



**GÜNTHER**





## Index

<b>INTRODUCTION</b>	<b>2</b>
GÜNTHER GmbH Temperature Measurement Technology	2
GÜNTHER temperature sensors in action	4
Principles of temperature measurement	6
Temperature measurement using thermocouples	8
Temperature measurement Using resistance thermometers	8
Protective fitting	9
<b>THERMOCOUPLES</b>	<b>10</b>
<b>00-TMT</b> Thermocouple assemblies with metal protection tube	10
<b>05-TKT</b> Thermocouple assemblies with ceramic Protection tube	12
<b>08-TMP</b> Thermocouple assemblies with noble metal protection tube	14
<b>10-TMM</b> Thermocouple assemblies with metal protection tube and mineral-insulated measuring insert	16
<b>12-THD</b> Thermocouple assemblies for welding with thermowell form 4 (former D-sleeve)	18
<b>13-TFL</b> Thermocouple assemblies with welded blank flange	20
<b>14-TES</b> Thermocouple assemblies with threaded socket	22
<b>15-TKM</b> Thermocouple assemblies with ceramic protection tube and mineral-insulated measuring insert	24
<b>18-TKL</b> Micro- and laboratory thermocouple assemblies	26
<b>20-TOM</b> Sheathed thermocouple assemblies without Protection tube	28
<b>30-WTE</b> Angled thermocouple assemblies with threaded elbow protection tube	30
<b>35-WGG</b> Angled thermocouple assemblies with bent or welded protection tube	32

<b>RESISTANCE THERMOMETERS</b>	<b>34</b>
<b>50-WMS</b> Resistance thermometers with metal protection tube	34
<b>52-WOS</b> Mineral-insulated resistance thermometer without protection tube	36
<b>53-WHD</b> Resistance thermometers with welding thermowell form 4 (former D-sleeve)	38
<b>54-WFL</b> Resistance thermometers with welded blank flanges	40
<b>55-WES</b> Resistance thermometers with threaded socket and mineral-insulated measuring insert	42
<b>Specialized temperature sensors</b>	<b>44</b>
<b>60-WTH / 60-TE</b> Temperature sensors with bayonet nut connector	44
<b>71-KFT / 72-KFW</b> Cable thermocouples & cable resistance thermometers	46
<b>74-WTH</b> Threaded resistance thermometers with machine connectors	48
<b>Explosionproof thermocouples</b> according to ATEX-directive 2014/34/EU	50
<b>THERMOELECTRIC &amp; COMPENSATION CABLES</b>	<b>58</b>
<b>INDIVIDUAL PARTS</b>	<b>60</b>
<b>Connection heads</b>	61
<b>Transducers</b>	63
<b>Socket connectors</b>	64
<b>Stop and counter flanges</b>	65
<b>Threaded sockets / clamp connectors</b>	66
<b>GÜNTHER SERVICE</b>	<b>67</b>
<b>Technical information</b>	<b>71</b>
<b>Colour codes for thermoelectric and compensation cables, including connectors</b>	72
<b>Tolerances according to EN 60584-2</b>	73
<b>Properties of common ceramic materials</b>	73



## 50 years of precision

Starting with the founding year in 1968, the name GÜNTHER remains symbolic of state-of-the-art solutions in temperature measuring technology. Having started with the production of electronic temperature sensors for industrial furnaces, we have continually developed and expanded our expertise, offering our services to an increasing variety of industry sectors.

Today, we are standing on a foundation built on over 50 years of experience, based on cooperation with numerous partners and the development of efficient solutions for their individual applications. In every instance where precise measuring data in high temperature environments are essential, GÜNTHER Temperaturmesstechnik (Temperature Measurement Technology) has established itself as a modern, reliable and leading partner.

## Success through preparation

At our five international production sites, we are able to manufacture almost any required, customized component for our customers. Industry standard dimensions of rare/noble metal thermowells, thermocouple wiring, metal and ceramic tubing are always in stock, allowing a prompt and flexible fulfilment of our partners' individual requirements.

Sophisticated logistics network and optimised production processes are the prerequisites for timely order fulfilment and worldwide product delivery.

Note: Apart from buying and trading precious metals for our sensors, we offer our customers the option of opening a precious metals account.



Visit us online at **[www.guenther.eu](http://www.guenther.eu)**



### Diversity through progress

Moreover, the continuous expansion of our expertise on an international scale remains as a firm cornerstone of our company philosophy.

Always on the cutting edge, with an eye on the future, we go beyond providing our customers more and precise solutions, leading the way in the field of temperature measurement.

Only in this fashion, are we able to meet a variety of application scenarios and offer customized temperature sensors, while keeping an eye on the future and sustaining preparedness in meeting the varying, growing demands of the market.

Combined, these two elements form the philosophy of our company and drive the motor in maintaining both the diversity and highest standard in quality of our products.

### Quality through standards

Our quality management system has been established for many years and, along with our internal calibration laboratory, allows us to guarantee the highest possible standards in quality for every process of our operation. Certification according to DIN EN ISO 9001:2000, constant control of incoming spare parts and outgoing products, the permanent training and development of our staff and high delivery performance reliability underscore our quality and reliability standards.

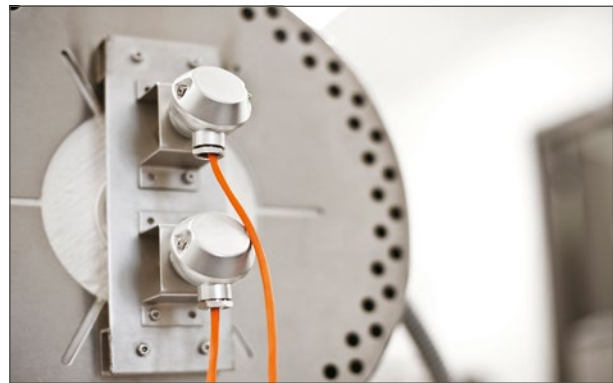
Our experience – gathered over decades, a future-oriented and sound business structure, as well as the highest quality standards, create the environment necessary in order to provide you with premium products.

Products that guarantee security and result-oriented operation.

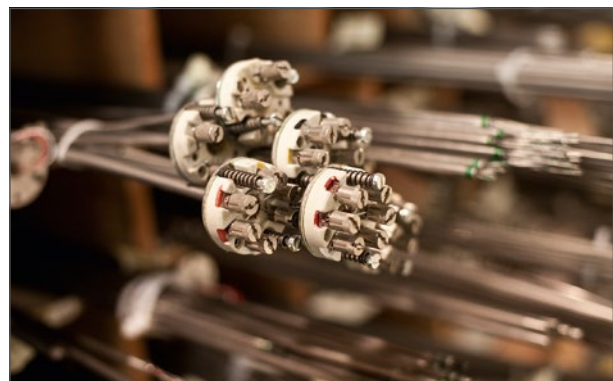
We measure our performance against your goals. Together with our highly qualified staff, we will find ideas and solutions to ensure you good and efficient results.



Our main office in Schwaig near Nuremberg



Our long-established QM System and our internal calibration laboratory, which has existed for more than 20 years, was accredited in 2014 by the German accreditation body DAkkS.

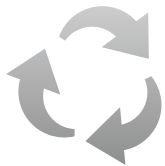


GÜNTHER GmbH is able to manufacture nearly every desired, customized configuration in-house.

## GÜNTHER temperature sensors in action

Our temperature sensors find application in a diversity of industry sectors all around the world, wherever their exact measurements are required, all throughout the various stages of manufacturing processes.

This is a summary of the most common sectors and areas of application:



### Waste recycling / waste incineration

Applied sensors:

00-TMT / 05-TKT / 10-TMM / 12-THD  
13-TFL / 14-TES / 15-TKM / 20-TOM  
53-WHD / 54-WFL / 55-WES



### Glass industry

Applied sensors:

00-TMT / 05-TKT / 08-TMP  
10-TMM / 20-TOM



### Plant and machine construction

Applied sensors:

00-TMT / 05-TKT / 10-TMM / 12-THD  
13-TFL / 14-TES / 15-TKM / 18-TKL  
20-TOM / 50-WMS / 52-WOS  
53-WHD / 54-WFL / 55-WES



### Steel and iron industry

Applied sensors:

00-TMT / 05-TKT / 10-TMM  
12-THD / 13-TFL / 18-TKL  
30-WTE / 35-WGG



### Automobile industry

Applied sensors:

00-TMT / 05-TKT / 10-TMM / 12-THD  
13-TFL / 14-TES / 15-TKM / 18-TKL  
20-TOM / 30-WTE / 35-WGG / 50-WMS  
52-WOS / 53-WHD / 54-WFL / 55-WES





### Food industry

Applied sensors:

55-WES / 72-KFW / 74-WTH



### Heat treatment

Applied sensors:

05-TKT / 18-TKL / 20-TOM  
30-WTE / 35-WGG



### Chemicals industry

Applied sensors:

12-THD / 13-TFL / 14-TES /  
18-TKL / 50-WMS / 53-WHD /  
54-WFL / 55-WES / as their  
"EX"-variants



### Laboratories

Applied sensors:

05-TKT / 10-TMM / 12-THD / 13-TFL  
18-TKL / 20-TOM / 52-WOS / 53-WHD  
54-WFL / 55-WES / 72-KFW



### Industrial furnace construction

Applied sensors:

00-TMT / 05-TKT / 10-TMM  
15-TKM / 18-TKL / 20-TOM  
55-WES



### Aluminium and non-ferrous metal industry

Applied sensors:

00-TMT / 05-TKT / 10-TMM  
20-TOM / 30-WTE / 35-WGG



### Cement and building material industry

Applied sensors:

00-TMT / 05-TKT / 10-TMM  
15-TKM / 20-TOM



### Energy production

Applied sensors:

00-TMT / 05-TKT / 10-TMM / 12-THD  
13-TFL / 14-TES / 15-TKM / 20-TOM  
50-WMS / 52-WOS / 53-WHD  
54-WFL / 55-WES / 72-KFW



### Plastic industry

Applied sensors:

20-TOM / 52-WOS  
60-WTH / 72-KFW





### Principals of temperature measurement

Essentially, there are several physically different possibilities of measuring temperature, such as gas or liquid thermometers, bimetallic strip thermometers, pyrometers, thermal imaging and of course thermocouples and resistance thermometers

The last two are examples known as measuring devices. These instruments are having direct contact to the medium to be measured.

#### Principals of thermocouples

According to the Seebeck effect, the point of contact results in a certain voltage at the point of contact, which is dependent on the temperature. The measuring insert of a thermocouple assembly possesses two of these touching points.

If there is no difference in temperature, both of these contact voltages cancel each other out. If the points of contact have different temperatures, a measurable thermoelectric current starts flowing.

