

Thermocouple Thermometer *omnigrad M TC 12*

*Replaceable insert and thermowell with compression fitting
PCP (4...20 mA), HART® or PROFIBUS-PA® electronics*



The TC 12 Omnigrad M range temperature sensors are thermocouples designed for use in the fine chemicals industry but also suitable for general applications.

They are made up of a measurement probe with a protection well, and a housing, which may contain the transmitter for conversion of the variable measured.

Thanks to its modular configuration and the structure defined by the DIN 43772 standard (form 2/3), the TC 12 is suitable for almost all industrial processes.

Features and benefits

- SS 316L, SS 316Ti, Hastelloy® C276 and Inconel 600® for the "wetted" parts
- The most common compression fitting as standard; others are available upon request
- Customized immersion length
- Surface finishing Ra < 0.8 µm
- Tip of the thermowell with a reduced diameter or tapered for a faster response time
- Stainless steel, aluminium or plastic housing, with protection grade from IP65 to IP67
- Replaceable mineral insulated insert
- PCP (4...20 mA), HART® and PROFIBUS-PA® transmitters
- Thermocouple sensing element type K or J, DIN EN 60584 or ANSI MC96.1
- Class 1/special accuracy
- Single or double, grounded or ungrounded measurement junction
- Material certification (3.1.B)
- Pressure test

Endress + Hauser

The Power of Know How



Areas of application

- Fine chemicals industry
- Light energy industry
- General industrial services

Function and system design

Measuring principle

The thermocouple 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 Omnigrad M TC 12 temperature sensor is made up of a measurement probe, with a protection well and a housing (head), which may contain a transmitter or the terminals on ceramic block for electrical connection. Construction of the sensor is based on the following standards: DIN 43729 (housing), 43772 (thermowell) and 43735 (probe), and can therefore guarantee a good level of resistance to the most typical and common industrial processes. The measurement probe (replaceable insert) is placed inside the thermowell; the insert is spring loaded to its base in order to improve heat transfer. The sensing element (type K or J) is positioned close to the tip of the probe. The thermowell is made from a tube with a diameter of 9, 11 or 12 mm. The final part can be straight, tapered (i.e. with a gradual reduction of the stem achieved thanks to a swaging procedure), or reduced (stepped). The TC 12 can be fitted onto the plant (tube or tank) through the use of a compression fitting, which can be chosen from the most common models (see the section "System components"). The electrical structure of the thermometer always complies with DIN EN 60584/61515 or ANSI MC96.1/ASTM E585 standard rules. The sensing element is available in two versions: insulated hot junction or grounded hot junction. The housing can be of different types and materials (plastic, painted aluminium alloy, stainless steel). The way in which it fits to thermowell and the cable gland ensure a minimum grade of IP65 (Ingress Protection).

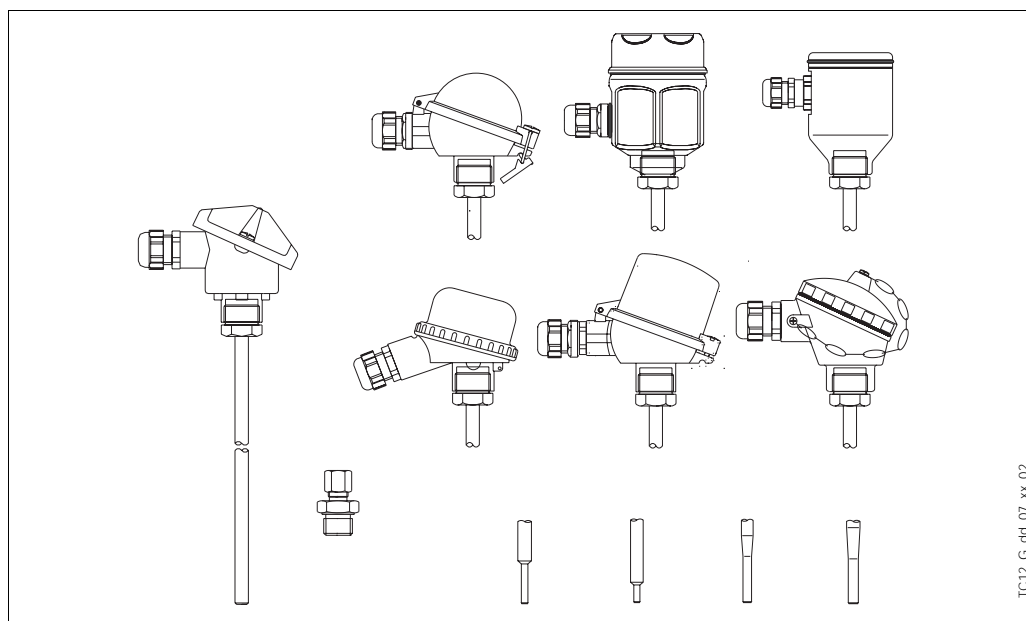


Fig. 1: TC 12 with the various types of heads, process connections and end parts of the thermowell

Material	Thermowell wetted parts in SS 316L/1.4404, SS 316Ti/1.4571, Hastelloy® C276/2.4819 or Inconel 600®/2.4816. Compression fitting in SS 316/1.4401.
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Weight	From 1.5 to 3.5 kg for standard options.
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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 of the transmitters can be easily programmed using a personal computer through the ReadWin® 2000 and FieldCare public domain softwares (for transmitters 4...20 mA and HART®), or the CommuWin II software (for PROFIBUS PA® transmitters). The HART® transmitters can also be programmed with the hand-held operating module DXR 275 (Universal HART® Communicator). In the case of PROFIBUS-PA® transmitters, E+H recommends the use of PROFIBUS® dicated connectors. The Weidmüller type (Pg 13.5 - M12) 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).

