

## Technical Information

# Omnigrad S TC61

Thermocouple thermometer EEx-d certified, replaceable insert, thermowell from pipe, process connection: threaded, flanged or sliding. PCP (4...20 mA), HART® or PROFIBUS-PA® electronics



### Range of uses

The Omnigrad S TC61 is an industrial thermometer (thermocouple TC: K or J) and thermowell from pipe, developed for the use in the chemical, petrochemical and energy industries, but suitable also for other generic applications.

In compliance to EN 50014/18/20 (ATEX certification) it is therefore particularly suitable also for hazardous areas.

When required, it's also available with a transmitter (PCP, HART® or PROFIBUS-PA®) into the housing.

The process connection of the thermowell can be threaded, flanged or with a sliding compression fitting in compliance to the standard rule DIN 43772 (form 2/3, 2G/3G and 2F/3F).

### Application areas

- Chemicals industry
- Energy industry
- Gas Processing industry
- Petrochemical industry
- General industrial services

### Features and benefits

- Materials: SS 316L/1.4404, SS 316Ti/1.4571, Hastelloy ©C276/2.4819 and Inconel® 600/2.4816
- The most common process connections: threaded, flanged and sliding compression fitting are standard; others are on request
- Customized immersion length
- Surface finishing down to Ra < 0.8 µm
- Aluminium housing, with protection grade from IP66 to IP68
- Thermocouple with hot junction grounded or ungrounded in mineral oxide cable (MgO cable) diameter: 3 or 6 mm
- PCP, HART® and PROFIBUS-PA®, (4...20 mA 2-wire transmitters)
- The accuracy of the TC (K (NiCr-Ni) and J (Fe-CuNi)) are: Cl. 1 - 2 (EN 60584) or Cl. Special - Standard (ANSI MC96.1)
- The TC (K or J) are available in single or double element
- ATEX II 1/2 GD EEx-d IIC certification
- ATEX II 2 GD EEx-d IIC certification



## Function and system design

### Measuring principle

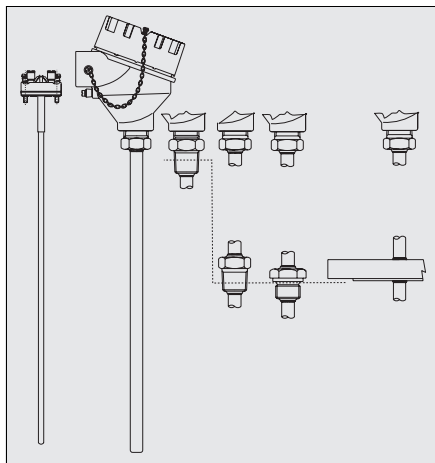
The thermocouple (TC) thermometer's sensing element consists of two metal wires that are homogeneous but different one from the other and insulated along their entire length. The two wires are welded together at one end, known as the "measurement or hot junction". The other end, where the wires are free, is known as the "cold or reference junction" and is connected to a electromotive force measurement circuit 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 (T1) and the cold joint (Seebeck effect). The cold junction has to be "compensated" with reference to the temperature of 0°C (T0). The function that links the electromotive force to the temperatures T1 and T0 is a curve whose characteristics depend on the materials used in the construction of the thermocouple. 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 construction of the Omnigrad S TC61 temperature sensor is based on the following standards:

- EN 50014/18 (housing)
- EN 60584 (inset)
- DIN 43772 (thermowell)

The housing is in painted aluminium alloy; it is suitable to contain a transmitter and/or the ceramic block of the inset; the "Ingress Protection" is from IP66 to IP68.



The replaceable insert is placed inside the thermowell; the insert is spring loaded to its base in order to improve heat transfer. The hot junction of the thermocouple (type K or J) are positioned close to the tip of the probe. The thermocouple is available in two versions: grounded or ungrounded hot junction. The electrical structure of the thermocouple always complies with DIN EN 60584/61515 or ANSI MC96.1, ASTM E585 standard rules.

The thermowell is made from tube with diameter 9, 11 or 12 mm. The final part of the thermowell can be straight, tapered or reduced. The thermowell materials are: SS 316L/1.4404, SS 316Ti/1.4571, Hastelloy®C276/2.4819 and Inconel® 600/2.4816. The process connection of the thermowell can be threaded (GAS or NPT), flanged (DIN or ANSI) or with a compression fitting (see the section "System components").