#### Principals of resistance thermometers

In contrast to the thermoelectric principals of thermocouples, resistance thermometers are metals that change their resistance when heated. A differentiation is made between metals with a negative temperature coefficient (NTC), whose resistance declines when heated, and metals with a positive temperature coefficient (PTC), whose resistance increases when heated. For example, platinum's electrical resistance increases when heated.





Both principals share the property that the thermometer can only indicate the temperature that exists at the point of measurement. In order to receive precise measurements, it is essential for the point of measurement to have acquired an identical temperature to the medium being measured. At first glance, this appears quite logical. In practice, this is one of the main reasons for reduced quality, regulation errors and measurement deviations between different points of measurement on the same medium. An unsuitable protective fitting or construction can lead to the measured temperature differing from the actual temperature of the measured medium.

For this reason, the main challenge in constructing a suitable temperature sensor is finding the optimal compromise between reaction time, holding time, measurement precision and economy.

With over 50 years of experience, GÜNTHER GmbH is happy to advise you in finding the best suited format for your required temperature sensor. Using our extensive inventory and sophisticated logistics, we will supply you with your custom, high quality instruments quickly and reliably.

### Composition of Thermocouples and Resistance thermometers

In most cases, the components of thermocouple assemblies and resistance thermometers are described as follows:

#### A Measuring insert

This insert is usually not visible from the outside and contains the actual point of measurement.

#### B Protective fitting

Its primary function is to protect the point of measurement from other chemical and mechanical factors within the application environment.

Important aspects include the type of material used, its dimensions and much more.

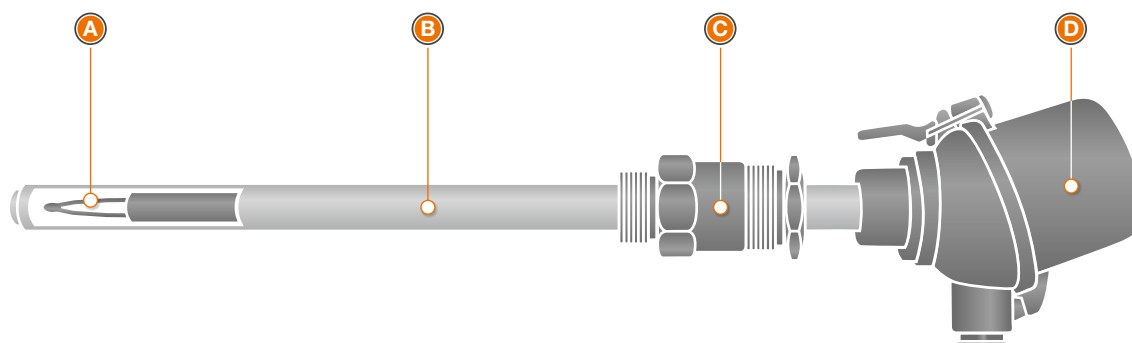
#### C Process connection

Used to affix the thermometer, for instance, to an oven wall, forging die, etc.

Differentiation is made between detachable/adjustable process connectors (threaded sleeves, stop flanges, etc.) and sealed/welded connectors (i.e. blank flanges or screw necks welded to a protective fitting).

#### D Connection head

These casing, mostly cast of light metal, contain a ceramic connection socket through which the compensation or copper wires are connected to the upper end of the measuring insert. The connection head may also contain a measurement converter (transducer), that - mounted inside the connection head - converts the measurement result into a stable signal.



## Temperature measurement using thermocouples

The actual temperature measurement is made at the thermocouple inside the thermocouple assembly. With a heat increase, the resulting difference in temperature between the different metals results in a measurable electrical voltage, allowing for exact and standardized deduction of the adjoining temperature.
















## Temperature measurement using resistance thermometers

The central component here is the precision resistor, which is mounted inside the sensor tip instead of a thermocouple. This resistor is traversed by an auxiliary current with anywhere between 0,1 and 10 mA and then the adjoining electrical resistance is measured.



**The various standardized thermocouples in Europe are:**

-  Pt13Rh-Pt, Type R, Color code orange (DIN EN 60584-2)
-  Pt10Rh-Pt, Type S, Color code orange (DIN EN 60584-2)
-  Pt30Rh-Pt6Rh/B, Type B, Color code grey (DIN EN 60584-2)
-  Fe-CuNi, Type J, Color code black (DIN EN 60584-2)
-  Cu-CuNi, Type T, Color code brown (DIN EN 60584-2)
-  NiCr-CuNi, Type E, Color code violet (DIN EN 60584-2)
-  NiCr-Ni, Type K, Color code green (DIN EN 60584-2)
-  NiCrSi-NiSi, Type N, Color code pink (DIN EN 60584-2)
-  W5Re-W26Re, Type C, No color code (DIN EN 60584-2)
-  W5Re-W20Re, Type A, No color code (DIN EN 60584-2)
-  W3Re-W25Re, Type D, No color code (DIN EN 60584-2)
-  Fe-CuNi, Type L, Color code blue (DIN 43710)
-  Cu-CuNi, Type U, Color code brown (DIN 43710)

This electrical resistance, according to DIN EN 60751, which standardizes resistances from -200° C up to +850° C, allows an exact deduction of the resistor's ambient temperature. A sensor tip may contain up to three different precision resistors. The enclosed construction of the resistance thermometer enables use of all three without a protective fitting. Today, industrial temperature measurement commonly relies on resistance thermometers with platinum precision resistors.

For further information regarding colour codes and tolerances of the various thermocouples, please take a look at the chapter

**Technical information, page 72.**





## Protective fittings

Normally, thermocouples whose conductor pairs are insulated against each other, are applied in pure, dry conditions and up to certain temperatures without protective fitting. With a fast reaction time, quick through heating and minor heat dissipation this approach is - when possible - quite advantageous.



### Metal protection tubes

Depending on the circumstances, several different stainless steels with high nickel and chrome content for reductive or oxidizing environments, heat resistant steels, nickel-chrome-molybdenum alloys, enamelled steel pipes, commercially pure iron, sheaths made of platinum-rhodium alloys and much more may find application. The upper temperature range for metallic protection tubes is somewhere between a maximum of 1150°C and 1200°C depending on the application scenario, or a maximum of 1700°C for platinum-rhodium alloys.

Most often, a Protection tube has to be utilized to protect the thermocouple from the aggressive environmental conditions inside the measuring site.



### Ceramic protection tubes

These are divided into oxide ceramic protection tubes with varying oxide content (i.e. C799, C610 and C530) and ceramic protection tubes with gas-tight and porous structures.

The Aluminum oxide content of a ceramic protection tube defines the temperature resistance of the sensor. The higher the content, the higher the temperatures the substance is able to withstand. Moreover, the gas-tight or porous structure of the ceramic substance will influence its resistance to temperature fluctuations. The tighter the structure, the higher its resistance.

Ceramic sheaths are suited for higher temperatures than metallic protection tubes, however ceramics react more sensitively to abrupt temperature fluctuations.

## 00-TMT

### Thermocouple assemblies with metal protection tube



#### Application examples for thermocouple assemblies with metal protection tube:

-  Waste recycling / waste incineration
-  Glass industry
-  Plant- and machine construction
-  Steel and iron industry
-  Automobile industry
-  Industrial furnace construction
-  Aluminium and non-ferrous metal industry
-  Cement and building material industry
-  Energy production

#### 00-TMT

##### Thermocouple assemblies with metal protection tube

Straight line thermocouple assemblies with metal protection tubes are used, depending on the properties of the protection tube, for common temperature measurements in liquid, gaseous or plastic mediums up to a temperature of 1200°C.

The protective fittings of this product line are composed of seam welded or seamlessly drawn metal tubing. Depending on the application, GÜNTHER GmbH has over 40 different, partly high-alloyed materials in a large array of measurements in stock. The tips for the Protection tubes are closed either through hot forming or welded shut with a bottom blank.

Tapered measuring tips may be used in this product line in order to shorten the reaction time. For prolonging the holding time, strengthening the wall thickness and utilization of ceramic inner tubing are possible.

All internationally prevalent thermocouple pairs, detachable process connectors (for example mobile flanges or threaded sleeves) and connection heads are employed.

The selected thermocouple and/or protection tube material with the lowest permissible operating temperature defines the maximum operating temperature of the entire thermocouple assembly.

Thermoelectric voltages and tolerances of our thermocouples are according to DIN EN 60584, class 1. For specialised thermal sensors, whose construction and components require technical clarification, we engineer customized solutions. Please contact us about your specific application requirements in reference to material and assembly and we will develop your optimized individual solution.

**Further Technical information for this product line is available  
for download on our website.  
[www.guenther.eu/downloads](http://www.guenther.eu/downloads)**



Visit us online at [www.guenther.eu](http://www.guenther.eu)



**① Connection head (s. page 61)**

A	B
AUS	BUS
AUZ	BUZ
AUZH	BUZH
AUSH	BBK

**② Protection tube (materials)**

St. 35.8	Mat. No. 1.0305
Kanthal	
Stainless steel	Mat. No. 1.4301
Stainless steel	Mat. No. 1.4571
X18CrN28	Mat. No. 1.4749
X15CrNiSi2520	Mat. No. 1.4841
Inconel 600	Mat. No. 2.4816
Heat resistant steel	Mat. No. 1.4893

