Process thermocouple
Model TC12, for additional thermowell

Applications

- Chemical industry
- Petrochemical industry
- Off-shore
- Machine building, plant and vessel construction

Special features

- For many variants of temperature transmitters with field transmitter
- For mounting in all standard thermowell designs
- Spring-loaded measuring insert (replaceable)
- Explosion-protected versions Ex-i, Ex-n and NAMUR NE24
- ATEX Ex-d (in preparation)

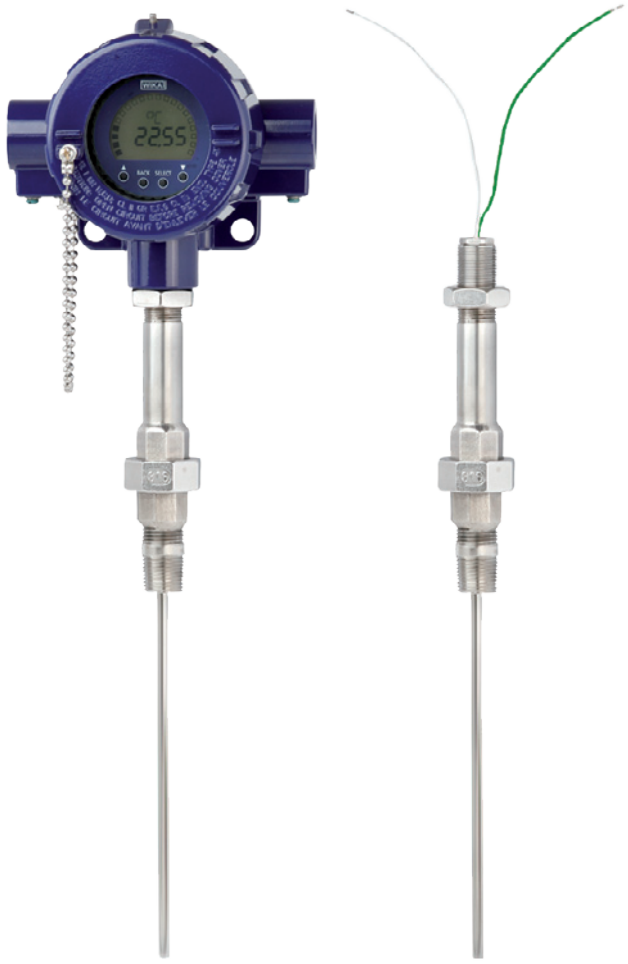


Fig. left: Process thermocouple model TC12-B
Fig. right: Basis module model TC12-M

Description

Thermocouples in this series can be combined with a large number of thermowell designs. The replaceable, centrically spring-loaded measuring insert and its extended spring travel enable combination with the widest range of connection head designs.

A wide variety of possible combinations of sensor, connection head, insertion length, neck length, connection to thermowell etc. are available for the thermometers; suitable for any thermowell dimension and any application.

Data sheets showing similar products:
Process resistance thermometer; model TR12; see data sheet TE 60.17

Specifications

Output signal thermocouple

Temperature range	Measuring range 0 ... +1200 °C
Thermocouple per DIN EN 60584-1	Types K, J, E, T, N
measuring point	■ welded insulated (ungrounded) ■ Thermocouples in the "welded to the bottom" (grounded) version on request
Sensor tolerance value per DIN EN 60584-1 per ISA (ANSI) MC96.1	Class 1 Class 2 Standard Special

Output signal 4 ... 20 mA, HART® protocol, FOUNDATION™ fieldbus and PROFIBUS® PA [1)]

Transmitter (selectable versions)	model T12	model T32	model T53	model TIF50
Data sheet	TE 12.03	TE 32.04	TE 53.01	TE 62.01
Output				
■ 4 ... 20 mA	x	x		x
■ HART® protocol		x		x
■ FOUNDATION™ Fieldbus and PROFIBUS® PA			x	
Galvanic isolation	yes	yes	yes	yes

