Technical information
TI 248T/02/en
60017796

Thermocouple temperature sensor omnigrad S TSC 266

Thermometer with EEx d certification
Lamination nipple and/or 3 elements coupling
Thermowell made from a metal bar

The Omnigrad S TSC 266 is an industrial thermometer with thermocouple (type J, K), developed for the use in the chemical, petrochemical and energy industries but suitable also for other generic applications.
The TSC 266 is supplied with EEx d certification, in compliance with European standards EN 50014 and EN 50018, and is therefore suitable also for industrial areas with potentially explosive environments.
The unit is usually fitted on pipes or tanks by means of threaded or flanged process connections.
The TSC 266, which is available in several standard versions and different configurations, can also be configured with specific dimensions and characteristics depending on process requirements.

Features and benefits

- Several types of process connections
- Thermowell available in several materials
- Material certification in accordance with 3.1.B, NACE or PMI
- Transmitters with 2-wire technology (PCP 4...20 mA, HART®, PROFIBUS-PA®)
- Customisable immersion length
- Thermowells compliant with standard ENI and Montedison, made of a bar, also of a significant length
- Head/thermowell connection fitting in SS 304 (nipple + 3 elements coupling + nipple)
- Explosion-proof enclosure with EEx d certification and lamination coupling on the insert
- Mineral oxide replaceable insert (MgO)
- Thermocouple sensing element type J or K

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Areas of application

The TSC 266 can also be used in generic industrial applications but is particularly suitable for EEx d certified applications like:
- chemical industry
- petrochemical industry
- energy industry
- gas processing industry.

Function and system design

Measuring principle

The thermocouple thermometer's sensing element consists of two metal wires that are homogenous but different one from the other and insulated along their entire length. The two wires are welded together at one end, known as the “measurement or hot junction”. The other end, where the wires are free, is known as the “cold or reference junction” and is connected to a electromotive force measurement where the force is generated by the different thermoelectric power of each of the thermocouple's wires if there is a temperature difference between the hot joint (T_1) and the cold joint (Seebeck effect). The cold junction has to be “compensated” with reference to the temperature of 0°C (T_0).
The function that links the electromotive force to the temperatures T_1 and T_0 is a curve whose characteristics depend on the materials used in the construction of the thermcouple. Some thermocouples curves, and particularly those most reliable for the purposes of industrial readings, are those compliant with standards DIN EN 60584 and ANSI MC96.1.

Equipment architecture

The TSC 266 thermocouple thermometer comprises:
- an EEx d certified aluminium housing
- an insert with thermocouple (type J or K), insulated with mineral oxide (MgO), with oversheath and terminals on a ceramic support
- lamination nipple and 3 elements coupling
- thermowell made from a bar with threaded or flanged process connection.

Dimensions are determined as follows (fig. 1):
- N = length of the head/thermowell connection fitting
- A = total length of the thermowell
- U = immersion length of the thermowell
- T = length of the extension neck of the thermowell
- ØDf = diameter of the internal hole of the thermowell
- ØD1 = diameter of the extension neck of the thermowell
- ØQ1 = diameter of the area below the thermowell process connection
- ØQ2 = diameter of the lower side of the thermowell.