**③ Process connector (detachable)**

Flange
Threaded socket
Flange / Counter flange

**④ Ceramic inner tubing**

C610	TEP
C799 (gas-tight)	Aluminum oxide

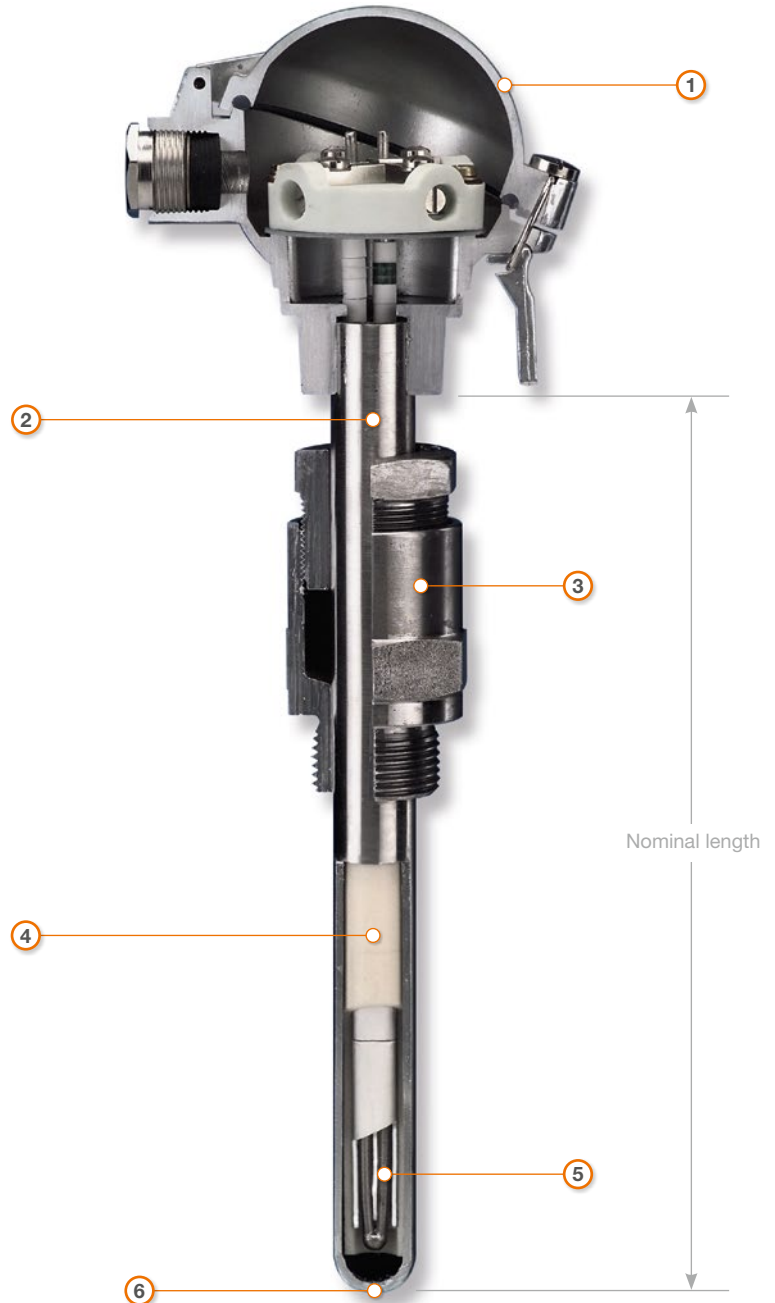
**Thermocouple**

<b>⑤</b>	Type R	Pt13Rh-Pt
	Type S	Pt10Rh-Pt
	Type B	Pt30Rh-Pt6Rh
	Type K	NiCr-Ni
	Type J	Fe-CuNi
	Type L	Fe-CuNi
	Type C	W5Re-W26Re
	Type N	NiCrSi-NiSi
	Type D	W3Re-W25Re

**Configuration**

<b>⑥</b>	Fast response time:
	Tapered protection tube
	Protective sheath diameter: 6-15 mm

Example of a common implementation in this product line



Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 05-TKT

### Thermocouple assemblies with ceramic protection tube



#### Application examples for thermocouple assemblies with ceramic protection tube:

-  Waste recycling / waste incineration
-  Glass industry
-  Plant and machine construction
-  Steel and iron industry
-  Automobile industry
-  Heat treatment
-  Laboratories
-  Industrial furnace construction
-  Aluminium and non-ferrous metal industry
-  Cement and building material industry
-  Energy production

#### 05-TKT

#### Thermocouple assemblies with ceramic protection tube

Straight line thermocouple assemblies with ceramic protection tube (05-TKT) are mainly used for general temperature measurement in gaseous environments up to 1800°C.

Measurement and regulation processes can lead to strenuous operational demands through abrasion and corrosion. This is the reason for the protection tubes of these thermal sensors consisting of high grade heat-resistant ceramics. Metals often will not be able to bear the stress of this strain.

Aside from the industry customary oxide ceramics (purity of up to 99,8%), we offer non-oxide ceramics and individual solutions with a diversity of dimensions and materials. In most cases, GÜNTHER GmbH will have these items available from stock.

An overview of the individual properties of the most common ceramics can be found on page 72, in the chapter "Technical information".

The assemblies of this product line can be fitted with an additional ceramic inner tube, which, in most cases, considerably increases endurance strength and total durability.

The maximum operating temperature is dependent both upon the mounting orientation (vertical / horizontal) and the corrosiveness of the respective ambient media.

Thermoelectric voltages and tolerances of our thermocouples are according to DIN EN 60584, class 1.

**Further Technical information for this product line is available  
for download on our website.**

**[www.guenther.eu/downloads](http://www.guenther.eu/downloads)**



Visit us online at **[www.guenther.eu](http://www.guenther.eu)**



① Connection head (s. page 61)

A	B
AUS	BUS
AUZ	BUZ
AUZH	BUZH
AUSH	BBK

② Holding pipe (materials)

Available in various lengths

St. 35.8	Mat. No. 1.0305
Stainless steel	Mat. No. 1.4571
X10Cr Al 24	Mat. No. 1.4762
X15CrNiSi2520	Mat. No. 1.4841
Inconel 600	Mat. No. 2.4816
Kanthal	

③ Process connector (detachable)

Flange
Threaded socket
Flange / Counter flange

④ Protection tube (materials)

C610	Quartz glass
C799	Sapphire
C530	Ekatech S
Ekatech C	

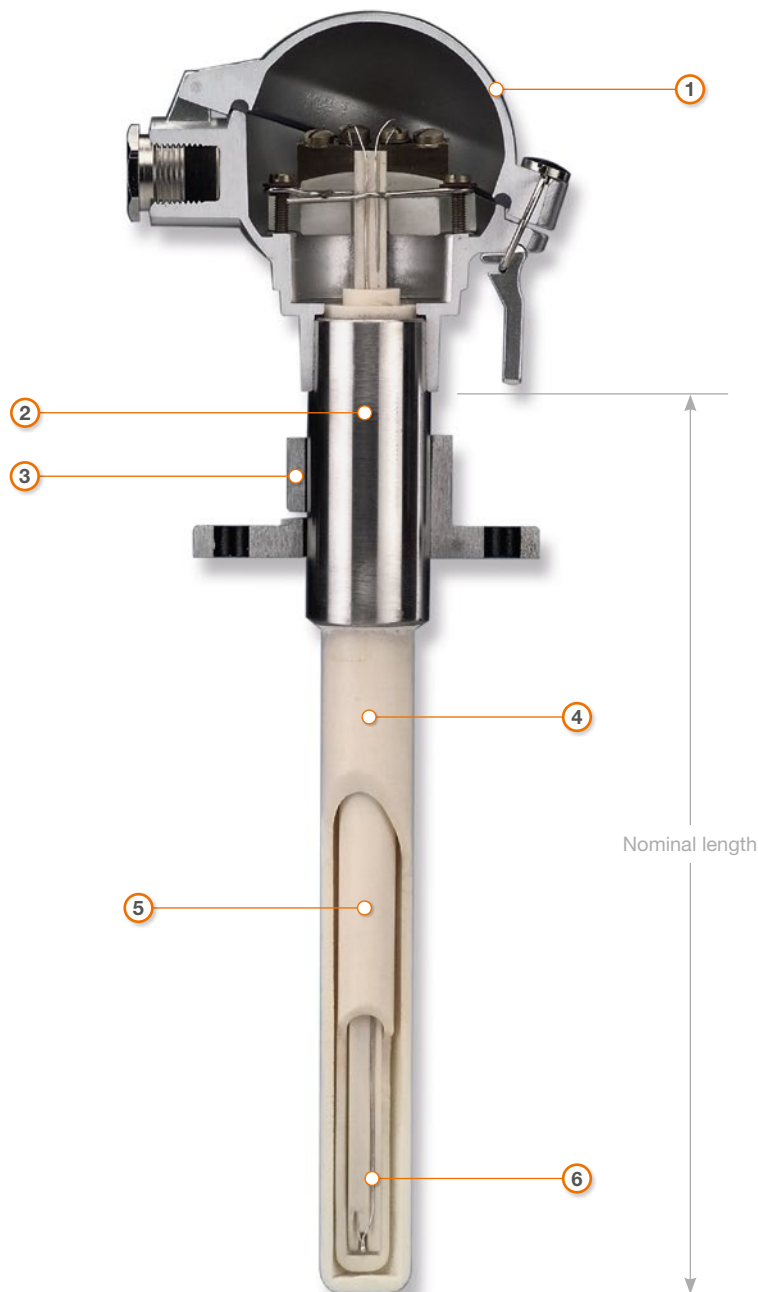
⑤ Inner tube

C610	TEP
C799 (gas-tight)	Aluminum oxide
C530	Porous ceramic

⑥ Thermocouple

Type R	Pt13Rh-Pt
Type S	Pt10Rh-Pt
Type B	Pt30Rh-Pt6Rh
Type K	NiCr-Ni
Type J	Fe-CuNi
Type L	Fe-CuNi
Type C	W5Re-W26Re
Type N	NiCrSi-NiSi
Type D	W3Re-W25Re

Example of a common implementation in this product line



Thermocouples

Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 08-TMP

### Thermocouple assemblies with noble metal protection tube



**GÜNTHER GmbH has been a supplier of thermocouples for over 50 years to the following sectors of the glass industry:**

- Container glass
- Fibreglass
- Sheet glass
- Glass wool
- Dinnerware glass
- Dinnerware glass
- Medical glass

**Further Technical information for this product line is available for download on our website.**

**[www.guenther.eu/downloads](http://www.guenther.eu/downloads)**

#### 08-TMP

##### Thermocouple assemblies with noble metal protection tube

Straight line thermocouple assemblies with noble metal protection tube (08-TMP) are used in the glass industry for temperature measurement in glass melting. The applied protection tubes consist of alloyed noble metals. In order to meet the extreme environment conditions, only high grade materials are used in production.

A large selection of various dimensions and platinum alloys are available from stock in order to ensure fast delivery times.

Aside from alloying with other metals such as iridium and rhodium, we offer dispersion-hardened protection tubes and platinum coated ceramic tubes.

Thermocouples are available as required, in single, double or triple element version.

Also, GÜNTHER GmbH will deliver bubbler pipes or glass level probes in various versions according to customer specifications.

Thermoelectric voltages and tolerances are according to DIN EN 60584, class 1 for thermocouple types S and R, class 2 for thermocouple type B.