Fig. 1: TC61 with the various types of process connections and end parts of the probe

### Material & Weight

Housing	Insert	Process connection	Weight
aluminium epoxy coated	sheath in: SS 316L/1.4404, Inconel® 600/2.4816	fixed or sliding: SS 316L/1.4404, SS 316Ti/1.4571, Hastelloy® C276/2.4819 and Inconel® 600/2.4816	From 0.5 to 1.0 kg for standard options

## Performance

### Operating conditions

Operating condition or test	Product type or rules	Value or data of test
Ambient temperature	housing (without head-mounted transmitter)	-40÷130°C
	housing (with head-mounted transmitter)	-40÷85°C
Process temperature	It is restricted by the thermowell material:	< 600°C SS 316L/1.4404
		< 800°C SS 316Ti/1.4571
		< 1100°C Hast.® C276/2.4819 - Inc.600®/2.4816
Process pressure (Maximum)	The pressure values to which the thermowell can be subjected at the various temperatures are illustrated by the drawings in fig. 2 . For 9 mm diameter pipes, with a limited flow velocity, the maximum tolerated pressures are the following:	50 bar to 20°C 33 bar to 250°C 24 bar to 400°C
Maximum flow velocity	The highest flow velocity, (of the stream or of the fluid), tolerated by the thermowell, diminishes with increasing lengths, of the thermowell/probe exposed (fig. 2 ).	

Shock and vibration resistance test	TC Inset in according to the rule IEC 60751:	Acceleration	3 g of peak
		Frequency	from 10Hz to 500Hz and back
		Time of the test	10 hours

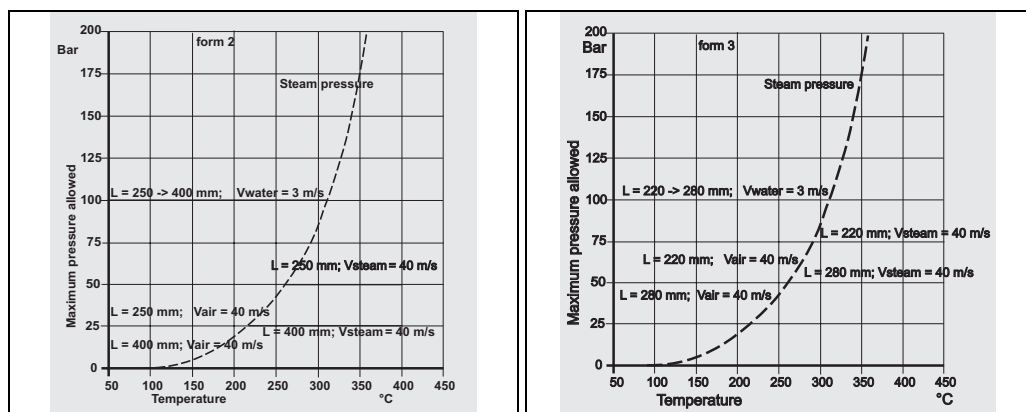


Fig. 2: Pressure/temperature drawing for thermowell with straight tube  $\varnothing$  11 mm in SS 316Ti/1.4571 (left), with tapered tube  $\varnothing$  12 mm in SS 316Ti/1.4571 (right)

### Accuracy

Thermocouple and range °C	EN 60584				
	Class	Max deviation	Class	Max deviation	Cable colours
J (Fe-CuNi) -40° ... 750°C	2	+/-2.5°C (-40...333°C) +/-0.0075 Itl (333...750°C)	1	+/-1.5°C (-40...375°C) +/-0.004 Itl (375...750°C)	+ black - white
K (NiCr-Ni) -40 ... 1200°C	2	+/-2.5°C (-40...333°C) +/-0.0075 Itl (333...1200°C)	1	+/-1.5°C (-40...375°C) +/-0.004 Itl (375...1000°C)	+ green - white
Itl = absolute temperature value in °C					
Thermocouple and range °C	ANSI MC96.1				
	Class	Max deviation	Class	Max deviation	Cable colours
J (Fe-CuNi) 0 ... 750°C	Stand- ard	+/-2.2°C (0...293°C) +/-0.75% (293...750°C)	Special	+/-1.1°C (0...275°C) +/-0.4% (275...750°C)	+ black - red
K (NiCr-Ni) 0...1250°C	Stand- ard	+/-2.2°C (0...293°C) +/-0.75% (293...1250°C)	Special	+/-1.1°C (0...275°C) +/-0.4% (275...1250°C)	+ yellow - red
Itl = absolute temperature value in °C					
<b>Others errors</b>					
Transmitter maximum error		See the corresponding documentation (codes at the end of the document)			
Display maximum error		0.1% FSR + 1 digit (FSR = Full Scale Range)			