Performance

Operating conditions	<u>Ambient temperature</u> (housing without head-mounted transmitter)	
	• metal housings	-40÷130°C
	• plastic housings	-40÷85°C
	<u>Ambient temperature</u> (housing with head-mounted transmitter)	-40÷85°C
	<u>Ambient temperature</u> (housing with display)	-20÷70°C
	<u>Process temperature</u>	
	If the thermowell is welded to the plant:	
	• SS 316L/1.4404	< 600°C
	• SS 316Ti/1.4571	< 800°C
	• Hastelloy® C276/2.4819 and Inconel 600®/2.4816	< 1100°C.
If the thermowell is not welded to the plant:		
• Sleeve in SS (TA 50 compression fitting)	max 500°C.	
<u>Maximum process pressure</u>		
• Sleeve in SS (TA 50 compression fitting)	4 MPa (40 bar) at 20°C	
If the thermowell is welded to the plant, the thermowell can be exposed to different pressure values depending on the temperature values, as shown in the graphs of figures 2 and 3. For 9 mm diameter pipes, with a limited flow velocity, the maximum tolerated pressures are the following:		
• 5 MPa (50 bar)	at 20°C	
• 3.3 MPa (33 bar)	at 250°C	
• 2.4 MPa (24 bar)	at 400°C.	
<u>Maximum flow velocity</u>		
The highest flow velocity tolerated by the thermowell diminishes with increasing lengths of the well/probe exposed to the stream of the fluid. Some information may be taken from the graphs in figures 2 and 3.		
<u>Shock and vibration resistance</u>		
According to DIN EN 60751	3 g peak / 10÷500 Hz	

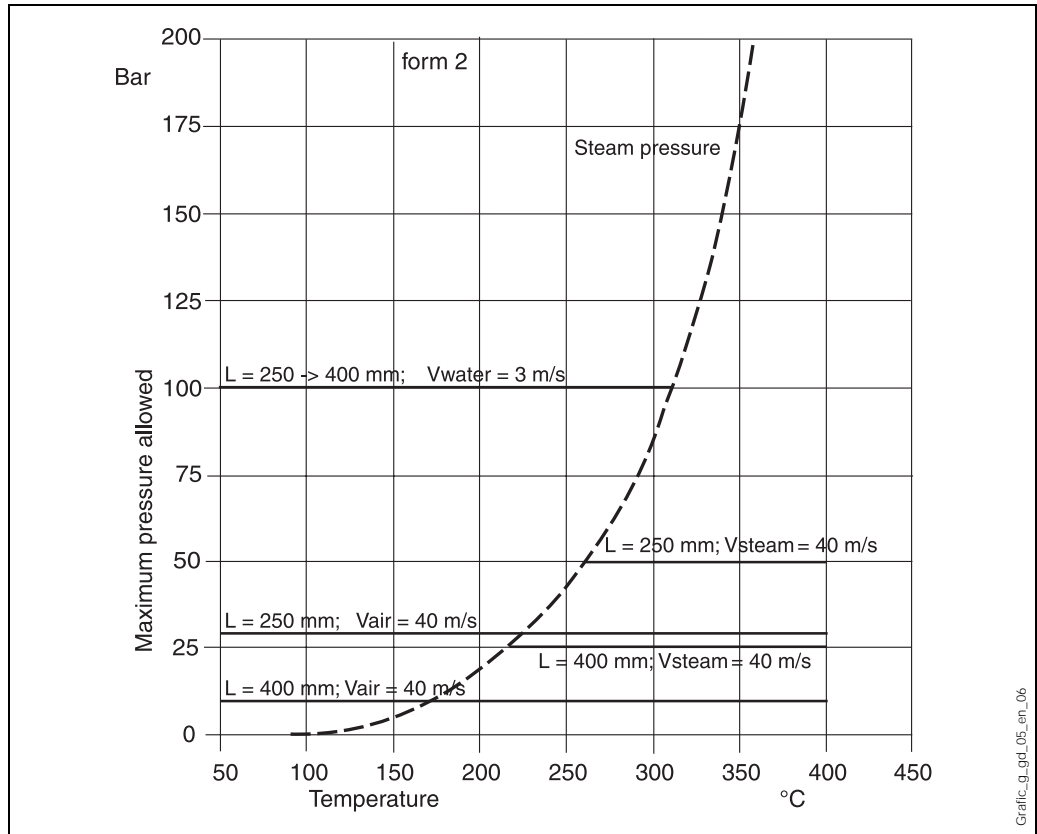


Fig. 2: Pressure/temperature drawing for thermowell with straight tube \varnothing 11 mm in SS 316Ti/1.4571