#### Operation temperature

##### for platinum-rhodium/platinum thermocouples

Type	Diameter	Maximum Temperature
S	0,35 mm	1350 °C
S	0,50 mm	1600 °C
R	0,35 mm	1350 °C
R	0,50 mm	1600 °C
B	0,35 mm	1600 °C
B	0,50 mm	1800 °C

Other wire diameters on customer request



Visit us online at **[www.guenther.eu](http://www.guenther.eu)**



① Connection head (s. page 61)

A	B
AUS	BUS
AUZ	BUZ
AUZH	BUZH
AUSH	BBK

② Process connector (detachable)

Flange
Threaded socket
Flange / Counter flange

③ Protection tube (materials)

C610
C799
C530

④ Inner tube

C610	TEP
C799 (Gas-Tight)	Aluminum oxide

⑤ Noble metal protection tube

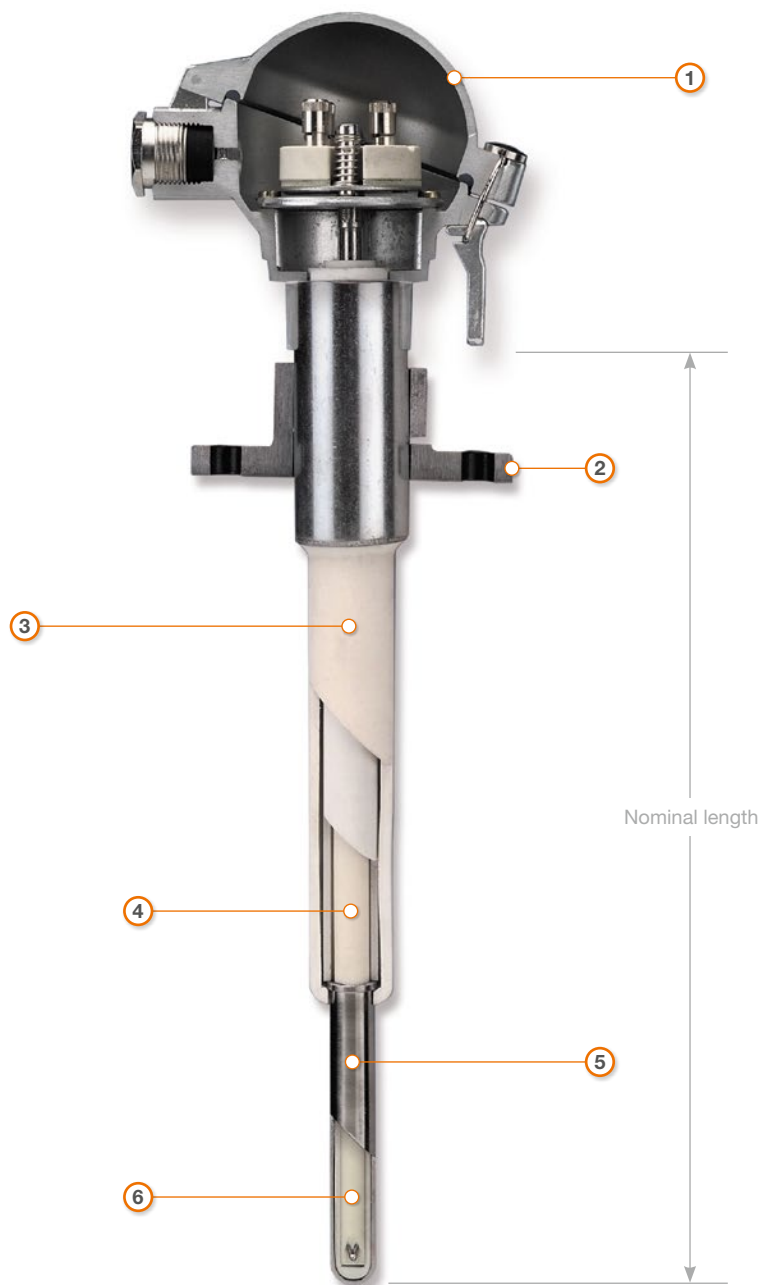
PtRh90/10	9,1 x 0,3 mm
PtRh90/10	9,1 x 0,5 mm
PtRh90/10	6,5 x 0,5 mm
PtRh90/10	9,0 x 0,4 mm
PtRh85/15	7,3 x 0,4 mm
PtRh80/20	9,1 x 0,5 mm
PtRh90/10	9,0 x 0,5 mm

⑥ Thermocouple

Type R	Pt13Rh-Pt
Type S	Pt10Rh-Pt
Type B	Pt30Rh-Pt6Rh

We are constantly expanding our stock of protection sleeve raw material. Therefore, many dimensions are also available in dispersion hardened platinum (Pt DPH) design from stock.

Example of a common implementation in this product line



Thermocouples

Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.  
Please contact us for further information!

## 10-TMM

### Thermocouple assemblies with metal protection tube and sheathed mineral-insulated measuring insert



#### 10-TMM

##### Thermocouple assemblies with metal protection tube and sheathed mineral-insulated measuring insert

Straight line thermocouples with metal protection tubes and sheathed mineral-insulated measuring insert (10-TMM) are used for general temperature measurement in liquid, gaseous and plastic media up to 1200°C.

The main difference to thermocouples with ceramic protection tubes (00-TMT) lies in the use of a sheathed mineral-insulated measuring insert. The thermocouple wires are fully embedded in a highly pure magnesium oxide with an additional metallic sheath. The advantages compared to thermocouples with ceramic protection tubes include:

- Easy replacement
- Vibration and impact resistance
- Increased holding time
- Possibility for test bores

#### Application examples for thermocouple assemblies with metal protection tube and sheathed mineral-insulated measuring insert



Waste recycling / waste incineration



Glass industry



Plant and machine construction



Steel and iron industry



Automobile industry



Laboratories



Industrial furnace construction



Aluminium and non-ferrous metal industry



Cement and building material industry



Energy production

In order to achieve extra speed in measuring temperature changes, we also offer these temperature sensors with tapered sensor tip.

The thermoelectric voltages and tolerances of our mineral insulated sensor inserts are according to standard DIN EN 60584, class 1.

Further Technical information for this product line is available for download on our website.  
[www.guenther.eu/downloads](http://www.guenther.eu/downloads)



Visit us online at [www.guenther.eu](http://www.guenther.eu)

**① Connection head (s. page 61)**

A	B
AUS	BUS
AUZ	BUZ
AUZH	BUZH
AUSH	BBK

**② Protection tube (materials)**

St. 35.8	Mat. No. 1.0305
Kanthal AF	
Stainless steel	Mat. No. 1.4301
Stainless steel	Mat. No. 1.4571
X18CrN28	Mat. No. 1.4749
X15CrNiSi2520	Mat. No. 1.4841
Inconel 600	Mat. No. 2.4816
Heat-resistant steel	Mat. No. 1.4893

**③ Process connector (detachable)**

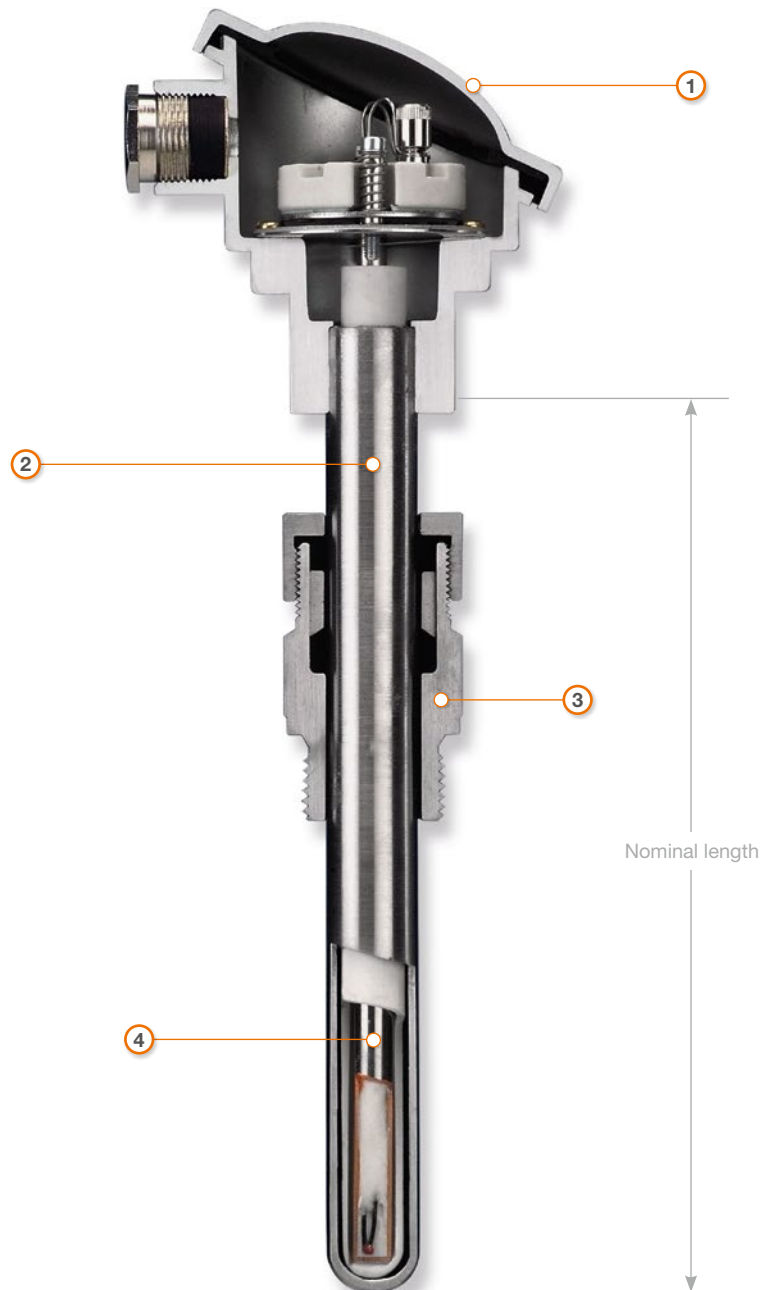
Flange
Threaded socket
Flange / Counter flange

**④ Mineral-insulated measuring insert**

Sheath material:	Inconel 2.4816
	Mat. No. 1.4541
Thermocouple:	NiCr-Ni / K
	Fe-CuNi / L
	Fe-CuNi / J
	NiCrSi-NiSi / N
Diameter:	0,5 - 8 mm

The sheathed mineral-insulated measuring insert is available as required, in single, double or triple version and may be fitted, optionally, with a parallel test bore for inserting a reference thermometer.

Example of a common implementation in this product line



Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 12-THD

### Thermocouple assemblies for welding with thermowell form 4 (former D-sleeve)



#### Application examples for thermocouple assemblies for welding with thermowell form 4 :

-  Waste recycling / waste incineration
-  Plant and machine construction
-  Steel and iron industry
-  Automobile industry
-  Chemical industry
-  Laboratories
-  Energy production

#### 12-THD

#### Thermocouple assemblies for welding with thermowell form 4 (former D-sleeve) according to DIN 43772

Thermocouple assemblies for welding (12-THD) are used in gaseous or liquid media such as air, steam, water, oil, etc. with high current speeds and pressure. The thermowell's material defines the operating temperature. Specialized assemblies for welding are suitable for up to 700 bar of pressure. The mountings of this product line are fitted with exchangeable gauge slides.

The main component is a thermowell crafted from high-grade or pressure-vessel steel, with which the thermocouple assembly is welded to the respective machine or measuring location.

Selection of the thermowell is dependent on spatial proportions at the point of installation, as well as demands as dictated by temperature, pressure, current flow and chemical attack.