### Response time

Tests in water at 0.4 m/s (according to IEC 60751; from 23 to 33°C step changes):

Stem diameter of the insert	Sensing element type	Temperature of test	Response time
SS 316 - d. 6 mm	K (NiCr-Ni) or J (Fe-CuNi)	t <sub>50</sub>	2,5 s
		t <sub>90</sub>	7,0 s

### TInsulation

Measurement Insulation type	Result
Insulation resistance between terminals and probe sheath according to EN 60584, test voltage 500 V	> 1 GΩ at 25°C > 5 MΩ at 500°C

### Self heating

Negligible when the E+H iTEMP® transmitters are employed.

## Installation

The Omnigrad S TC61 thermometers can be installed on pipes or tanks by means of threaded or flanged connections. The immersion length must take into account all the parameters of the thermometer and 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. In the case of ATEX certified components (transmitter, insert), please refer to the relevant documentation

(refer to the code at the end of this document). 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 thermometer with a small diameter on well and an immersion length (L) of at least  $80 \div 100$  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). With regard to corrosion, the base material of the wetted parts can tolerate the common corrosive media right up to even the highest temperatures. For a best installation, in the industries, it's better to follow the rule:  $h \approx d$ ,  $L > D/2 + h$ .

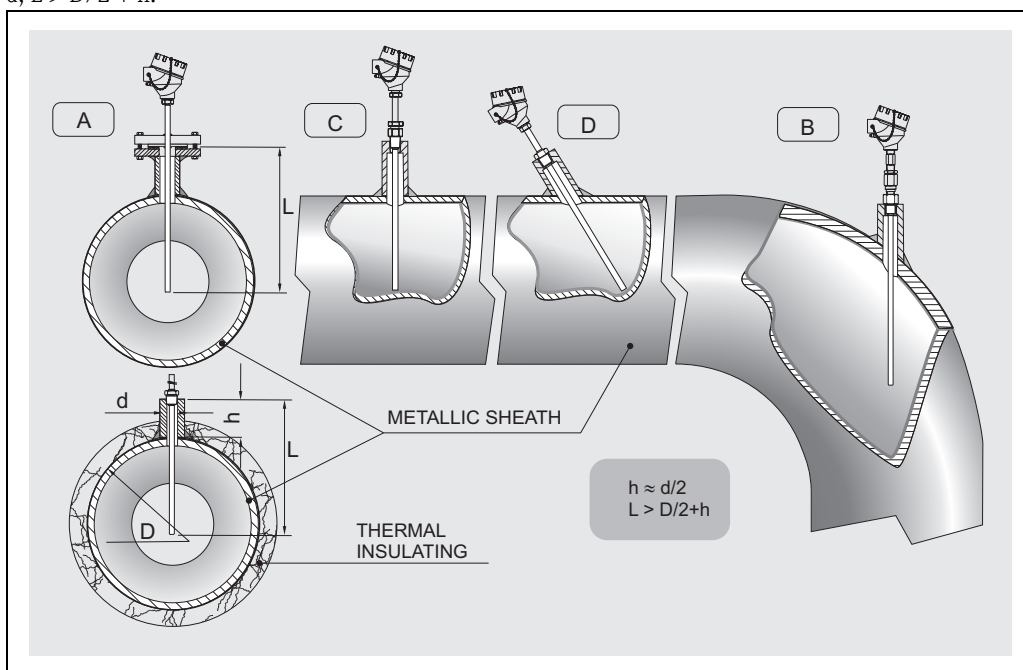


Fig. 3: Installation examples

For further information on specific applications, please contact the E+H Customer Service Department. In the case that the sensor components are disassembled, in the following reassembly procedure the definite torques must be employed. This will assure the housings with the IP grade defined.