Measuring insert (replaceable)

Material	Ni-alloy 2.4816 (Inconel 600)
Diameter	Standard: 3 mm, 4.5 mm, 6 mm, 8 mm Option (on request): 1/8 inch (3.17 mm), 1/4 inch (6.35 mm), 3/8 inch (9.53 mm)
Spring travel	approx. 20 mm
Response time	t_{50} < 5 s t_{90} < 10 s (measuring insert diameter 6 mm: the thermowell required for the operation increases the response time depending on its mass and dimensions)

Neck tube

Material	Stainless steel 316/316L
Thread to the thermowell	G 1/2 B G 3/4 B 1/2 NPT 3/4 NPT M14 x 1.5 M18 x 1.5 M20 x 1.5 M27 x 1.5
Connection thread to the head	M20 x 1.5, with counter nut M24 x 1.5, with counter nut 1/2 NPT, welded 3/4 NPT, welded
Neck tube length	min. 150 mm, standard neck tube length 200 mm 250 mm Other neck tube lengths on request

Ambient conditions

Ambient and storage temperature	{-50} -40 ... +85 °C
Ingress protection	IP 65 per IEC 529/EN 60529 The indicated ingress protection only applies for TC12-B with corresponding connection head, cable gland and appropriate cable dimensions
Vibration resistance	50 g (DIN EN 60751)

Use thermocouples with shielded cable, and ground the shield on at least one end of the lead.
For a correct determination of the overall measuring error, both sensor and transmitter measuring deviations have to be considered.
{ } Items in curved brackets are optional extras
1) The temperature transmitter should therefore be protected from temperatures over 85 °C

Sensor

Sensor types

Model	Recommended max. operating temperature
K (NiCr-Ni)	1200 °C
J (Fe-CuNi)	800 °C
E (NiCr-CuNi)	800 °C
T (Cu-CuNi)	400 °C
N (NiCrSi-NiSi)	1200 °C

The application range of these thermometers is limited both by the max. permissible temperature of the thermocouple and by the max. permissible temperature of the thermowell material.

Listed thermocouples are available both as single or dual thermocouples. The thermocouple will be delivered with an insulated measuring point.

Tolerance value

A cold junction temperature of 0 °C is taken as basis with the definition of the tolerance value of thermocouples.

Type K

Class	Temperature range	Tolerance value
DIN EN 60584 part 2		
1	-40 ... +375 °C	± 1.5 °C
1	+375 ... +1000 °C	± 0.0040 · | t | [1]
2	-40 ... +333 °C	± 2.5 °C
2	+333 ... +1200 °C	± 0.0075 · | t | [1]
ISA (ANSI) MC96.1-1982		
Standard	0 ... +1250 °C	± 2.2 °C or [2] ± 0.75 %
Special	0 ... +1250 °C	± 1.1 °C or [2] ± 0.4 %

Type J

Class	Temperature range	Tolerance value
DIN EN 60584 part 2		
1	-40 ... +375 °C	± 1.5 °C
1	+375 ... +750 °C	± 0.0040 · | t | [1]
2	-40 ... +333 °C	± 2.5 °C
2	+333 ... +750 °C	± 0.0075 · | t | [1]
ISA (ANSI) MC96.1-1982		
Standard	0 ... +750 °C	± 2.2 °C or [2] ± 0.75 %
Special	0 ... +750 °C	± 1.1 °C or [2] ± 0.4 %

Type E

Class	Temperature range	Tolerance value
DIN EN 60584 part 2		
1	-40 ... +375 °C	± 1.5 °C
1	+375 ... +800 °C	± 0.0040 · | t | [1]
2	-40 ... +333 °C	± 2.5 °C
2	+333 ... +900 °C	± 0.0075 · | t | [1]

Type T

Class	Temperature range	Tolerance value
DIN EN 60584 part 2		
1	-40 ... +125 °C	± 0.5 °C
1	+125 ... +350 °C	± 0.0040 · | t | [1]
2	-40 ... +133 °C	± 1.0 °C
2	+133 ... +350 °C	± 0.0075 · | t | [1]