Standard values for stress capacity can be found in the diagrams of DIN 43772.

In particular the question of chemical stress capacity must be examined carefully for each individual scenario. Often times, only field testing will yield authoritative information, as even minor impurities in the ambient media can have significant impact on the performance of the thermowell within the application environment.

Thermoelectric voltages and tolerances of our thermocouples and measuring inserts are according to DIN EN60584, class 1.

**Further Technical information for this product line is available for download on our website.**

[www.guenther.eu/downloads](http://www.guenther.eu/downloads)





**① Connection head (s. page 61)**

B (M24 x 1,5) BBK

BUS BUSH

BUZ BUZH

**② Connection tube according to DIN 43772**

with screw connection:

M24 x 1,5 / M14 x 1,5

M24 x 1,5 / M18 x 1,5

Also available without neck tube

**③ Thermowell according to DIN 43772**

Cone length: 40 - 125 mm

Shaft length: 50 or 110 mm

Thermowell length: 115 - 260 mm

Diameter: 18 or 24 mm

Material: 1.7335

1.4571

1.5415

**④ Measuring Insert**

Sheath material: Inconel 2.4816

Mat. No. 1.4541

Thermocouple: NiCr-Ni / K

Fe-CuNi / L

Fe-CuNi / J

NiCrSi-NiSi / N

Diameter: 2 - 8 mm

Single or double

Example of a common implementation in this product line



Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 13-TFL

### Thermocouple assemblies with welded blank flange



#### Application examples for thermocouple assemblies with welded blank flange:

-  Waste recycling / waste incineration
-  Plant and machine construction
-  Steel and iron industry
-  Automobile industry
-  Chemical industry
-  Laboratories
-  Energy production

## 13-TFL

### Thermocouple assemblies with welded blank flange

Thermocouple assemblies with welded blank flange (13-TFL) are used to measure temperatures in gaseous or fluid media, such as air, steam, water or oil.

Distinctive characteristic of these sensors is a blank flange welded to or onto the protective sheath, most commonly according to DIN EN 1092, enabling a tight connection of the sensor with the respective wall of an over- or under-pressure facility as can be found in power plants, for example.

Sensors in this component assembly contain either a thermocouple with ceramic insulation or an exchangeable mineral-insulated measuring insert.

#### Preferred application environments:

- Containers and Pipes
- Instruments and machinery
- Laboratories
- Testing facilities
- Process technology
- Energy production und heat distribution
- Food and beverage industry
- Plant and machine construction

Thermoelectric voltages and tolerances of our thermocouples and mineral-insulated measuring inserts are according to DIN EN 60584, class 1, for thermocouples and mineral-insulated measuring inserts of Type L according to DIN 43710.

Further Technical information for this product line is available for download on our website.

[www.guenther.eu/downloads](http://www.guenther.eu/downloads)



Visit us online at [www.guenther.eu](http://www.guenther.eu)

① Connection head (s. page 61)

A	BUSH (M24 x 1,5)
B (M24 x 1,5)	BUZH (M24 x 1,5)
BUS (M24 x 1,5)	DL / MA (M10 x 1)
BUZ (M24 x 1,5)	

② Blank flange according to DIN EN 1092

DN 10 - DN 100	
Material:	
Mat. No. St37-2	Mat. No. 1.4571
Mat. No. C22.8	Alloy C4

③ Mineral-insulated measuring insert

Material:	NiCr-Ni
	Fe-CuNi
	NiCrSi-NiSi
Diameter:	3 - 8 mm
Single or double	

④ Protection tube material / dimensions

St. 35.8	Mat. No. 1.0305
Stainless steel	Mat. No. 1.4571
X18CrN28	Mat. No. 1.4749
X15CrNiSi2520	Mat. No. 1.4841
Inconel	Mat. No. 2.4816
Kanthal	
Alloy C4	
Diameter:	6 - 22 mm
Wall:	0,75 - 3 mm

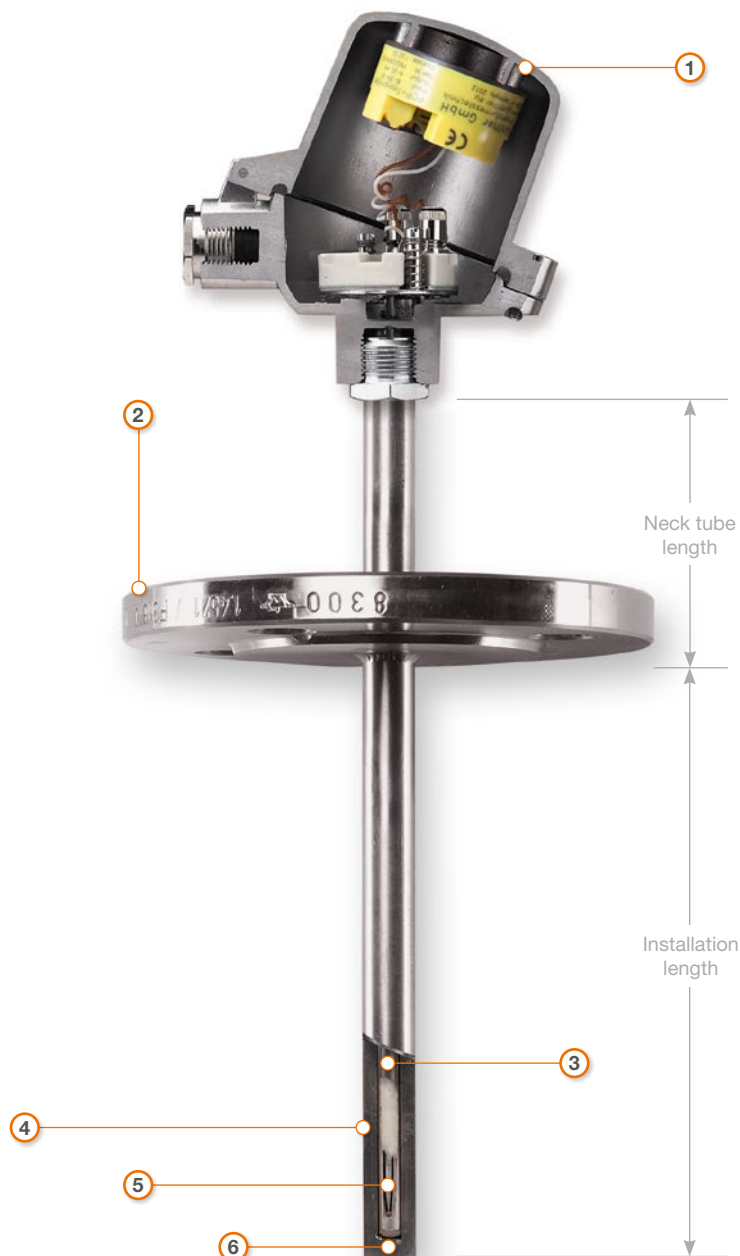
⑤ Thermocouple with ceramic insulation

Single or double:	
NiCr-Ni/K	Fe-CuNi/J
Fe-CuNi/L	NiCrSi-NiSi/N
Pt10Rh-Pt/S	Pt13Rh-Pt/R
Pt30Rh-Pt6Rh/B	

⑥ Configuration

Normal (straight protection tube)
Fast reacting
(Tapered protection tube):
Tube tip diameter: 6-15 mm

Example of a common implementation in this product line



Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.  
Please contact us for further information!

## 14-TES

### Thermocouple assemblies with threaded socket



#### Application examples for thermocouple assemblies with threaded socket:



Waste recycling / waste incineration



Plant and machine construction



Automobile industry



Chemical industry



Energy production

#### 14-TES

##### Thermocouple assemblies with threaded socket

Thermocouple assemblies with threaded socket (14-TES) are used for common temperature measurement in low-pressure gaseous, liquid and plastic media environments, depending on the properties of Protection tube and surrounding media up to a temperature of 1200°C.

A threaded socket is welded to the Protection tube, providing for the stability of the process connector in this component assembly. Depending on the application, the socket is welded to the protective pipe either directly beneath the connection head or with a gap of 100 or 200 mm, for example.

The protective fittings are usually made from a single seamlessly drawn high-grade steel tube with a circular blank welded inside.

Optionally, our thermocouple assemblies with threaded sockets may be fitted with an internal ceramic tube, which significantly increases the long-term stability and electrical insulation of the measuring thermocouple in many application scenarios.

Further Technical information for this product line is available for download on our website.

[www.guenther.eu/downloads](http://www.guenther.eu/downloads)



Visit us online at [www.guenther.eu](http://www.guenther.eu)



① Connection head (s. page 61)

B (M24 x 1,5)	BUSH
BUS	BUZH
BUZ	NA
BBK	DL / MA (M10 x 1)
other	

② Process connector

G 1 A
G 1/2 A
M18 x 1,5
G 3/4 A
M20 x 1,5
Combined: M24 x 1,5 / G 1/2 A
M10 x 1 / G 1/2 A
Other

③ Outer protection tube material / dimensions

St. 35.8	Mat. No. 1.0305
Stainless steel	Mat. No. 1.4571
X18CrN28	Mat. No. 1.4749
X15CrNiSi2520	Mat. No. 1.4841
Inconel	Mat. No. 2.4816
Kanthal	
Diameter:	6 - 22 mm
Wall:	0,75 - 3 mm