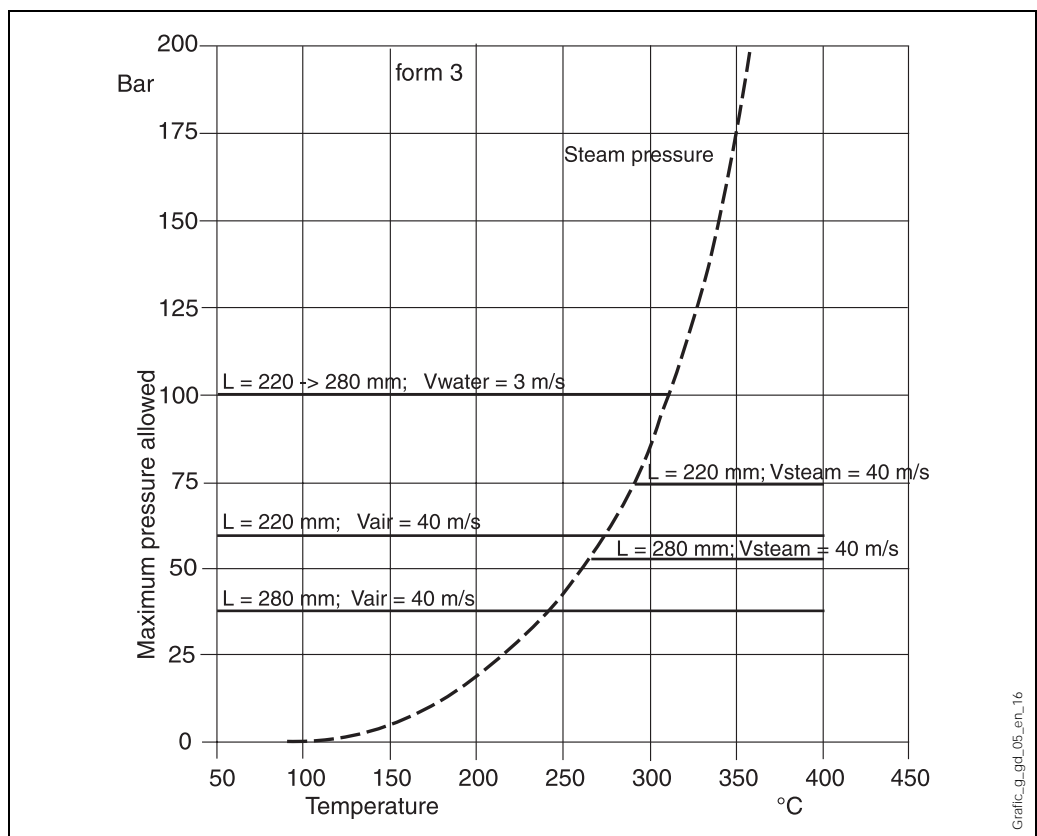


Fig. 3: Pressure/temperature drawing for thermowell with tapered tube \varnothing 12 mm in SS 316Ti/1.4571

Accuracy

The tolerances set by the standards DIN EN 60584 and ANSI MC96.1 are the following:

Type of thermocouple	DIN EN 60584				
	Class	Max deviation	Class	Max deviation	Cable colours
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)	+ black - white
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)	+ green - white

Type of thermocouple	ANSI MC96.1				
	Class	Max deviation	Class	Max deviation	Cable colours
J (Fe-CuNi)	Standard	+/-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)	Standard	+/-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

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

Table 1: Tolerances

Transmitter maximum error

See the corresponding documentation (codes at the end of the document).

Display maximum error

0.1% of the set span + 1 digit

Measurement range

The measurement ranges defined in standards are shown in the following table 2:

Type of thermocouple	DIN EN 60584	ANSI MC96.1
J	-40...750°C	0...750°C
K	-40...1200°C	0...1250°C

Table 2: Measurement ranges

Response time

Tests in water at 0.4 m/s (according to DIN EN 60751; temperature variation from 23 to 33°C):

Diameter of the stem	Type of TC	Response time	Grounded			Ungrounded		
			Reduced tip	Tapered tip	Straight tip	Reduced tip	Tapered tip	Straight tip
9 mm	J, K	t ₅₀	5.5 s	9 s	15 s	6 s	9.5 s	16 s
		t ₉₀	13 s	31 s	46 s	14 s	33 s	49 s
11 mm		t ₅₀	5.5 s	--	15 s	6 s	--	16 s
		t ₉₀	13 s	--	46 s	14 s	--	49 s
12 mm		t ₅₀	--	8.5 s	32 s	--	9 s	34 s
		t ₉₀	--	20 s	106 s	--	22 s	110 s

Table 3: Response times

Insulation

Insulation resistance between terminals and probe sheath (according to DIN EN 60584, test voltage 500 V)

> 1GΩ at 25°C
> 5 MΩ at 500°C

Installation

The Omnigrad M TC 12 thermometers can be mounted on the wall of pipes or vessels or other plant parts that may be necessary.

The interface components for the connection to the process and the relative gaskets are not normally provided with the sensors and are customer's responsibility.

In the case of ATEX-certified components (transmitter), please refer to the relevant documentation (refer to the code at the end of this document).

Immersion depth may have an effect on the accuracy of the measurement. 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. In order to avoid this source of inaccuracy, the thermowell should have a small diameter and the immersion length (L) should be, if possible, at least $80 \div 100$ mm.

In pipes of a small section the axis line of the duct must be reached and if possible slightly exceeded by the tip of the probe (refer to fig. 4A-4B). Insulation of the outer part of the sensor reduces the effect produced by a low immersion. Another solution may be a tilted installation (see fig. 4C-4D). In processes involving gases at very high temperature ($>500 \div 600^\circ\text{C}$), where radiation effects are important, the immersion length may be a secondary problem.

In the case of two-phase flows, pay special attention to the choice of measurement point, as there may be fluctuations in the value of the detected temperature.