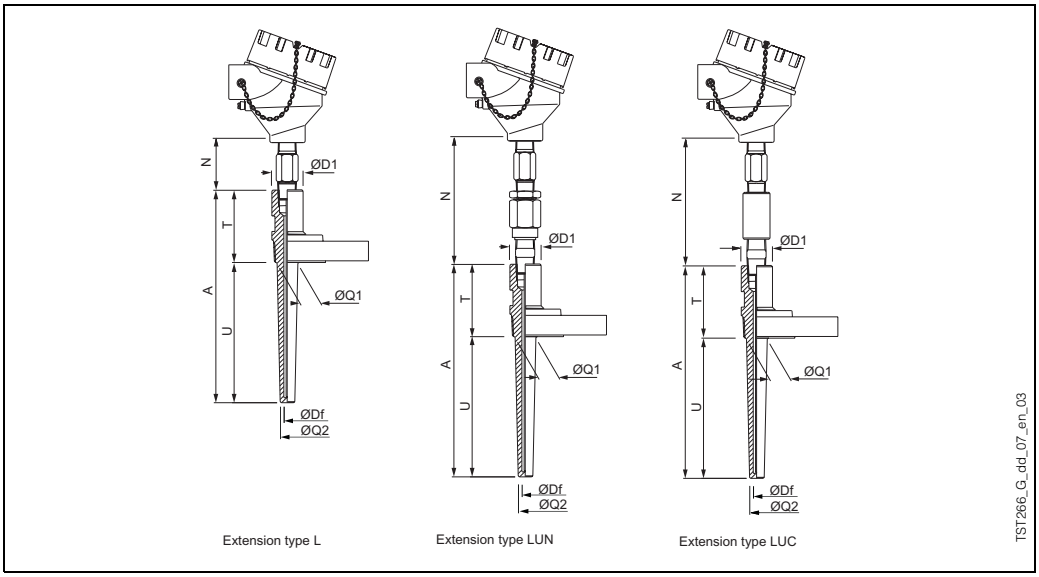


Fig. 1: General information on sizes

Material

Housing: treated and painted aluminium alloy.
Measuring insert: external sheath in SS 316/1.4401, Inconel® 600/2.4816.
Head/thermowell connection: SS 304/1.4301.
Thermowell: SS 316/1.4401, SS 316L/1.4404, Hastelloy® C276/2.4819, Monel® 400/2.4360, Inconel® 600/2.4816.

Weight

From 1 to 5 Kg for standard options.

Electronics

The required type of output signal can be obtained by choosing the correct head-mounted transmitter.
Endress+Hauser supplies "state-of-the-art" transmitters (the iTEMP® series) built in 2-wire technology and with 4…20 mA output signal, HART® or PROFIBUS-PA®. All transmitters can be easily programmed using a personal computer and the ReadWin® 2000 public domain software (for transmitters 4…20 mA and HART®) or the Commuwin II software (for PROFIBUS-PA® transmitters). HART® transmitters can also be programmed with the hand-held operating module DXR 275 (Universal HART® Communicator).
For more detailed information on the transmitters, see the related documentation (codes TI at the end of this document).
If no head transmitter is used, it is also possible to connect the thermocouple to a remote transmitter DIN-rail.

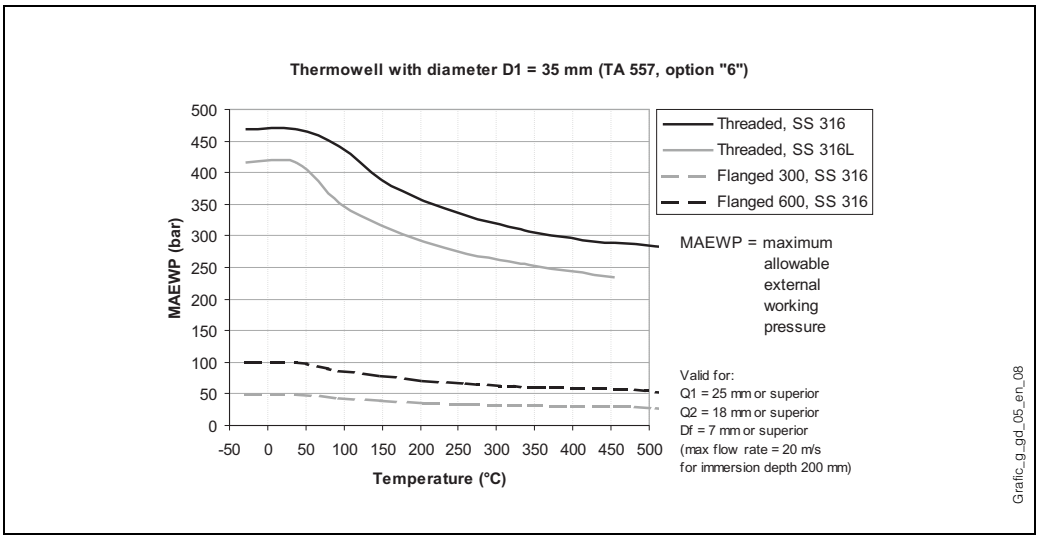
Performance

Operating conditions

Ambient temperature
- Metal head with terminal block and without transmitter -40÷130°C
- Metal head without terminal block and with transmitter -40÷85°C

Process temperature
Same of measurement range (see below).