Type N

Class	Temperature range	Tolerance value
DIN EN 60584 part 2		
1	-40 ... +375 °C	± 1.5 °C
1	+375 ... +1000 °C	± 0.0040 · | t | [1]
2	-40 ... +333 °C	± 2.5 °C
2	+333 ... +1200 °C	± 0.0075 · | t | [1]

1) \| t \| is the value of the temperature in °C without consideration of the sign
2) Whichever is the greater

Tolerance value with selected temperatures in °C for thermocouples type K and type J

Temperature (ITS 90) °C	Tolerance value DIN EN 60584 part 2 Class 1 °C	Class 2 °C
0	± 1.50	± 2.50
100	± 1.50	± 2.50
200	± 1.50	± 2.50
300	± 1.50	± 2.50
400	± 1.60	± 3.00
500	± 2.00	± 3.75
600	± 2.40	± 4.50
700	± 2.80	± 5.25
800	± 3.20	± 6.00
900	± 3.60	± 6.75
1000	± 4.00	± 7.50
1100	± 4.40	± 8.25
1200	± 4.80	± 9.00

Potential measuring uncertainties due to ageing effects

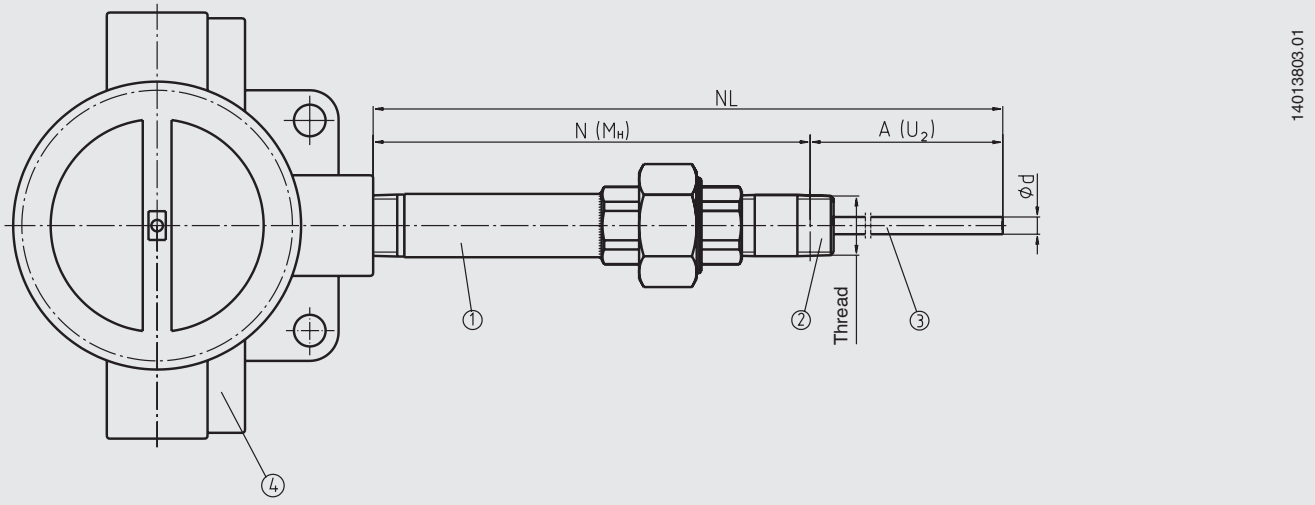
Thermocouples are subject to ageing and change their temperature/thermal voltage characteristic. Type J thermocouples of (Fe-Cu-Ni) age slightly due to oxidation of the pure metal leg. In types K and N thermocouples (NiCrSi-NiSi), high temperatures can result in substantial changes to the thermal voltage due to chrome depletion in the NiCr leg, leading to a lower thermal voltage.