With regard to corrosion, the base material of the wetted parts (SS 316L/1.4404, SS 316Ti/1.4571, Hastelloy® C276/2.4819, Inconel 600®/2.4816) can tolerate the common corrosive media right up to even the highest temperatures. 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.

In environments with the presence of strong electromagnetic noise, the grounded hot junction is not recommended, because of the possible interferences which might be generated on the thermocouple wires.

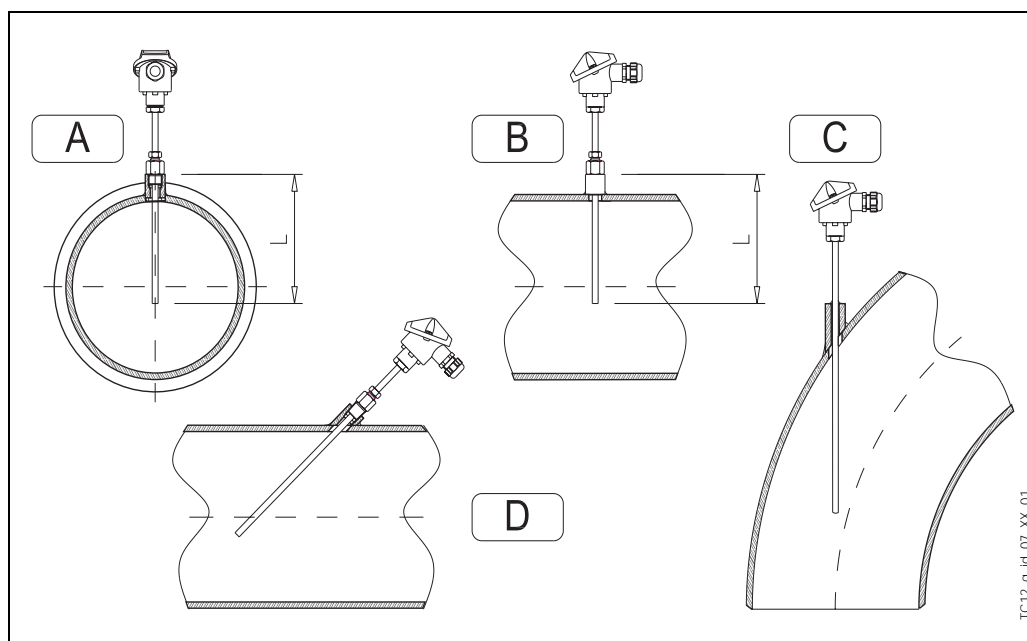


Fig. 4: Installation examples

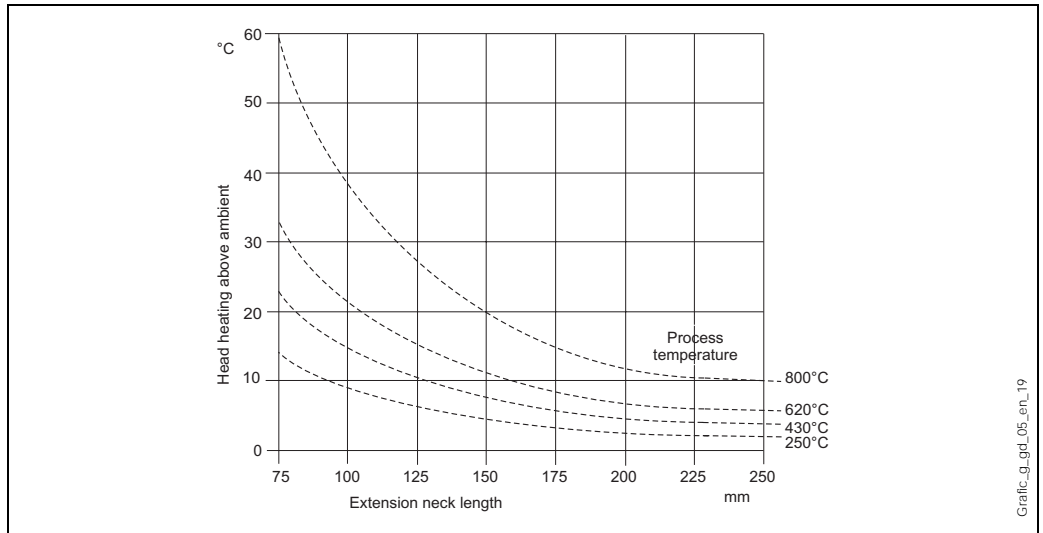


Fig. 5: Heating of the head consequent to the process temperature

System components

Housing

The housing, which contains the electric terminals or the transmitter, is available in different types and materials, e.g. plastic, painted aluminium alloy and stainless steel. The coupling method with the rest of the probe and the gland for the cable entry ensures a minimum IP65 grade (refer also to fig. 6).

All available heads have internal geometry according to DIN 43729 standard (form B), and thermometer connection M24x1.5.

Head type TA20A is the basic E+H aluminium housing for temperature sensors. It is supplied in the E+H corporate colours, without any extra charge.

Head TA20B is a black polyamide housing, sometimes referred to as the BBK in the "Temperature" market.

A screw cap is employed in TA21E and is joined to the head body by a chain.

The TA20D head (aluminium), also referred to as BUZH, is able to contain a terminal block or two transmitters at the same time. The order of the double transmitter must be carried out by choosing the option "flying wires" in the sales structure, and two transmitters in a separate position (THT1, see the table at the end of the document).