Maximum process pressure
The pressure values that the thermowell can withstand at different temperatures, are shown in the following graphs, which can be used for some reference configurations:



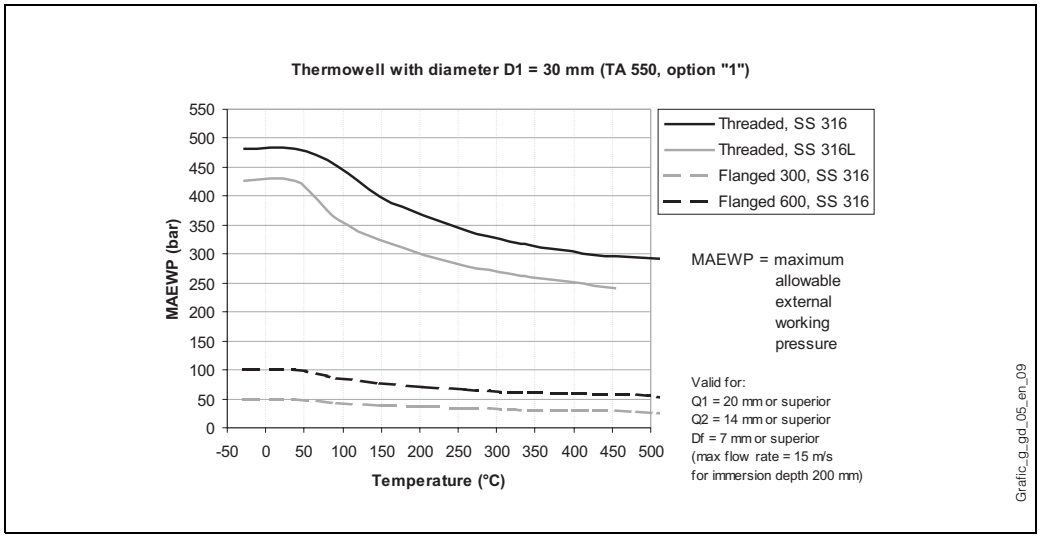


Fig. 2: Pressure / Temperature ratings

Maximum flow rate
The maximum flow rate tolerated by the thermowell decreases as the immersion length increases (U).
The methods used to verify the resistance of thermowells with pressure, temperature and flow rate data can also be compliant with those indicated in standard ASME/ANSI PTC 19.3. For assistance on resistance verifications, please contact the E+H Customer Service Department.

Shock and vibration resistance
According to DIN EN 60751 — 3 g di peak / 10÷500 Hz

Accuracy

The tolerances set by the standard DIN EN 60584 are the following:

Type	Standard tolerance (DIN EN 60584)		Special tolerance (DIN EN 60584)	
	Class	Max. deviation	Class	Max. deviation
J (Fe-CuNi)	2	+/-2.5°C (-40...333°C) +/-0.0075|t| (333...750°C)	1	+/-1.5°C (-40...375°C) +/-0.004|t| (375...750°C)
K (NiCr-Ni)	2	+/-2.5°C (-40...333°C) +/-0.0075|t| (333...1200°C)	1	+/-1.5°C (-40...375°C) +/-0.004|t| (375...1000°C)

Note! (|t|=absolute temperature value in °C)

Transmitter maximum error
See the corresponding documentation (codes are shown at the end of this document).

Measurement range

- Type J sensor: -40...750°C
- Type K sensor: -40...1100°C

Response time

Tests in water at 0.4 m/s (according to DIN EN 60751; temperature variation from 23 to 33°C), only on the TC thermometer insert:
- t_{50}: 2.5 s
- t_{90}: 7 s

Insulation

Insulation resistance between terminals and probe sheath (in accordance with DIN EN 60584, test voltage 500 Vdc): > 1 GΩ at 25°C; > 5 MΩ at 500°C