This effect is accelerated if there is a shortage of oxygen, since a complete oxide layer, which would protect it from further oxidation, cannot be formed on the surface of the thermocouple. Chromium is oxidised, but nickel isn't. This results in the so-called "**green rot**", destroying the thermocouple. When NiCr-Ni thermocouples that have been operating above 700 °C are cooled quickly, this cooling causes certain states in the crystal structure (**short-range order**) to freeze, which in type K thermocouples can result in a change of the thermal voltage of up to 0.8 mV (K effect).

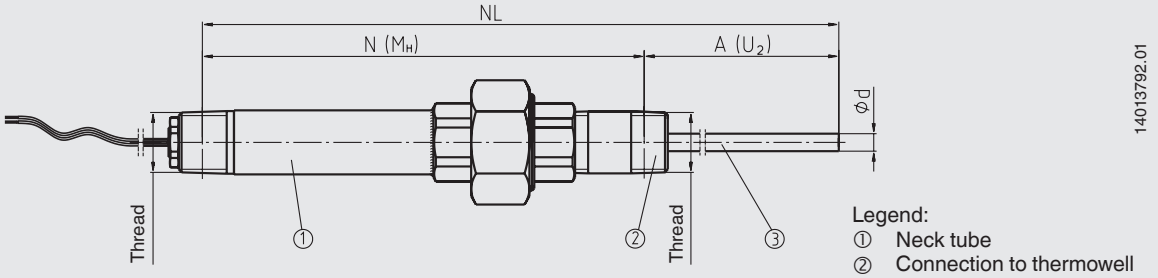
In Type N thermocouple (NiCrSi-NiSi), it has been possible to reduce the **short-range-order effect** by alloying both legs with silicon. The effect is reversible and is largely eliminated again by annealing above 700 °C, followed by slow cooling. Thin sheathed thermocouples are particularly sensitive. Cooling in still air can even result in deviations of more than 1 K.

