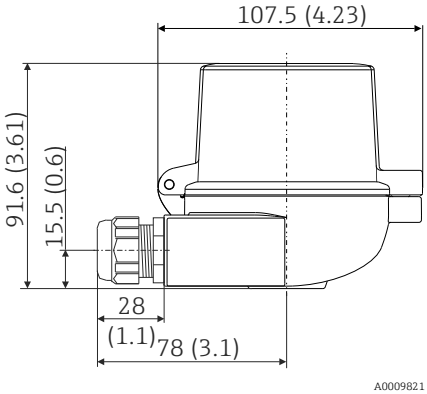
1 Spiral coils as expansion compensation

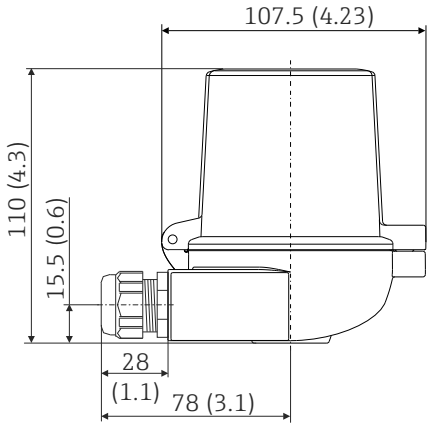
Terminal heads

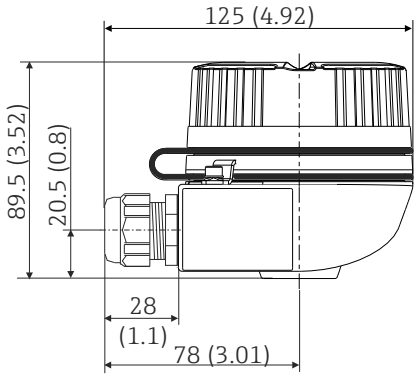
All terminal heads have an internal shape and size in accordance with DIN EN 50446, flat face, and a thermometer connection with a M24x1.5 or ½" NPT thread. All dimensions in mm (inches). The sample cable glands in the diagrams correspond to M20x1.5 connections with non-Ex polyamide cable glands. Specifications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

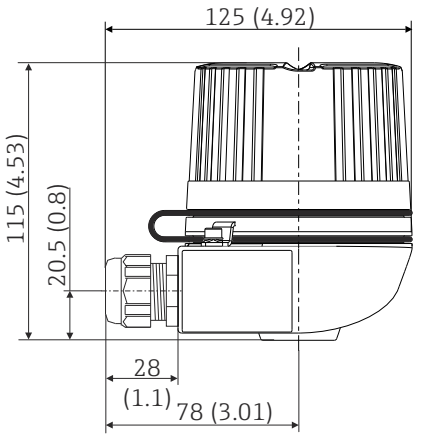
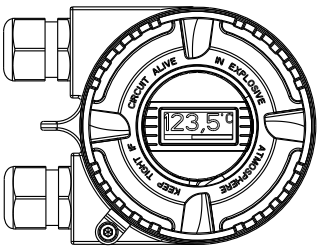
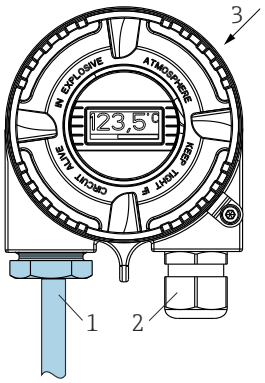
As a special feature, the manufacturer offers terminal heads with optimum access to the terminals for easy installation and maintenance.

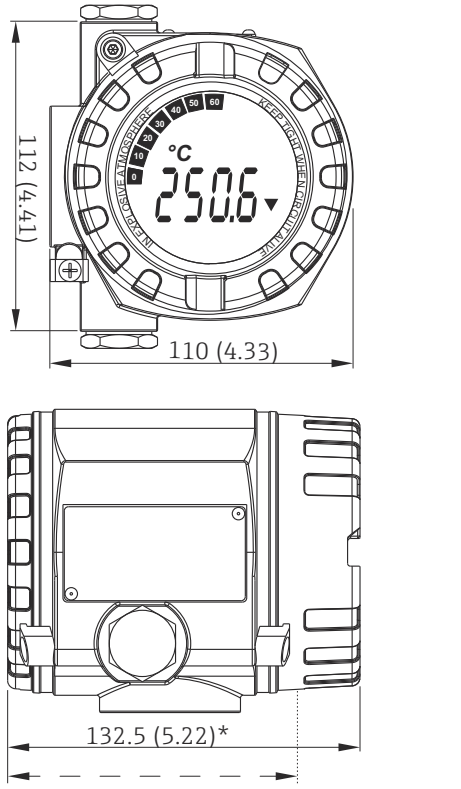
TA30A	Specification
	▪ Degree of protection: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Temperature: −50 to 150 °C (−58 to 302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", NPT ½" and M20x1.5; ▪ Head color: blue, RAL 5012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