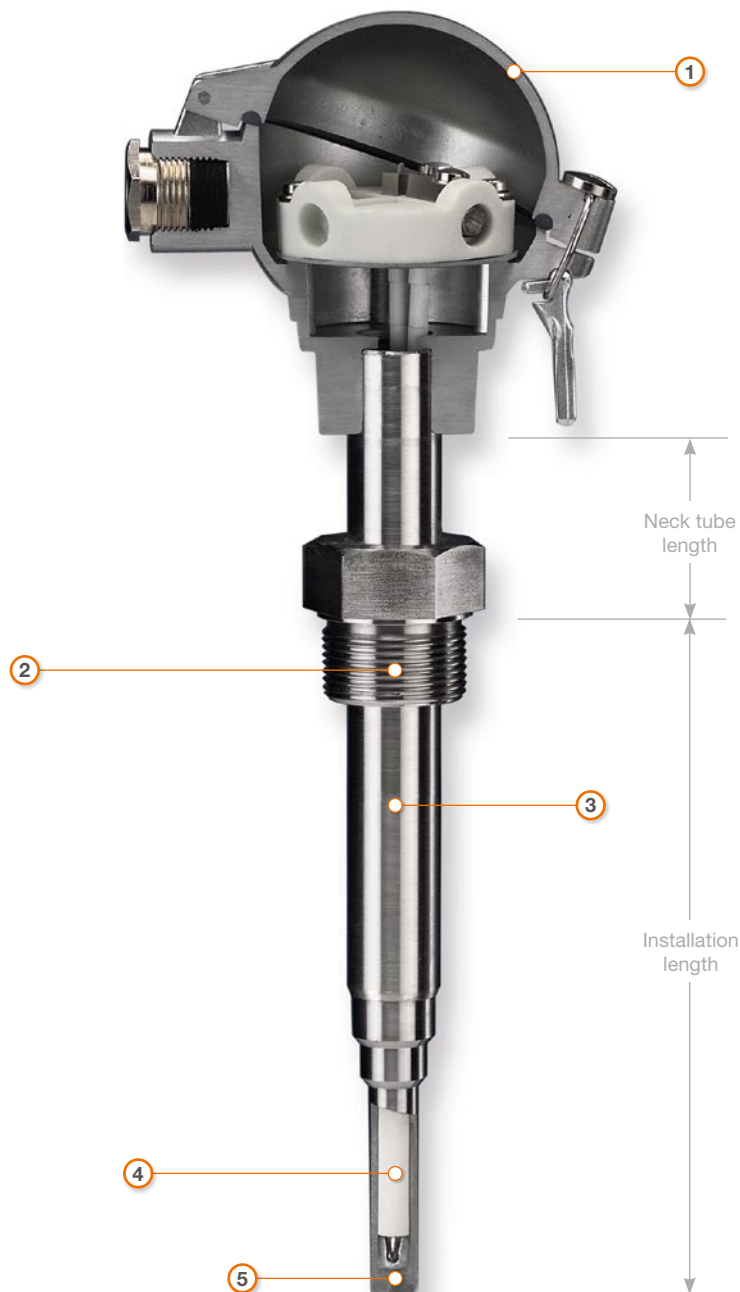
④ Mineral-insulated measuring insert

Thermocouple Type / Mantle Material:	
Fe-CuNi / L	1.4541
Fe-CuNi / J	1.4541
NiCrSi-Ni / K	Inconel 2.4816
NiCrSi-NiSi / N	Inconel 2.4816
Measuring insert:	1,5 - 6 mm
Thermocouple:	1 - 3 mm
Single or double	

⑤ Configuration

Normal (straight protection tube)
Fast reacting (tapered protection tube)
Tube tip diameter: 6-15 mm

Example of a common implementation in this product line



Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 15-TKM

### Thermocouple assemblies with ceramic protection tube and mineral-insulated measuring insert



#### Application examples for Thermocouple assemblies with Ceramic protection tube and mineral-insulated measuring insert:



Waste recycling / waste incineration



Plant and machine construction



Automobile industry



Industrial furnace construction



Cement and building material industry



Energy production

#### 15-TKM

##### Thermocouple assemblies with ceramic protection tube and mineral-insulated measuring insert

Straight line thermocouple assemblies with ceramic protection tube and mineral-insulated measuring inserts (15-TKM) are used for common temperature measurement up to 1200°C, mainly in gaseous media.

For sensors of this product line, mainly base metal thermocouples are employed, combining the advantages of mineral-insulated measuring inserts on one hand, and the advantages of technical ceramics on the other hand.

The individual properties of the most common ceramic types can be found on page 73, in the chapter "Technical information".

Additionally and in contrast to thermocouples, mineral-insulated measuring inserts are easily exchangeable, they are resilient to temperature changes, vibration and impact resistant. In consequence of the compact and slender configuration of the mineral-insulated measuring inserts, enough space usually remains to allow for the insertion of an additional mineral insulated thermocouple for measurement verification if necessary.

During measurement and control processes, often high operational wear occurs due to corrosion and abrasion, which even high grade metal protection tubes are not able to withstand. In these scenarios, thermal sensors with Protection tubes made of heat-resistant, technical ceramics allow for increased holding time in many instances.

Thermoelectric voltages and tolerances of our mineral-insulated measuring inserts are according to DIN EN 60584, class 1.

Further Technical information for this product line is available for download on our website.

[www.guenther.eu/downloads](http://www.guenther.eu/downloads)



Visit us online at [www.guenther.eu](http://www.guenther.eu)

① Connection head (s. page 61)

A	B
AUS	BUS
AUZ	BUZ
AUZH	BUZH
AUSH	BBK

② Holding tube (materials)

Available in various lengths

Stainless steel	Mat. No. 1.4571
X18CrN28	Mat. No. 1.4749
X15CrNiSi2520	Mat. No. 1.4841
Inconel	Mat. No. 2.4816
Kanthal	

③ Process connector (detachable)

Flange
Threaded socket
Flange / Counter flange

④ Protection tube (materials)

C610	Quartz glass
C799	Sapphire
C530	Ekatech S
Ekatech C	

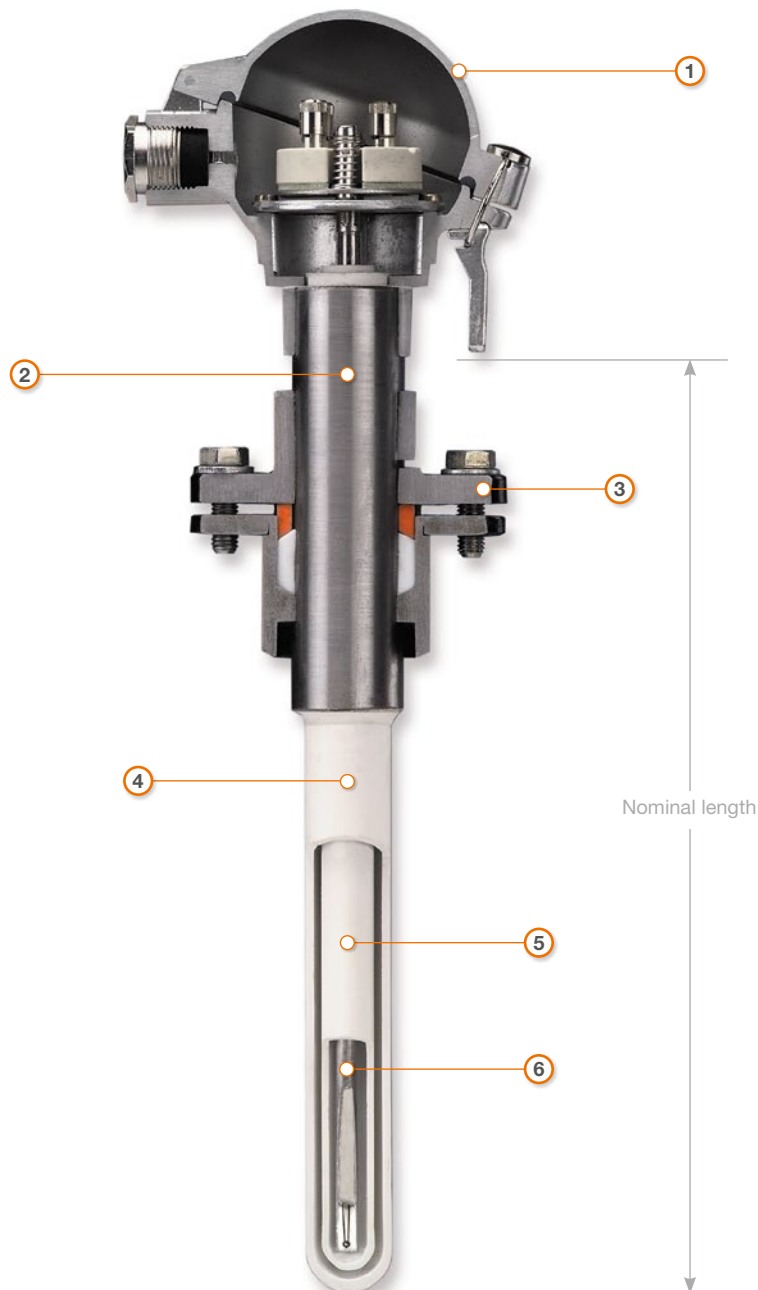
⑤ Inner tube

C530	Porous ceramic
C610	TEP
C799	Aluminum oxide

⑥ Mineral-insulation sheath / thermocouple

Thermocouple / sheath material:	
Fe-CuNi / L	1.4541
Fe-CuNi / J	1.4541
NiCrSi-Si / K	Inconel 2.4816
NiCrSi-NiSi / N	Inconel 2.4816
Sheath-diameter:	1,5 - 8 mm
Single or partly double testable	

Example of a common implementation in this product line



Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 18-TKL

### Micro- and laboratory thermocouple assemblies



The individual properties of the most common ceramic types can be found on page 73, in the chapter "Technical information".

#### Application examples for micro- and laboratory thermocouple assemblies:

-  Plant and machine construction
-  Steel and iron industry
-  Automobile industry
-  Heat treatment
-  Chemical industry
-  Laboratories
-  Industrial furnace construction

## 18-TKL

### Micro- and laboratory thermocouple assemblies

Micro- and laboratory thermocouple assemblies (18-TKL) are preferentially used for technical temperature measurements in liquid and gaseous media within a temperature range between 200°C and 1800°C.

Micro- and laboratory thermocouple assemblies differ from conventional thermocouple assemblies in their very small dimensions, light weight and variable mounting options. They also warrant exact temperature measurements within a constrained installation space. In consequence of design, these sensors also have very short reaction times.

There is a notable danger of "poisoning" noble metal thermocouples in micro- and laboratory thermocouple assemblies by substances diffusing through the protective fitting, such as those to be found in flue gas, for example. In order to avoid these types of influences, we recommend using a version employing gas-tight ceramic.

#### Operation temperature for platinum-rhodium / platinum thermocouples:

Type	Diameter	Maximum Temperature
S	0,35 mm	1350°C
S	0,50 mm	1600°C
R	0,35 mm	1350°C
R	0,50 mm	1600°C
B	0,35 mm	1600°C
B	0,50 mm	1800°C

The thermal materials used by GÜNTHER GmbH for micro- and laboratory thermocouple assemblies are according to DIN EN 60584.

Further Technical information for this product line is available for download on our website.  
[www.guenther.eu/downloads](http://www.guenther.eu/downloads)



Visit us online at [www.guenther.eu](http://www.guenther.eu)



### 1 Connection types

Head B

Head DL

Head L

connection socket type S

The following listed connection types are fitted with welded holding tubes and connection socket type S.