TC12 components

Process thermocouple model TC12-B



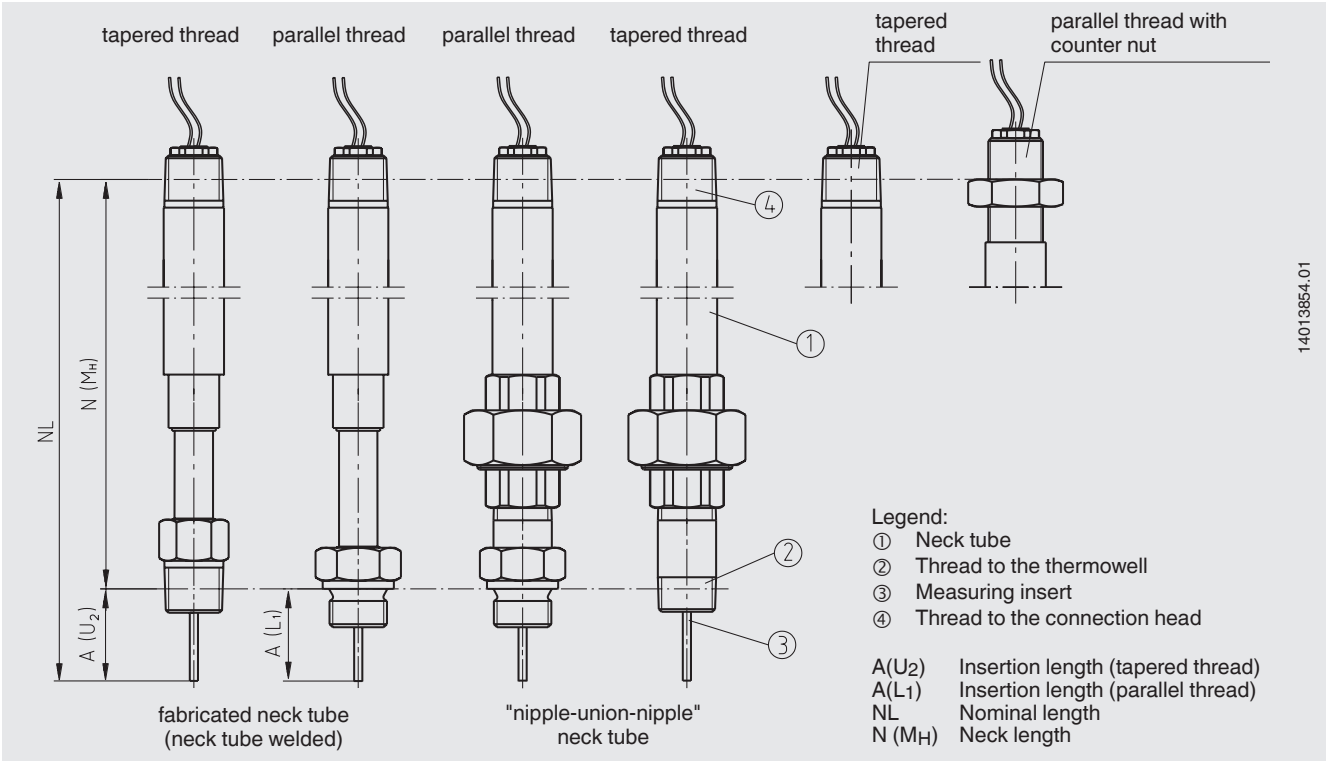
Basis module model TC12-M



Legend:
① Neck tube
② Connection to thermowell
③ Measuring insert
④ Connection head

$A\ (U_2)$ Insertion length
NL Nominal length
$N\ (M_H)$ Neck length

Neck tube version



Measuring insert

The exchangeable measuring insert is made of a vibration-resistant sheathed measuring cable (MI cable).
The diameter of the measuring insert should be approx. 1 mm smaller than the bore diameter of the thermowell. Gaps of more than 0.5 mm between thermowell and the measuring insert will have a negative effect on the heat transfer, and they will result in unfavourable response behaviour from the thermometer.

When fitting the measuring insert into a thermowell, it is very important to determine the correct insertion length (= thermowell length for bottom thicknesses of ≤ 5.5 mm). The measuring insert should be spring-loaded (spring travel: 0 to 20 mm) in order to ensure that it presses against the bottom of the thermowell.

The standard material used for the measuring insert sheath is Inconel 2.4816. Other materials on request.

This model series has outstanding resistance to vibration (50 g amplitude).

Neck tube

The neck tube is screwed into the connection head or the case. The neck length depends on the intended use. Usually an isolation is bridged by the neck tube. Also, in many cases, the neck tube serves as a cooling extension between the connection head and the medium, in order to protect any possible built-in transmitter from high medium temperatures.

In the Ex-d version the flameproof joint is integrated in the neck tube.

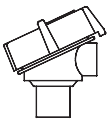
Material for the neck tube is stainless steel 316/316L.

Thermowell selection

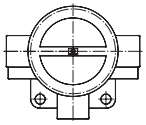
TW10	TW15	TW20	TW25	TW31	TW50	TW55
						
Data sheets: TW 95.10 TW 95.11 TW 95.12	Data sheet: TW 95.15	Data sheet: TW 95.20	Data sheet: TW 95.25	Data sheet: TW 95.31	Data sheet: TW 95.50	Data sheet: TW 95.55

Special thermowells on request

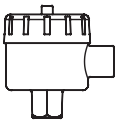
Connection head



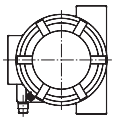
1/4000 F



5/6000



7/8000



on request

Model	Material	Cable outlet	Ingress protection	Cap	Surface finish
1/4000 F	Aluminium	½ NPT, ¾ NPT or M20 x 1.5	IP 65	Screw cover	blue, painted [1]
	Stainless steel	½ NPT, ¾ NPT or M20 x 1.5	IP 65	Screw cover	blank
5/6000	Aluminium	½ NPT, ¾ NPT or M20 x 1.5	IP 65	Screw cover	blue, painted [1]
7/8000	Aluminium	½ NPT, ¾ NPT or M20 x 1.5	IP 65	Screw cover	blue, painted [1]
	Stainless steel	½ NPT, ¾ NPT or M20 x 1.5	IP 65	Screw cover	blank