Installation

The Omnigrad S TSC 266 can be installed on pipes or tanks by means of threaded or flanged connections. The counterparts for process connections and gaskets, when required, are not supplied with the sensor and must be purchased separately by the user.
The immersion length must take into account all the parameters of the thermometer and thermowell in the process to measure. If the immersion is too low, an error may be generated in the temperature recorded due to the lower temperature of the process fluid near to the walls and heat transfer, which takes place through the sensor stem. The incidence of such an error can be not negligible if there is a big difference between the process temperature and the ambient temperature. To prevent measuring errors of this kind, it is advisable to use thermowells with a small diameter and an immersion length (U) of at least 100÷150 mm.
In small section ducts the tubing's axis must be reached and preferably slightly exceeded by the tip of the probe (see fig. 3A-3C). Insulation of the outer part of the sensor reduces the effect produced by a low immersion. Alternatively, it is also possible to adopt a tilted installation (see fig. 3B-3D).
In processes involving gases at very high temperature (>500÷600°C), where radiation effects are important, the immersion length may be a secondary problem.
As far as corrosion is concerned, the base material for parts in contact with the fluid is able to withstand the most common corrosive agents up to the highest temperatures. Even the nipples and 3 elements coupling supplied with the connection fitting of the instrument are able to withstand a wide range of aggressive substances. For further information on specific applications, contact the E+H Customer Service Department.
Disassembled components of the sensors must be reassembled with the recommended clamping torques in order to ensure the appropriate IP protection class within the sensor-housing coupling.

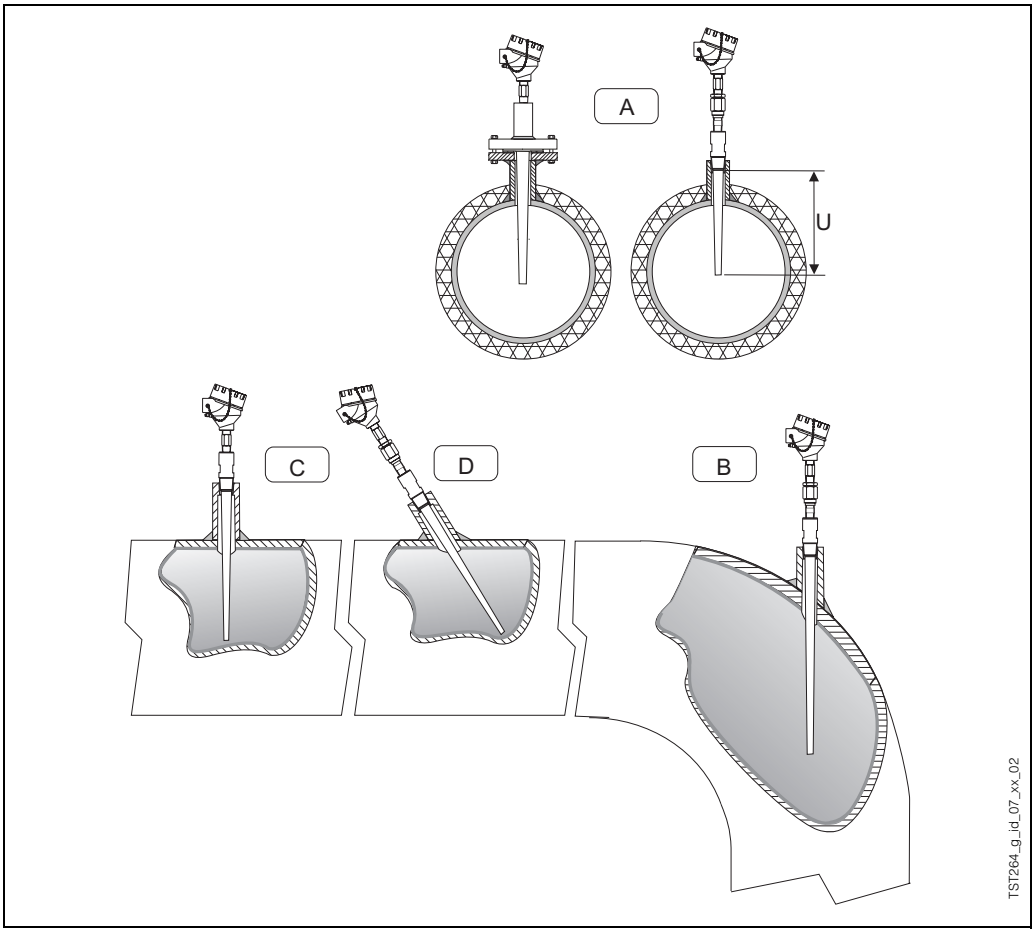


Fig. 3: Installation on pipes and tanks by means of flanged or threaded process connections

System components

Housing

The protection housing, commonly referred to as "connection head" is used to contain and protect the terminal block or the transmitter and to join the electric connections to the mechanical component.
The head used for the TSC 266 is compliant with DIN 43729 (form B) and EN 50014/50018 standards (EEx certification for explosion-proof instruments).
The matching of the head with the extension below the head and the cover (threaded) ensures an IP66 class of protection.
The head also has a chain to connect the body to the cover, which facilitates the use of the instrument during the maintenance on systems.
The single or double electrical cable input has M20x1.5, 1/2" NPT or 3/4" NPT threading.