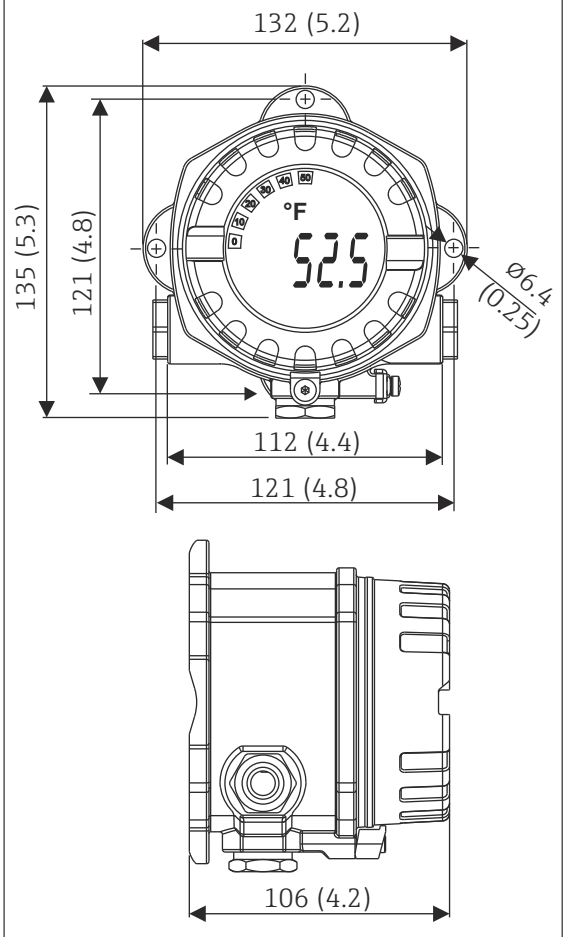
TA30A with display window in cover	Specification
	▪ Degree of protection: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Temperature: −50 to 150 °C (−58 to 302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", NPT ½" and M20x1.5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

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).

TA30H with display window in cover	Specification
  A0009831  A0044217 *10 Terminal head used as field housing with display frontal mounted* *1 One cable input serves as a sensor input channel with an 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: ▪ Aluminum 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).

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

Cable glands and connectors depend on the product and configuration.

Type	Suitable for cable entry	Degree of protection	Temperature range	Suitable cable diameter
Cable gland, polyamide blue (indication of Ex-i circuit)	NPT ½"	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)	-

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)	-

Cable glands are not available for encapsulated, flameproof thermometers.

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**.

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

Modems/Edge devices

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

Software

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.

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.

www.endress.com/sfe500

Online tools

Product information about the entire life cycle of the device is available at:
www.endress.com/onlinetools

System components

Data Manager of the RSG product family

Data Managers are flexible and powerful systems to organize process values. Up to 20 universal inputs and up to 14 digital inputs for direct connection of sensors, optionally with HART, are available as an option. The measured process values are clearly presented on the display and logged safely, monitored for limit values and analyzed. The values can be forwarded via common communication protocols to higher-level systems and connected to one another via individual plant modules.

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

Process indicators from the RIA product family

Easily readable process indicators with various functions: loop-powered indicators for displaying 4-20 mA 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

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Document type	Purpose and content of the document
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Document type	Purpose and content of the document
Safety Instructions (XA)	Safety Instructions for electrical equipment in hazardous areas are supplied with the product depending on the approval. These are an integral part of the Operating Instructions. The nameplate indicates the Safety Instructions (XA) that are relevant to the product.
Supplementary device-dependent documentation (SD/CY/ FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the product documentation.

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