## System components

### Housing

The protection housing, our "TA21H", commonly referred to the "connection head", is used to contain and protect the terminal block or the transmitter and to join the electric connections to the mechanical component.

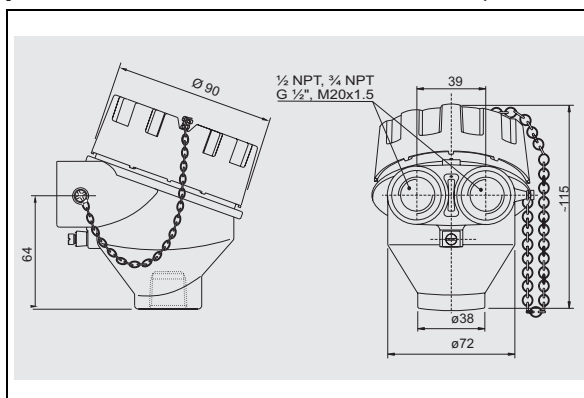


Fig. 4: Housing TA21H

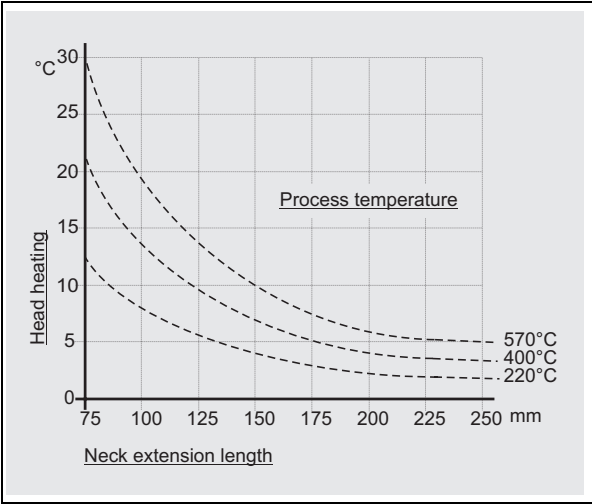
The TA21H used for the TC61 is compliant with EN 50014/18 and EN 50281-1-1, EN 50281-1-2 standards (Ex-d certification for explosion proof type of protection).

The matching of the head with the extension below the head and the cover (threaded) ensures a degree of protection from IP66 to IP68. 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 threaded electrical cable entry can be: M20x1.5, 1/2" NPT or 3/4" NPT, G1/2".

Extension neck

The extension neck is the part between the process connection and the housing.  
It is normally made of a tube with dimensional and physical characteristics (diameter and material) which are the same of the tube under the connection.



The standard lengths of the neck are 80 or 145 mm, according to the selected option. In accordance with the norm DIN 43772, in the case of a thermowell with a diameter of 12 mm and a tapered tip (form 3G), the extension neck will be respectively 82 or 147 mm. The connection situated in the upper part of the neck allows for orientation of the sensor head. As illustrated by the drawing in figure 5, the length of the extension neck 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”.

Fig. 5: Heating of the head consequent to the process temperature

Electronic head transmitter

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 of the transmitters can be easily programmed using a PC:

Head transmitter	Communication software
PCP TMT181	ReadWin® 2000
HART® TMT182	ReadWin® 2000, FieldCare, Hand held module DXR275, DXR375
PROFIBUS PA® TMT184	FieldCare

In the case of PROFIBUS-PA® transmitters, E+H recommends the use of PROFIBUS® dedicated connectors. The Weidmüller type is provided as a standard option. For detailed information about transmitters, please refer to the relevant documentation (refer to TI codes at the end of the document). If a head-mounted transmitter is not employed, the sensor probe may be connected through the terminal block to a remote converter (i.e. DIN rail transmitter). The customer may specify the configuration desired during the order phase. The head-mounted transmitters available are:

Description	Dwg
<p>TMT181: PCP 4...20 mA. The TMT181 is a PC programmable transmitters</p> <p>TMT182: Smart HART®. The TMT182 output consists of 4...20 mA and HART® superimposed signals.</p>	<p>Technical drawings for TMT181 and TMT182. The front view shows a circular face with a diameter of Ø 33, a central hole of Ø 6.5, and a mounting flange with a diameter of Ø 44. The side view shows a total height of 22.5 mm and a mounting flange with a diameter of Ø 44. The drawings include the Endress+Hauser logo.</p>
<p>TMT184: PROFIBUS-PA®. For the TMT184, with PROFIBUS-PA® output signal, the communication address may be set via software or via mechanical dip-switch.</p>	<p>Technical drawings for TMT184. The front view shows a circular face with a diameter of Ø 33, a central hole of Ø 6.5, and a mounting flange with a diameter of Ø 44. The side view shows a total height of 26.8 mm and a mounting flange with a diameter of Ø 44. The drawings include the Endress+Hauser logo.</p>

**Process connection**

Standard connections are available in the following types: Threaded or Flanged

Other versions may be supplied upon request, while other characteristic are available in the structure at the and of this document. The table below illustrate the engaging lengths and types of process connections.

Type	ØD1	ØD2	ØS	ØF	C	Thread/Flanged	DWG
Flange	110	79.5	14,5	16	//	1" ANSI 150 RF	
Flange	124	50,8	17,5	19	//	1" ANSI 300 RF	
Flange	115	85	16	14	//	DN25 PN40 B1	
Flange	150	110	18	18	//	DN40 PN40 B1	
Flange	165	125	20	18	//	DN50 PN40 B1	
Thread	//	//	//	//	15	G1"	
Thread	//	//	//	//	15	G1/2"	
Thread	//	//	//	//	15	G3/4"	
Thread	//	//	//	//	8	1/2" NPT	
Thread	//	//	//	//	8	3/4" NPT	

**Probe**

In the TC61 the measuring probe is made up of a mineral insulated insert (MgO) positioned inside the thermowell. The employed MgO cable is compliant with the norm DIN EN 61515 (IEC 1515) or ASME E585 depending on the requested version. The insert length is available in the standard dimensions DIN 43772 and in the most commonly used ones, or it can be personalized by the client within a range of values (refer to "Sales Structure" at the end of the document).

For replacement, the length of the insert (IL) must be chosen in compliance with the immersion length (L) of the thermowell (see fig. 6). If spare parts are required, refer to the following table.

With regards to the thermowell, the surface roughness (Ra) of the wetted parts is 0.8 mm, while the various kinds of tips (reduced or tapered) are described in fig. 6;

Thermowell type	Tip of the sensor	Insert type	Insert	(E) Neck	Insert Length (mm)
TW 10 TW 13	Straight	TPC100/TPC300	Ø = 6 mm	E = 80/82 mm E = 145/147mm	IL = L + E + 33
	Reduced on Ø 9 and Ø 11		Ø = 3 mm		
	Tapered on Ø 9				
	Tapered on Ø 12				
TW 12	Straight	TPC100/TPC300	Ø = 6 mm	E = 80/82 mm E = 145/147mm	IL = L + 63
	Reduced on Ø 9 and Ø 11		Ø = 3 mm		
	Tapered on Ø 9				
	Tapered on Ø 12				
TW 11 (GAS)	Straight	TPC100/TPC300	Ø = 6 mm	//	IL = L + 70
	Reduced on Ø 9 and Ø 11		Ø = 3 mm		
	Tapered on Ø 9				
	Tapered on Ø 12				
TW 11 (NPT)	Straight	TPC100/TPC300	Ø = 6 mm	//	IL = L + 75
	Reduced on Ø 9 and Ø 11		Ø = 3 mm		
	Tapered on Ø 9				
	Tapered on Ø 12				