Head transmitter

Available head transmitters include (see also section "Electronics"):

- TMT 181 — PCP 4…20 mA
- TMT 182 — Smart HART®
- TMT 184 — PROFIBUS-PA®.

The TMT 181 is a PC programmable transmitter.
The TMT 182 output consists of 4…20 mA and HART® superimposed signals.

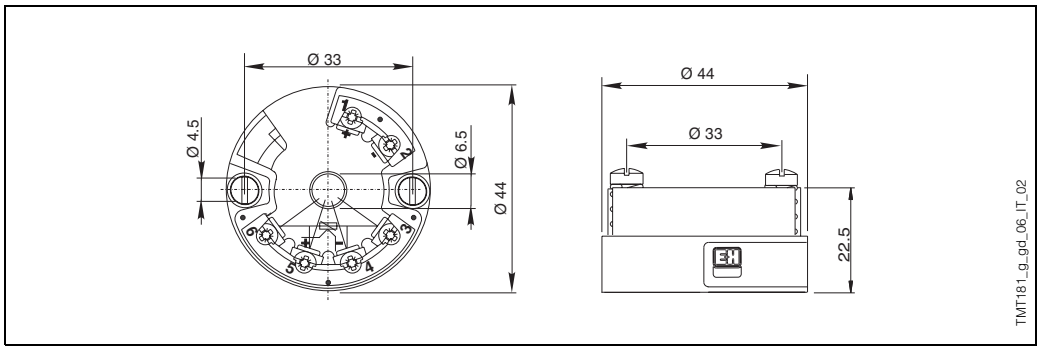


Fig. 4: TMT 181 - 182

In the TMT 184, with a PROFIBUS-PA® output signal, the communication address can be set via software or by means of a mechanical dip-switch (the configuration must be specified by the customer in order phase).

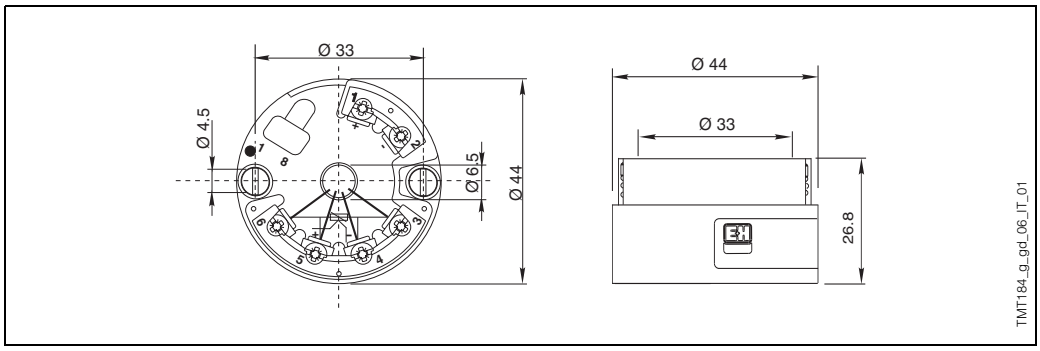
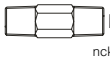
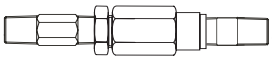
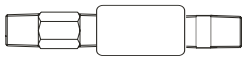


Fig. 5: TMT 184

Extension neck

The extension neck is the part between the thermowell and the transmitter housing. To prevent the process temperature from overheating the area of the transmitter, a special extension "neck" is inserted between the sensor, exposed to high temperature processes, and the transmitter. This enables to limit the operating temperature of the transmitter.
It normally consists of hydraulic connections (nipples and/or joints) that are suitable to allow the adjustment of the sensor to the thermowell.
The standard lengths (N) and the versions of the extension neck can be selected among the following options:

– 52 mm (only 1/2” NPT threaded nipple, type L)
– 148 mm (nipple+3 elements coupling+nipple, type LUN)
– 148 mm (nipple+coupling+nipple, tipe LCN).