1) RAL5022, polyester paint saltwater-resistant

Field temperature transmitter with digital display (option)

Field temperature transmitter model TIF50
As an alternative to the standard connection head the thermometer can be fitted with an optional model TIF50 field temperature transmitter.
The field temperature transmitter comprises a 4 ... 20 mA / HART® protocol output and is equipped with an LCD indication module.

Field temperature transmitter model TIF50

Transmitter (option)

As an option, WIKA transmitters can be installed in the TC12 connection head.

Model	Description	Explosion protection	Data sheet
T12	Digital transmitter, PC configurable	optional	TE 12.03
T32	Digital transmitter, HART® protocol	optional	TE 32.04
T53	Digital transmitter FOUNDATION™ fieldbus and PROFIBUS® PA	standard	TE 53.01
TIF50	Digital field temperature transmitter, HART® protocol	optional	TE 62.01

Other transmitters on request.

Explosion protection

For application in hazardous areas, intrinsically-safe versions are available.
The instruments meet the requirements of the 94/9/EC (ATEX) guideline, for gases and dust. Manufacturer's declarations in accordance with NAMUR NE24 are also available.

The classification/suitability of the instrument (permissible power P_{max} as well as the permissible ambient temperature) for the respective category can be seen on the EC type-examination certificate and in the operating instructions.

Built-in transmitters have their own EC type-examination certificate. The permissible ambient temperature ranges of the built-in transmitters can be taken from the corresponding transmitter approval.

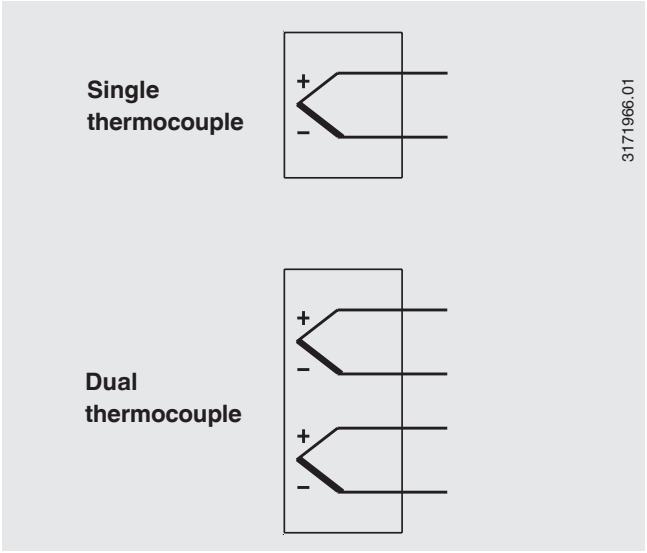
Functional safety (option)

In safety-critical applications, the entire measuring chain must be taken into consideration in terms of the failure risk. The SIL classification allows the required risk reduction as well as the associated remaining rest estimation of the measuring chain or the components used.

Model TC12 process thermocouples with integrated temperature transmitter model T32.1S is certified to IEC 61508 per SIL2.

Matched thermowells allow easy dismounting of the measuring insert for calibration.
The optimally tuned measuring point consisting of thermowell, temperature sensor in the measuring insert and certified SIL transmitter provides maximum reliability and a long service life under extreme conditions.

Termination at lead end



Colour code of cable strands

Sensor type	Standard	Positive	Negative
K	DIN EN 60584	green	white
J	DIN EN 60584	black	white
E	DIN EN 60584	violet	white
T	DIN EN 60584	brown	white
N	DIN EN 60584	pink	white

For the electrical connections of built-in temperature transmitters see the corresponding transmitter data sheets or operating instructions.

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