Head L with tube 1.4571

Connection clip 55x20 mm

Flanged plate 60x60 mm

connection socket type S

### 2 Holding tube (materials)

St. 35.8 Mat. No. 1.0305

Brass

Stainless steel Mat. No. 1.4571

Inconel Mat. No. 2.4816

### 3 Process connector (detachable)

Flange

Threaded socket

Flange / Counter flange

### 4 Protection tube (materials)

C610 Ekatech S

C799 Ekatech C

### 5 Thermocouple (Single, Double or Triple)

Type R Pt13Rh-Pt

Type S Pt10Rh-Pt

Type B Pt30Rh-Pt6Rh

Type K NiCr-Ni

Type J Fe-CuNi

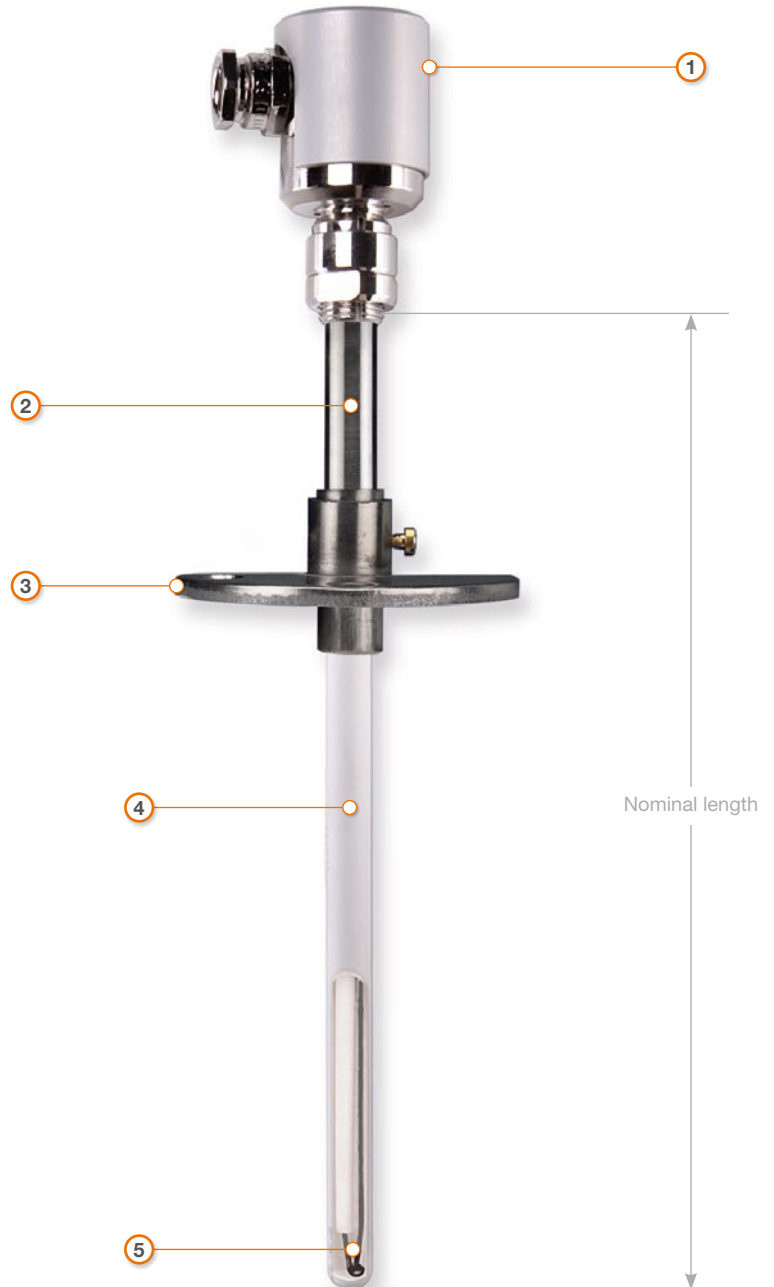
Type L Fe-CuNi

Type C W5Re-W26Re

Type N NiCrSi-NiSi

Type D W3Re-W25Re

Example of a common implementation in this product line



Thermocouples

Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 20-TOM

### Sheathed thermocouple assemblies without Protection tube



#### Application examples for sheathed thermocouple assemblies without protection tube:

-  Waste recycling / waste incineration
-  Glass industry
-  Plant and machine construction
-  Automobile industry
-  Heat treatment
-  Laboratories
-  Industrial furnace construction
-  Aluminium and non-ferrous metal industry
-  Cement and building material industry
-  Energy production
-  Plastic industry

## 20-TOM

### Sheathed thermocouple assemblies without protection tube

Sheathed thermocouple assemblies without protection tube (20-TOM) are used in almost every branch of industry up to a temperature of 1100°C, with a platinum-rhodium-sheath up to 1300°C. Sheathed thermocouple assemblies essentially consist of thermo wires (inner conductors) insulated with high-purity, condensed magnesium oxide powder and an external sheath of heat-resistant high-grade steel or nickel alloy (e.g. Inconel 600®).

Sheathed thermocouple assemblies are available in single, double or triple element version. The outer diameter lies somewhere between 0,5 mm and 8,0 mm depending on technical assembly and customer preference. As a result of their structure, sheathed thermocouple assemblies offer numerous advantages when compared to their conventional counterparts.

- Small dimensions for temperature measurements at measuring sites with difficult accessibility (any desired length available)
- Short response time for exact measurements of temperature fluctuations
- Vibration and pressure resistant
- Optimal protection of inner conductors against corrosion, oxidation, mechanical damage and chemical contamination
- Increased stability of electric insulation compared to ceramic insulated thermocouples
- Simple and sealed assembly

#### Availability

We are able to deliver every current design and diameter of sheathed thermocouple assemblies with mounted sockets, connection heads, compensation cables, as well as accessories and mounting structures of every type.

For specialised requirements and standards (such as AMS, CQI-9, etc.), we offer sheathed thermocouple assemblies available with exceptionally narrow tolerances, often referred to as “better class 1”. Thermoelectric voltages and tolerances of our mineral-insulated measuring inserts are according to DIN EN 60584, class 1.



**① Connectors (plug/socket)**

LEMO size 0 - 3

Standard

Miniature

High-temp.-standard

High-temp.-miniature

Ceramic-standard

Ceramic-miniature

**② Connection head (s. page 61)**

With connecting thread

B (M24 x 1,5)

BUS (M24 x 1,5)

BUZ (M24 x 1,5)

BUZH (M24 x 1,5)

BBK (M24 x 1,5)

DL (MA) (M10 x 1)

or with thread diameter of 15,3 mm

**③ Process connector (detachable)**

Clamp connectors Steel/High-grade steel

Pressure ring Teflon

Cutting ring High-grade stainless steel

M 8x1 for sheath diameter 1,0-3,0 mm

G 1/8 A for sheath diameter 1,0-3,0 mm

G 1/4 A for sheath diameter 4,5-8,0 mm

G 1/2 A for sheath diameter 4,5-8,0 mm

**④ Sheathed Thermocouple**

(Thermocouple/Sheath materials)

NiCr-Ni/K Inconel 2.4816

Fe-CuNi/L 1.4541/2.4816

Fe-CuNi/J 1.4541/2.4816

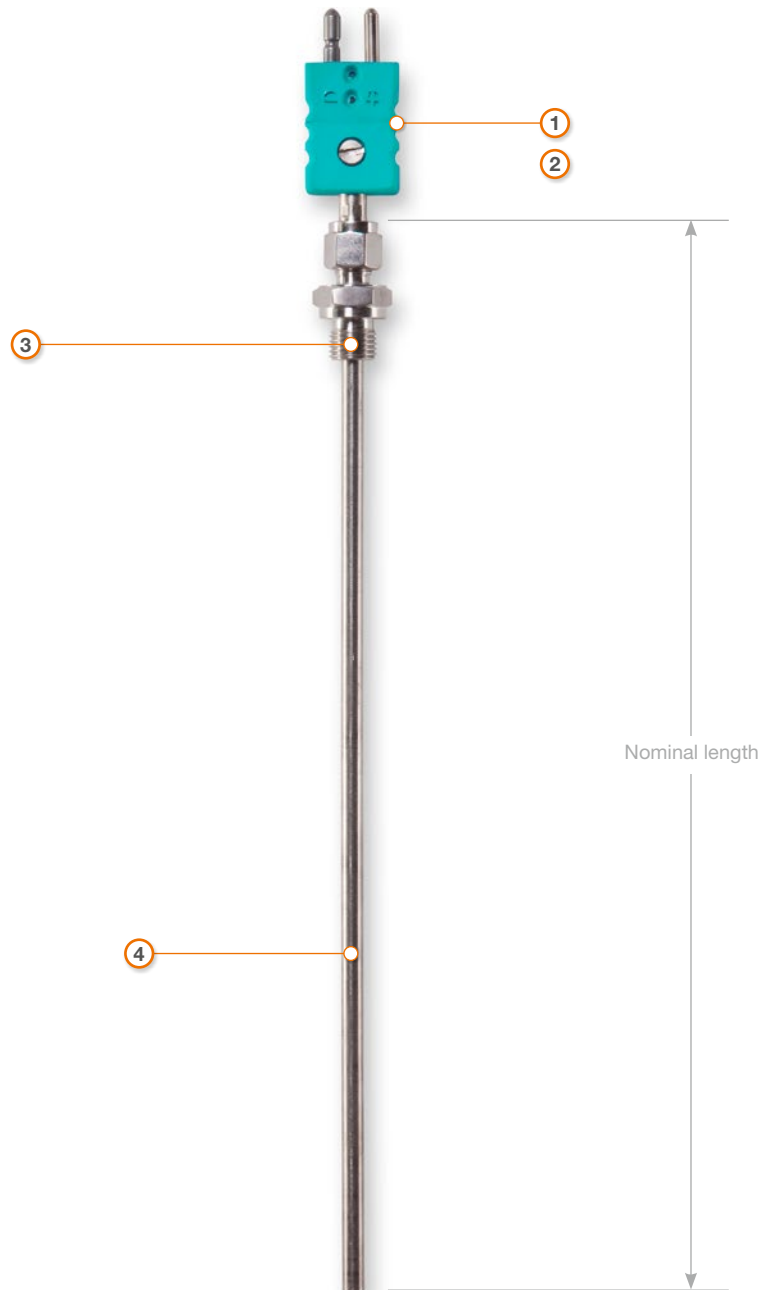
Pt10Rh-Pt/S Inconel 2.4816

NiCrSi-NiSi/N Inconel 2.4816

Sheath diameter: 0,5 - 8 mm

Single, souble or triple

Example of a common implementation in this product line



Further Technical information for this product line  
is available for download on our website.

[www.guenther.eu/downloads](http://www.guenther.eu/downloads)

Individual solutions such as, for example materials, process connectors,  
accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 30-WTE

### Angled thermocouple assemblies with threaded elbow tubing



#### 30-WTE

##### Angled thermocouple assemblies with threaded elbow tubing

Angled thermocouple assemblies with threaded elbow tubing (30-WTE) are primarily used for temperature measurement in metal smelting and salt baths.

The Angled shape allows for placement of the connection head away from the actual bath/smelt in order to avoid direct exposure to high temperatures and aggressive vapours.

Angled thermocouple assemblies with threaded elbow tubing offer the advantages of an exchangeable immersion tube and the possibility of using more economic material for the supporting tube due to reduced ambient stress factors.