The TA20J head is a stainless steel housing used in other instruments made by E+H and can be provided with a LCD display (4 digits), which operates with 4...20 mA transmitters. The TA20R is normally recommended by the Temperature division of E+H for hygienic applications.

The TA20W (BUS type) is a round blue/grey coloured head made of aluminium, with a clip for the cap closure.

The cable gland M20x1.5 provided with the housings, is compatible with cables of a diameter between 5 and 9 mm.

Housing type	IP	Housing type	IP	Housing type	IP	Housing type	IP
 TA20A	66 67	 TA20B	65	 TA20R	66 67	 TA20W	66
 TA20J	66 67	 TA20J (with display)	66 67	 TA20D	66	 TA21E	65

Fig. 6: Housings and relative IP grade

Head transmitter

The head-mounted transmitters available are (also refer to the section "Electronics"):

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

The TMT 181 is a PCP programmable transmitter (see fig. 7).

The TMT 182 output consists of 4...20 mA and HART® superimposed signals.

For the TMT 184 (see fig. 8), with PROFIBUS-PA® output signal, the communication address may be set via software or via mechanical dip-switch. The customer may specify the configuration desired during the order phase.

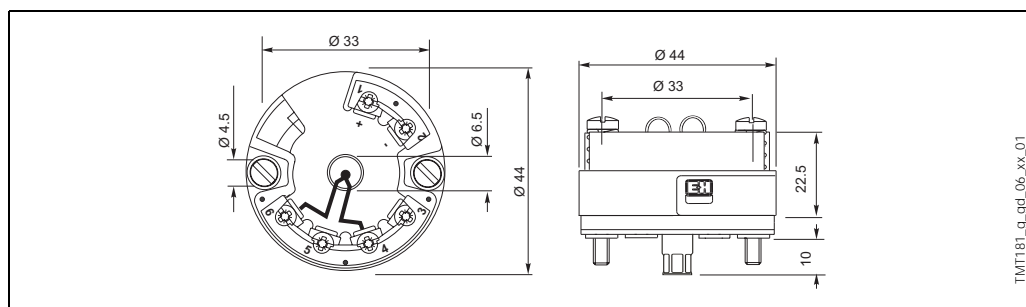


Fig. 7: TMT 181-182

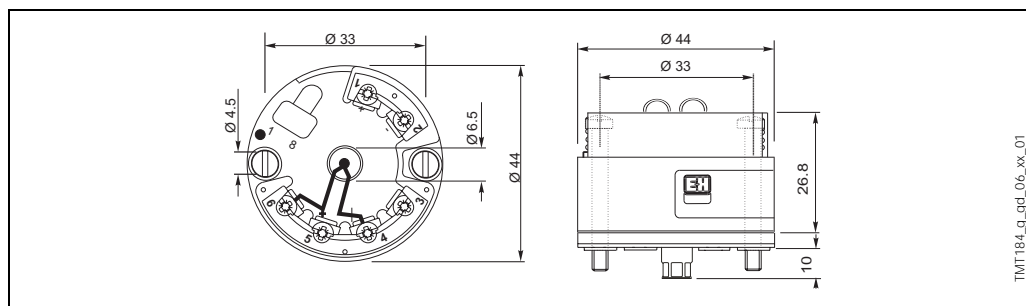


Fig. 8: TMT 184

Process connection

Standard compression fittings (in SS 316/1.4401) are available in the following types:

- Threaded G 1/2" and G 1", with sleeve in SS (TA 50).

Other versions may be supplied upon request. Figure 9 illustrates the basic dimensions.

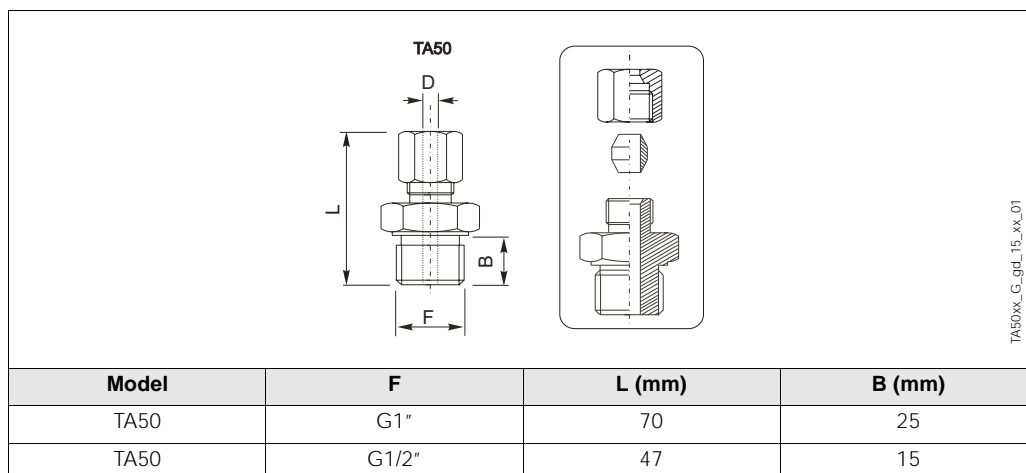


Fig. 9: Engaging lengths

Probe

In the TC 12 the measuring probe is made up of a mineral (MgO) insulated insert 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 43735/43772 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. If spare parts are required, refer to the following table:

Tip of the sensor	Insert	Insert diameter	Extension neck	Insert length (mm)
Straight	TPC 100	6 mm	80 mm	IL = L + 90
Reduced on Ø 9 and 11 / tapered on Ø 9	TPC 100	3 mm	80 mm	IL = L + 90
Tapered on Ø 12	TPC 100	6 mm	82 mm	IL = L + 90
Straight	TPC 100	6 mm	145 mm	IL = L + 155
Reduced on Ø 9 and 11 / tapered on Ø 9	TPC 100	3 mm	145 mm	IL = L + 155
Tapered on Ø 12	TPC100	6 mm	147 mm	IL = L + 155
Straight / tapered on Ø 12	TPC 100	6 mm	E	IL = L + E + 10
Reduced on Ø 9 and 11/ tapered on Ø 9	TPC 100	3 mm	E	IL = L + E + 10

Table 4: Insert dimensions

With regards to the thermowell, the surface roughness (Ra) of the wetted parts is 0.8 µm, up to a total length of 350 mm of the well; 1,6 µm for longer wells. The various kinds of tips (reduced or tapered) are described in figure 10. If ordered as a spare part, the thermowell is called TW 12 (consult the code of the relative TI at the end of the document).

The use of standard dimensions (extension neck and length of immersion) allows for the use of the inserts on sensors of various kinds, and guarantees rapid delivery times; this allows our customers to reduce the amount of spare parts to be kept on stock.

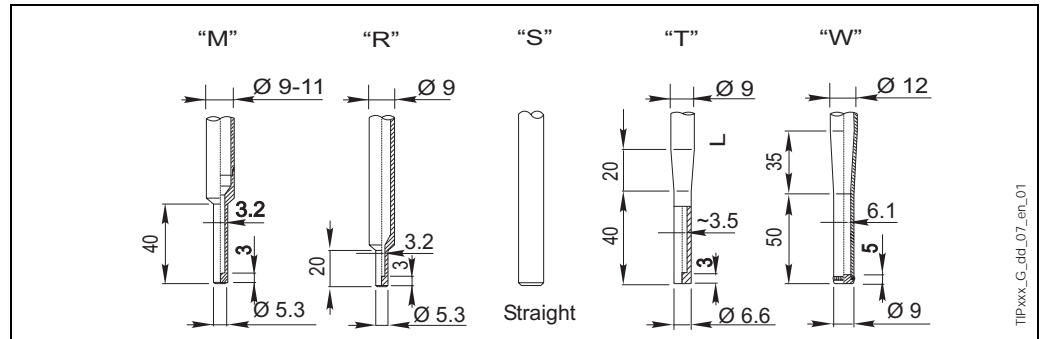
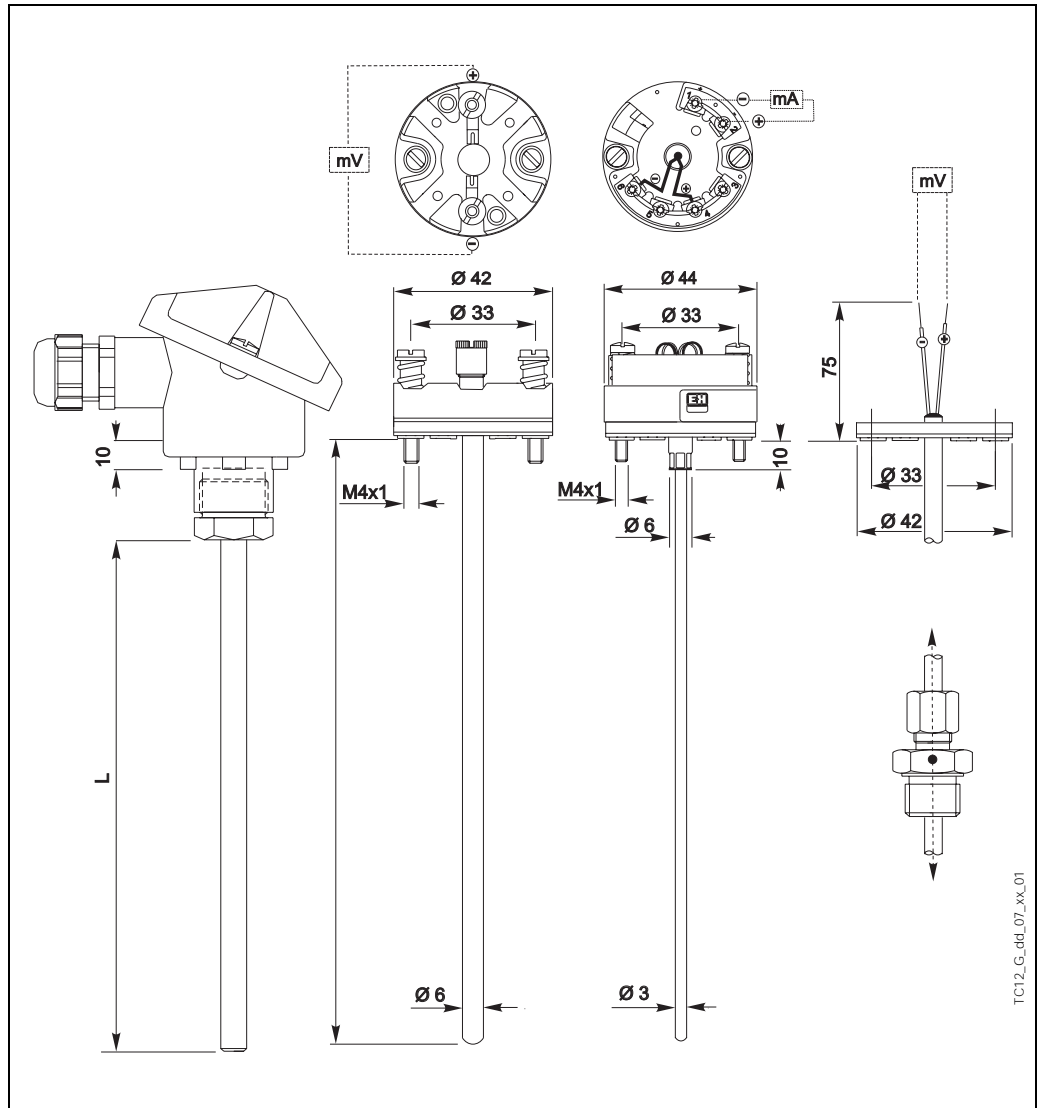
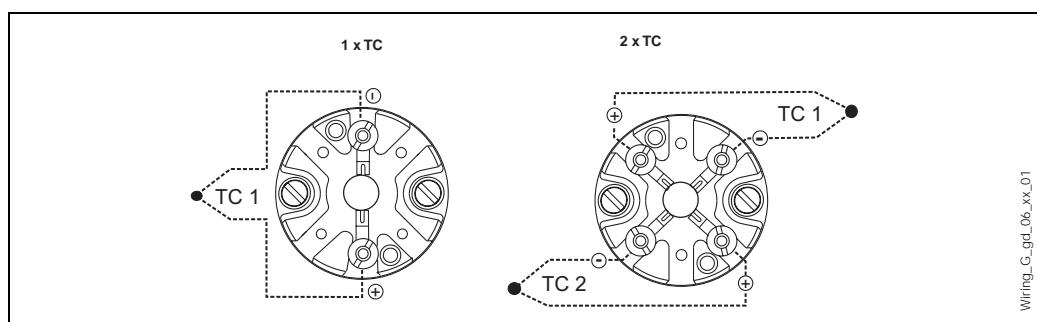