Threaded thermowell connections					
Type	**Thread**	**Length N (mm)**	**C (mm)**	**Detail**	**Type of neck**
Male	1/2” NPT	52	8	 ConNPT_G_dd_09_XX_01	 nckLxx_g_gd_15_xx_01
		148			 nckLUN_g_gd_15_xx_02
		148			 nckLCN_g_gd_15_xx_01

Attention! * This neck is available only for 1/2” NPT threads

"LUN" connections enable to orient the transmitter housing.
As illustrated by the chart in figure 6, the length of the sensor + thermowell extension may influence the temperature in the head. It is necessary that this temperature is kept within the limit values defined in the paragraph "Operating conditions".
In addition to the standard versions listed above, it is also possible to order the extension neck by specifying the desired length (see “Sales structure” chart).

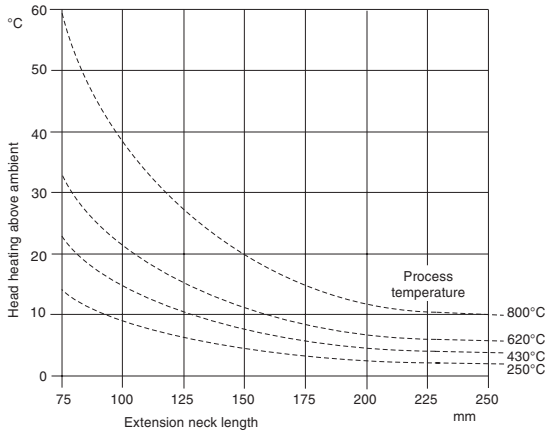


Fig. 6: Heating of the head caused by the process temperature

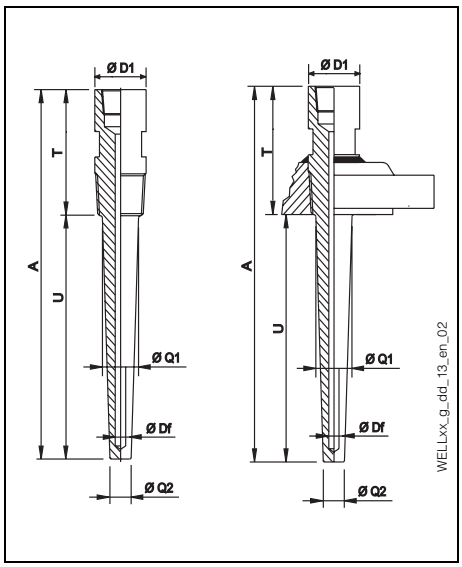
Process connection

Standard process connections differ in that they can be threaded or flanged:
- threaded connections in the same material of the thermowell:
  3/4” NPT, 1” NPT
- flanged connection, in SS 316 or A 105:
  slip-on 1” ANSI 150, 300, 600 RF
  slip-on 1” 1/2 ANSI 150, 300, 600 RF
  slip-on 2” ANSI 300, 600 RF.

Flanges, with standard finishing 125-250 AARH, are bolted and welded to the rear of the thermowell neck.
On request, it is possible to select also different materials, finishings and connections.

Thermowell

The thermowell is the component of the TSC 266 that must tolerate most of the mechanical stress transmitted by the process.
It is made from a round bar and supplied in different materials and dimensions, according the chemical/physical characteristics of the process: corrosion, temperature, pressure and speed of the fluid.