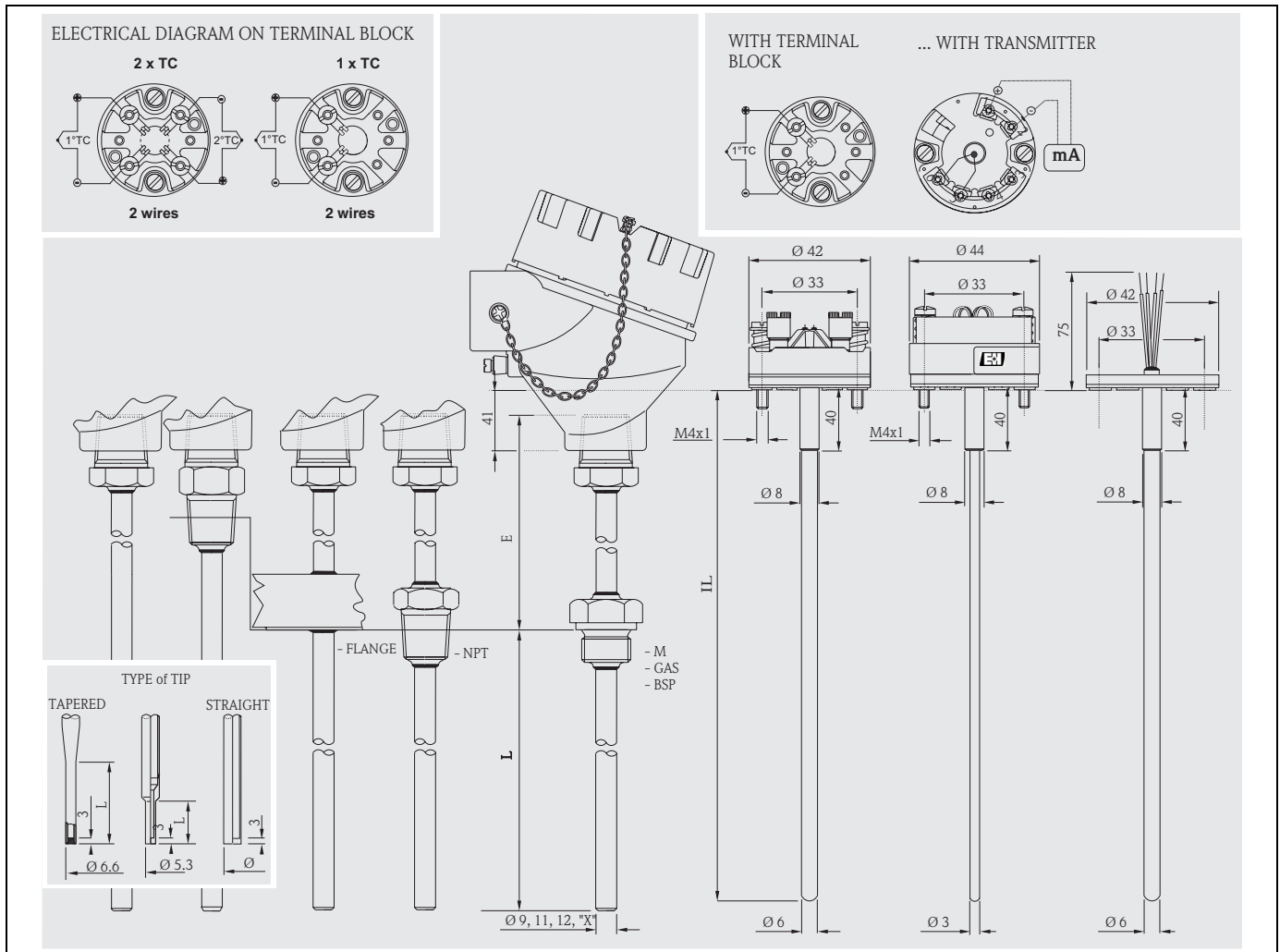


Fig. 6: Functional components, standard electrical diagrams (ceramic terminal block), Tip on the end of the probe

## Certificates & approvals

### Ex approval

- ATEX Certificate CESI 05ATEX038 for explosion proof type of protection: ATEX II 2 GD EEx-d IIC T6..T5 T85°...T100°C. The TC61 is **CE** marked.

With regards to the NAMUR NE 24 certificate and the Manufacturer's Declaration according to the standard EN 50018, EN 50020, EN 50281-1-1, EN 50281-1-2, E+H Customer Service will be able to provide further detailed information.

### PED approval

The Pressure Equipment Directive (97/23/CE) is respected. As paragraph 2.1 of article 1 is not applicable to these types of instruments. The **CE** mark according to PED Directive is not requested.

**Material certification**

The material certificate EN 10204 3.1 can be directly selected from the sale structure of the product and refers to the parts of the sensor in contact with the process fluid.

Other types of certificates related to materials can be requested separately.