Fig. 10: Reductions (on the left) and tapers (on the right) of the thermowell



TC12_G_dd_07_xx_01

Fig. 11: Functional components



Wiring_G_gd_06_xx_01

Fig. 12: Standard wiring diagrams (ceramic terminal block)

Certificates & Approvals

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 is not requested for the TC 12 destined for general use.

Material certification

The material certificate 3.1.B (according to standard EN 10204) can be directly selected from the sales 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. Tests at different pressures can be carried out upon request.

Further details

Maintenance

The Omnigrad M thermometers do not require any specific maintenance. In the case of ATEX certified components (transmitter) please refer to the corresponding specific relevant documentation (refer to the code at the end of the document).

Delivery time

For small quantities (10÷15 units) and standard options, between 10 and 15 days depending on the configuration required.

Ordering information

Sales structure

TC12		Safety (Ex) certification	
	A	Ex certification not required	
Head material, cable entry, IP grade			
A	TA20A Aluminium, conduit M20x1.5, IP66/IP67		
4	TA20A Aluminium, PROFIBUS® connector, IP66		
2	TA20A Aluminium, conduit 1/2" NPT, IP66/IP67		
7	TA20B Polyamide, black, conduit M20x1.5, IP65		
E	TA21E Aluminium, screw cap, M20x1.5, IP65		
6	TA20D Aluminium, high cap, conduit M20x1.5, IP66		
5	TA20D Aluminium, high cap, PROFIBUS® connector, IP66		
8	TA20D Aluminium, high cap, conduit 1/2" NPT, IP66		
J	TA20J SS 316L, conduit M20x1.5, IP66/IP67		
K	TA20J SS 316L, with display, conduit M20x1.5, IP66/IP67		
M	TA20J SS 316L, PROFIBUS® connector, IP66		
R	TA20R SS 316L, screw cap, conduit M20x1.5, IP66/IP67		
S	TA20R SS 316L, screw cap, PROFIBUS® connector, IP66		
W	TA20W Aluminium, round cap, clip, conduit M20x1.5, IP66		
Y	Special version		
Pipe size, material			
A	9 mm	material: SS 316L/1.4404	
D	9 mm	material: SS 316Ti/1.4571	
G	9 mm	material: Hastelloy® C276/2.4819	
J	9 mm	material: Inconel 600®/2.4816	
B	11 mm	material: SS 316L/1.4404	
E	11 mm	material: SS 316Ti/1.4571	
H	11 mm	material: Hastelloy® C276/2.4819	
K	11 mm	material: Inconel 600®/2.4816	
F	12 mm	material: SS 316Ti/1.4571	
Y	Special version		
Process connection (TA50 body material: SS 316/1.4401)			
0	No process	connection,	
1	Adj. compression	fitting TA50, G1/2"	SS sleeve
3	Adj. compression	fitting TA50, G1"	SS sleeve
9	Special version		
Tip design			
S	Straight tip		
R	Reduced tip, L >= 60 mm (SS 9 mm pipe)		
M	Reduced tip, L >= 80 mm (9 and 11 mm pipe)		
T	Tapered tip, L >= 100 mm (SS 9 mm pipe)		
W	Tapered acc. DIN 43772 form 3, L >= 120 mm (SS 12 mm pipe, neck length 82/147 mm)		
Y	Special version		
Immersion length (50-3700)			
A	125	mm, immersion length L	(TL=150 mm)
B	180	mm, immersion length L	(TL=205 mm)
C	240	mm, immersion length L	(TL=265 mm)
D	280	mm, immersion length L	(TL=305mm)
E	340	mm, immersion length L	(TL=365 mm)
F	370	mm, immersion length L	(TL=425 mm)
G	400	mm, immersion length L	(TL=545 mm)
K	520	mm, immersion length L	(TL=725 mm)
M	700	mm, immersion length L	
X	...	immersion length L to specify	
Y	...	special immersion length TL	
Terminal type or built-in transmitter			
F	Flying leads		
C	Ceramic terminal block		
P	TMT181-A, programmable from ... to ...°C, PCP, 2-wire, isolated		
Q	TMT181-B, programmable from ... to ...°C, PCP ATEX, 2-wire, isolated		
R	TMT182-A, programmable from ... to ...°C, HART®, 2-wire, isolated		
T	TMT182-B, programmable from ... to ...°C, HART® ATEX, 2-wire, isolated		
S	TMT184-A, programmable, from ... to ...°C, PROFIBUS-PA®, 2-wire		
V	TMT184-B, programmable, from ... to ...°C, PROFIBUS-PA® ATEX, 2-wire		
Y	Special version		