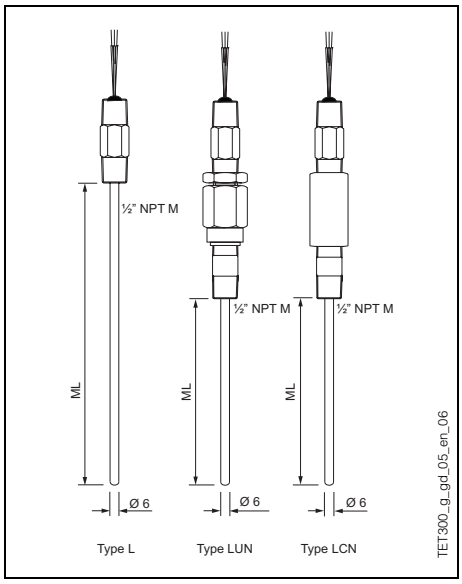
The thermowell consists of three parts:
–the extension neck (indicated as T), usually with a cylindrical shape (and standard diameters of 30 or 35 mm and lengths of 70/100 mm), represents the external part of the thermowell and is connected with the head of the probe by means of a neck (usually a nipple)
–the immersed part (identified as U), with a conical or cylindrical shape (the standard diameter of the area below the fitting is 20 or 25 mm), is situated next to the process connection in direct contact with the process fluid
–the threaded or flanged process connection represents the part inserted between the extension and the immersed part and guarantees the mechanical and hydraulic sealing of the thermometer and plant.
The external finishing of the thermowell stem is available with a standard value of Ra < 1.6 µm (different finishes are available on request).

Fig. 7: Thermowell with threaded or flanged process connection

⚠ Warning! The total standard length (A) of the thermowell must never exceed 1300 mm (that represents the maximum drilling limit; higher lengths are available only on request).

Probe

The measuring probe of sensor TSC 266 consists of a 6 mm diameter thermometric insert (TEC 300) whose stem is made in compressed MgO with SS 316/1.4401 or Inconel® 600/2.4816 (also called mineral insulated cable).



To improve heat transmission, the insert tip is pushed, by means of a spring system, to the inside bottom of the thermowell.
The insert is always supplied with lamination nipple and/or 3 elements coupling.
In case of spare parts, length ML must be calculated depending on the thermowell total length, using the formula: ML = A-11.

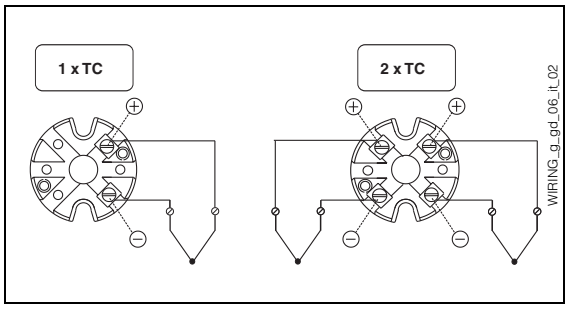


Fig. 8: Probe, dimensions and internal wiring

Certificates & Approvals

Ex approval

Certificate CESI 03 ATEX 114, 1/2 GD IIC EEx d T5/T6.

PED approval

The Pressure Equipment Directive (97/23/CE) is respected. As paragraph 2.1 of Article 1 is not applicable to this kind of instrument, the marking CE is not mandatory for TSC 266 models used for generic applications.

Material certification

The material certification can be selected directly in the sales structure and is available in different typologies. Certificate 3.1.B includes a statement that contains all the documents related to the material employed for the manufacture of each thermowell, along with a marking, consisting in a code punched on the thermowell, that guarantees the traceability of the product.
In the sales structure are also available other certifications related to materials which integrate the 3.1.B:

- 3.1.C certification
- NACE MR 0175 certification
- PMI certification.

Further details

Maintenance

The TSC 266 does not require specific maintenance.

Delivery time

For small orders (5÷10 units) and standard options, the delivery time is 25 working days.

Ordering information

Sales structure

TSC 266	Neck length N, material, type of connection			
	1	52 mm	SS 304	type L 1/2" NPT-M
	2	148 mm	SS 304	type LUN 1/2" NPT-M
	3	148 mm	SS 304	type LCN 1/2" NPT-M
	9	Extension length to specify		

	TC type, sheath material, standard, hot junction				
	A	1xTC - K,	Inconel® 600,	IEC 584 cl.2,	grounded
	C	1xTC - J,	AISI 316,	IEC 584 cl.2,	grounded
	E	1xTC - K,	Inconel® 600,	ANSI MC96.1,	grounded
	G	1xTC - J,	AISI 316,	ANSI MC96.1,	grounded
	1	1xTC - K,	Inconel® 600,	IEC 584 cl.2,	isolated
	3	1xTC - J,	AISI 316,	IEC 584 cl.2,	isolated
	5	1xTC - K,	Inconel® 600,	ANSI MC96.1,	isolated
	7	1xTC - J,	AISI 316,	ANSI MC96.1,	isolated
	Y	Special version			