The “short form” certificate includes a simplified declaration with no enclosures of documents related to the materials used in the construction of the single sensor and guarantees the traceability of the materials through the identification number of the thermometer.

The data related to the origin of the materials can subsequently be requested by the client if necessary.

**Test on thermowell**

The pressure tests are carried out at ambient temperature in order to verify the resistance of the thermowell to the specifications indicated by the norm DIN 43772.

With regards to the thermowells that do not comply with this norm (with a reduced tip, a tapered tip on a 9 mm tube, special dimensions, ...), the pressure of the corresponding straight tube with similar dimensions is verified. The sensors certified for use in Ex Zones, are always tested to pressure according to the same criteria.

## Further details

**Maintenance**

The Omnigrad S TC61 thermometers do not require any specific maintenance.

In the case of ATEX certified components (transmitter, insert or thermowell) please refer to the corresponding specific relevant documentation (at the end of the document).

## Ordering information

**Sales structure**

TC61-	Omnigrad S TC61. Thermocouple thermometer Thermometer complete of DIN style pipe thermowell. Replaceable mineral insulated inset, spring loaded in terminal head, IP66 - IP68 connection with epoxy coating. Two operating and measurement ranges: from -40 to 750°C (with TC J); -40 to 1100°C (with TC K)		
	Approval:		
	A	Non-harzarus area	
	E	*ATEX II 2 GD EEx d IIC	
	M	*ATEX II 1/2 GD EEx d IIC	
	Head, material, IP grade		
	A	TA21H    Alu. epoxy coating, , IP66/IP68	
	Y	Special version, to be specified	
	Cable entry		
	A	1 x 1/2 NPT	
	B	2 x 1/2 NPT	
	C	1 x 3/4 NPT	
	D	2 x 3/4 NPT	
	E	1 x M20 x1,5	
	F	2 x M20 x1,5	
	Y	Special version, to be specified	
	Pipe Diameter; Material: (price for 100 mm of L)		
	A	9 mm; 316L	
	B	11 mm; 316L	
	D	9 mm; 316Ti	
	E	11 mm; 316Ti	
	F	12 mm; 316Ti	
	G	9 mm; Hastelloy® C276	
	H	11 mm; Hastelloy® C276	
	J	9 mm; Inconel® 600	
	K	11 mm; Inconel® 600	
	Y	Special version, to be specified	



9

## Sales structure

TI285T/02/en/07.05  
FM+SGML6.0

## Supplementary documentation

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<input type="checkbox"/> Brochure Field of activities – Temperature measurement	FA006T/09/en
<input type="checkbox"/> Temperature head transmitter iTEMP® PCP TMT181	TI070R/09/en
<input type="checkbox"/> Temperature head transmitter iTEMP® HART® TMT182	TI078R/09/en
<input type="checkbox"/> Temperature head transmitter iTEMP® PA TMT184	TI079R/09/en
<input type="checkbox"/> TC insert for temperature sensors – Omniset TPC100	TI278T/02/en
<input type="checkbox"/> TC insert for temperature sensors – Omniset TPC300 (to be released)	TI291T/02/en
<input type="checkbox"/> Safety instructions for use in hazardous areas (TPC300 to be released)	XA017T/02/en
<input type="checkbox"/> TA fittings & sockets Omnigrad TA50, TA55, TA60, TA70, TA75	TI091T/02/en
<input type="checkbox"/> TC thermometers Omnigrad TSC – General information	TI090T/02/en
<input type="checkbox"/> Thermowell for temperature sensor – Omnigrad M TW10	TI261T/02/en
<input type="checkbox"/> Thermowell for temperature sensor – Omnigrad M TW11	TI262T/02/en
<input type="checkbox"/> Thermowell for temperature sensor – Omnigrad M TW12	TI263T/02/en
<input type="checkbox"/> Thermowell for temperature sensor – Omnigrad M TW13	TI264T/02/en

## International Head Quarter

Endress+Hauser  
GmbH+Co. KG  
Instruments International  
Colmarer Str. 6  
79576 Weil am Rhein  
Germany

Tel. +49 76 21 9 75 02  
Fax +49 76 21 9 75 34 5  
[www.endress.com](http://www.endress.com)  
[info@ii.endress.com](mailto:info@ii.endress.com)

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