										TC type, accuracy, inset sheath material			
										A	1xTC type K	cl. 1/spc.	Inconel 600®/2.4816
										B	2xTC type K	cl. 1/spc.	Inconel 600®/2.4816
										E	1xTC type J	cl. 1/spc.	SS 316L/1.4404
										F	2xTC type J	cl. 1/spc.	SS 316L/1.4404
										Y	Special version		
										TC reference standard, hot junction type			
										1	EN 60584 standard, hot junction ungrounded		
										2	EN 60584 standard, hot junction grounded		
										3	ANSI MC96.1 standard, hot junction ungrounded		
										4	ANSI MC96.1 standard, hot junction grounded		
										9	Special version		
										Material certification			
										0	Material certificate not requested		
										1	3.1.B EN10204, certificate for "wetted" parts		
										2	3.1.B EN10204, "short form" for "wetted" parts		
										9	Special version		
										Test on thermowell			
										0	Tests on the thermowell not requested		
										A	Hydrostatic internal pressure test on TW		
										Y	Special version		
										Additional options			
										0	Additional options not required		
										9	Special version		
TC12-										Complete order code			

Sales structure

THT1		Model and version of the head transmitter					
	F11	TMT181-A	PCP	2-wire, isolated	programmable	from...to...°C	
	F21	TMT181-B	PCP	ATEX	2-wire, isolated	programmable	from...to...°C
	F22	TMT181-C	PCP	FM IS	2-wire, isolated	programmable	from...to...°C
	F23	TMT181-D	PCP	CSA	2-wire, isolated	programmable	from...to...°C
	F24	TMT181-E	PCP	ATEX II3G EEx-nA	2-wire, isolated	programmable	from...to...°C
	F25	TMT181-F	PCP	ATEX II3D	2-wire, isolated	programmable	from...to...°C
	L11	TMT182-A	HART®	2-wire, isolated	programmable	from...to...°C	
	L21	TMT182-B	HART®	ATEX	2-wire, isolated	programmable	from...to...°C
	L22	TMT182-C	HART®	FM IS	2-wire, isolated	programmable	from...to...°C
	L23	TMT182-D	HART®	CSA	2-wire, isolated	programmable	from...to...°C
	L24	TMT182-E	HART®	ATEX II3G EEx-nA	2-wire, isolated	programmable	from...to...°C
	L25	TMT182-F	HART®	ATEX II3D	2-wire, isolated	programmable	from...to...°C
	K11	TMT184-A	PROFIBUS-PA®	2-wire, isolated	programmable	from...to...°C	
	K21	TMT184-B	PROFIBUS-PA®	ATEX	2-wire, isolated	programmable	from...to...°C
	K22	TMT184-C	PROFIBUS-PA®	FM IS	2-wire, isolated	programmable	from...to...°C
	K23	TMT184-D	PROFIBUS-PA®	CSA	2-wire, isolated	programmable	from...to...°C
	K24	TMT184-E	PROFIBUS-PA®	ATEX II3G EEx-nA	2-wire, isolated	programmable	from...to...°C
	K25	TMT184-F	PROFIBUS-PA®	ATEX II3D	2-wire, isolated	programmable	from...to...°C
	YYY	Special transmitter					
		Application and services					
		1	Assembled into position				
		9	Special version				
THT1-			Complete order code				

Supplementary documentation

<input type="checkbox"/> TC thermometers Omnigrad TSC - General information	TI 090T/02/en
<input type="checkbox"/> Terminal housings - Omnigrad TA 20	TI 072T/02/en
<input type="checkbox"/> Temperature head transmitter iTEMP® PCP TMT 181	TI 070R/09/en
<input type="checkbox"/> Temperature head transmitter iTEMP® HART® TMT 182	TI 078R/09/en
<input type="checkbox"/> Temperature head transmitter iTEMP® PA TMT 184	TI 079R/09/en
<input type="checkbox"/> TC insert for temperature sensor - Omniset TPC 100	TI 278T/02/en
<input type="checkbox"/> Thermowell for temperature sensor - Omnigrad M TW 12	TI 263T/02/en
<input type="checkbox"/> E+H Thermolab - Calibration certificates for industrial thermometers, RTD's and thermocouples	TI 236T/02/en

Subject to modification

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