		Type of terminal
	2	Flying leads
	3	Terminal block

		Thermowell dimensions: ext. "T", diam. D1, Df, Q1, Q2, finishing
	1	70 mm = T, D1 = 30 mm, Df = 7 mm, Q1 = 20 mm, Q2 = 14 mm, finishing 1,6 micron
	6	100 mm = T, D1 = 35 mm, Df = 7 mm, Q1 = 25 mm, Q2 = 18 mm, finishing 1,6 micron
	9	... mm = T, D1 = ... mm, Df = ... mm, Q1= ... mm, Q2 = ... mm, finishing to specify

		Immersion length "U"
	X	... mm immersion length to specify
	Y	... mm special immersion length

		Thermowell material
	C	Thermowell material AISI 316 - W 1.4401
	D	Thermowell material AISI 316L - W 1.4404
	H	Thermowell material Hastelloy® C 276- W 2.4819
	K	Thermowell material Inconel® 600 - W 2.4816
	M	Thermowell material Monel® 400 - W 2.4360
	Y	Thermowell material to specify

		Process connection	
	1	Threaded	3/4" NPT-M
	2	Threaded	1" NPT-M
	3	Slip-on 1"	ANSI 150 RF A 105
	4	Slip-on 1"	ANSI 150 RF SS 316
	5	Slip-on 1"	ANSI 300 RF A 105
	6	Slip-on 1"	ANSI 300 RF SS 316
	7	Slip-on 1"	ANSI 600 RF A 105
	8	Slip-on 1"	ANSI 600 RF SS 316
	A	Slip-on 1"1/2	ANSI 150 RF A 105
	B	Slip-on 1"1/2	ANSI 150 RF SS 316
	C	Slip-on 1"1/2	ANSI 300 RF A 105
	D	Slip-on 1"1/2	ANSI 300 RF SS 316
	E	Slip-on 1"1/2	ANSI 600 RF A 105
	F	Slip-on 1"1/2	ANSI 600 RF SS 316
	Q	Slip-on 2"	ANSI 300 RF A 105
	R	Slip-on 2"	ANSI 300 RF SS 316
	S	Slip-on 2"	ANSI 600 RF A 105
	T	Slip-on 2"	ANSI 600 RF SS 316
	1	Threaded	3/4" NPT-M
	2	Threaded	1" NPT-M
	Y	Process connection to specify	

									Flange finishing				
									1	Finishing not requested			
									2	Standard finishing 125-250 AARH			
									9	Finishing to specify			
										Certifications			
										A	Not requested		
										G	3.1.B EN10204, with stamping for wetted parts		
										E	3.1.B EN10204, + NACE MR 0175		
										C	3.1.C EN10204		
										F	3.1.B EN10204, + PMI		
										Y	Certification to specify		
											Head cable entry		
											A	Head cable entry: single 1/2" NPT	
											C	Head cable entry: double 1/2" NPT	
											B	Head cable entry: single 3/4" NPT	
											D	Head cable entry: double 3/4" NPT	
											E	Head cable entry: single M20x1.5	
											F	Head cable entry: double M20x1.5	
												Built-in head transmitter	
												0	Without built-in head transmitter
												P	2-wire transmitter PCP TMT 181-A, galvanically insulated, adjustable range from ...to...°C
												R	2-wire transmitter HART® TMT182-A, galvanically insulated, adjustable range from ...to...°C
												S	2-wire transmitter PROFIBUS-PA®, TMT184-A
												1	Built-in head transmitter THT1, to be ordered separately
TSC266-													Complete order code

Supplementary documentation

❑ General technical information on TSC thermometers	TI 090T/02/en
❑ Temperature transmitter - iTEMP® PCP TMT 181	TI 070R/09/en
❑ Temperature transmitter - iTEMP® HART® TMT 182	TI 078R/09/en
❑ Temperature transmitter - iTEMP® PA TMT 184	TI 079R/09/en
❑ Thermocouple insert for EEx-d. Omniset TEC 300	TI 226T/02/en
❑ Safety instructions for use in hazardous areas	XA 007T/02/z1
❑ E+H Laboratory Calibration certifications for industrial thermometers. *RTD and thermocouples*	TI 236T/02/en

Subject to modification

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