GÜNTHER GmbH has all prevalent angled thermocouples used in smelting and foundry technology. Standard assemblies with immersion tubes made of steel, pure iron, heat-resistant steels and special alloys are applied, as well as silicon nitride, graphite, SiC or special metal ceramics.

Optionally, these thermocouple assemblies may be fitted with an internal ceramic tube, which significantly increases the long-term stability and electrical insulation in many application scenarios.

As an alternative to the installed thermocouple, numerous angled thermocouple assemblies may be fitted with a mineral-insulated measuring insert, which yields several crucial advantages, such as optimal protection of the inner conductors from corrosion, oxidation, physical damage, and chemical contamination due to the enclosed structure of the outer insulation.

In order to ensure functionality of the thermocouple assembly during a suitable timeframe, careful consideration should be used when selecting the materials for thermocouple and Protection tube depending on the operating conditions.

Thermoelectric voltages and tolerances of our thermocouples and mineral-insulated measuring inserts are according to DIN EN 60584, class 1, for thermocouples and mineral-insulated measuring inserts of type L according to DIN 43710.

#### Recommended protection tube materials in salt baths

Smelter	Maximum Temperature	Materials
Tenifer®	600°C	Titanium NT
Saltpetre-, Chloride- & Cyanogen containing annealing, tempering and hardening baths	1000°C	Pure iron
	1300°C	1.4821

#### Recommended protection tube materials in metal smelting:

Aluminium	700°C	Ekatech S Ekatech C
Magnesium Al/Mg-alloys	700°C	Pure iron Ekatech S
Lead	600°C	Ekatech S
Zinc	600°C	Pure iron / Steel / Ekatech S
Copper	1200°C	1.4762 Graphite
Brass	900°C	1.4762 / Graphite / Ekatech S





① Connection head (s. page 61)

A	B
AUS	BUS
AUZ	BUZ
AUZH	BUZH
AUSH	BBK

② Supporting tube (materials)

ST 35.8
1.4571

③ Insertion Tube

Pure iron (techn. pure)	with prot. sleeve
Steel SL 25	Tapered tip
Cast iron GG-22	
Graphite	
Titanium	
Enamelled steel	
High-grade stainless steel	1.4541
X15CrNiSi2520	1.4841
Inconel	2.4816
Ekatech S	
Ekatech C	
Metal-ceramic	
Quartz glass	

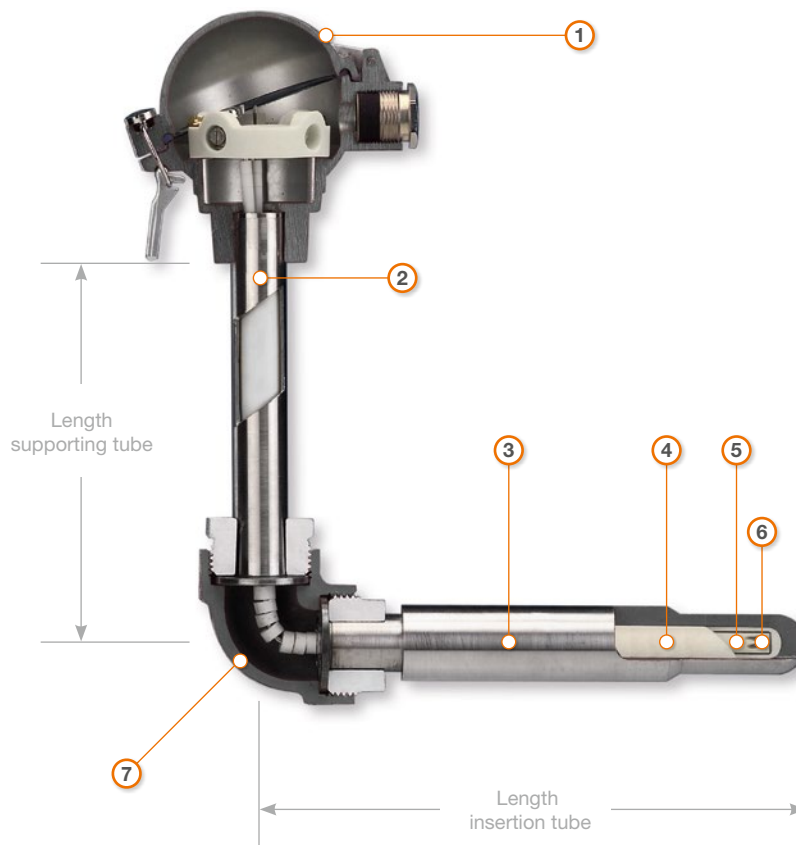
④ Inner tube

C610
C799

⑤ Mineral-insulated measuring insert

NiCr-Ni	Type KI
Fe-CuNi	Type LV
Fe-CuNi	Type JV
NiCrSi-NiSi	Type NI
Sheath diameter:	3,0 - 8,0 mm
Single or double	

Example of a common implementation in this product line



⑥ Ceramic insulated thermocouple

NiCr-Ni/K
Fe-CuNi/L
Fe-CuNi/J
NiCrSi-NiSi/N
Pt10Rh-Pt/S
Pt13Rh-Pt/R
Pt30Rh-Pt6Rh/B
Single or double

⑦ Angled section

Elbow tube	3/4"
	3/8"
	1 1/4"
	1/2"

Further Technical information for this product line  
is available for download on our website.  
[www.guenther.eu/downloads](http://www.guenther.eu/downloads)

**35-WGG****Angled Thermocouple assemblies  
with Bent or Welded Protection tube**

Angled thermocouple assemblies with bent or welded protection tube (35-WGG) are primarily used for temperature measurement in metal smelting and salt baths.

The angled shape allows for placement of the connection head away from the actual bath/melt in order to avoid direct exposure to high temperatures and aggressive vapours.

As an alternative to the installed thermocouple, numerous angled thermocouple assemblies may be fitted with a mineral-insulated measuring insert, which can have several crucial advantages:

- Optimal protection of the inner conductors from corrosion, oxidation, physical damage, and chemical contamination due to the enclosed structure of the outer insulation.
- Increased stability of the electrical insulation compared to ceramic insulated thermocouples.

In order to ensure functionality of the thermocouple assembly during a suitable timeframe, careful consideration should be used when selecting the materials for thermocouple and protection tube depending on the operating conditions.

Thermoelectric voltages and tolerances of our thermocouples and mineral-insulated measuring inserts are according to DIN EN 60584, class 1, for thermocouples and mineral-insulated measuring inserts of type L according to DIN 43710.

**Recommended protection tube materials in salt baths**

Smelter	Maximum Temperature	Materials
Tenifer®	600°C	Titanium NT
Saltpetre-, Chloride- & Cyanogen containing annealing, tempering and hardening baths	1000°C	Pure iron
	1300°C	1.4821

**Recommended protection tube materials in metal smelting:**

Aluminium	700°C	Ekatech S Ekatech C
Magnesium Al/Mg-alloys	700°C	Pure iron Ekatech S
Lead	600°C	Ekatech S
Zinc	600°C	Pure iron / Steel / Ekatech S
Copper	1200°C	1.4762 Graphite
Brass	900°C	1.4762 / Graphite / Ekatech S

**Further Technical information for this product line is available  
for download on our website.**

**[www.guenther.eu/downloads](http://www.guenther.eu/downloads)**



① Connection head (s. page 61)

A	B
AUS	BUS
AUZ	BUZ
AUZH	BUZH
AUSH	BBK

② Protection tube/holding tube (materials)

High-grade steel	1.4571
	1.4541
	1.4404
Heat-resistant steels	1.4762
	1.4841
	1.4893
	1.4749
Pure iron	

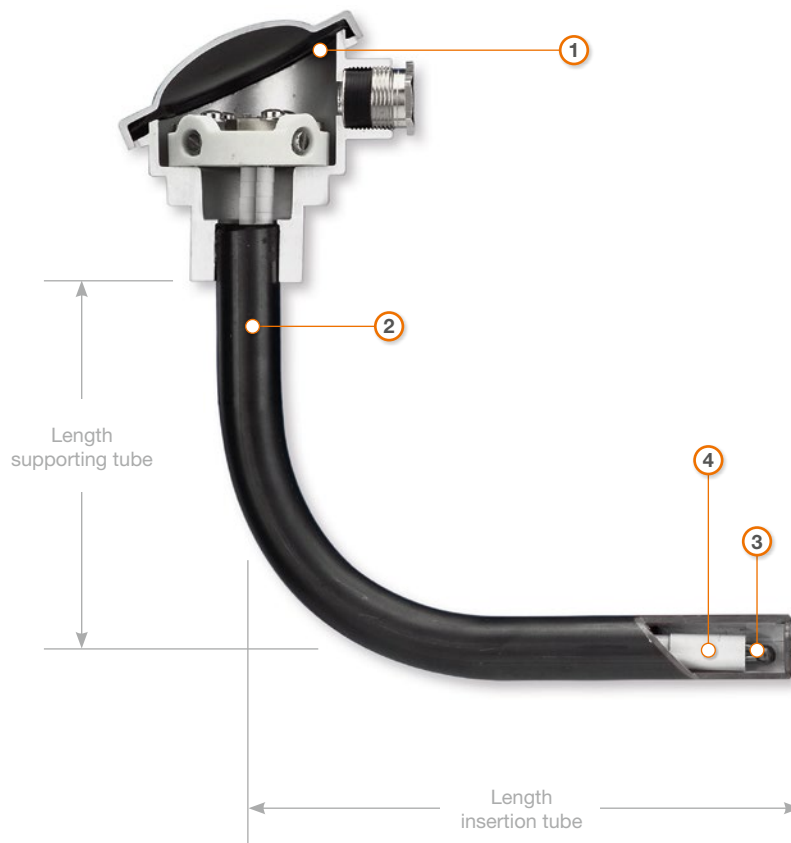
③ Ceramic insulated thermocouple

NiCr-Ni/K
Fe-CuNi/L
Fe-CuNi/J
NiCrSi-NiSi/N
Single or double

④ Mineral insulated measuring insert

NiCr-Ni	
Fe-CuNi	
Fe-CuNi	
NiCrSi-NiSi	
Sheath diameter:	3,0 - 8,0 mm
Single or double	

Example of a common implementation in this product line



Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!



#### Application examples for Resistance thermometers with metal protection tube:



Plant and machine construction



Automobile industry



Chemical industry



Energy production

#### 50-WMS

##### Resistance thermometers with metal protection tube

Sensors of this type are used for general temperature measurement, mostly in liquid and gaseous media at temperatures up to 600°C, on rare occasions up to 800°C. Typical applications include refrigeration and air conditioning technology, heating, oven and apparatus construction, as well as chemical industry.

Protective fittings in this product line consist of seam welded or seamlessly drawn metal tubes. Depending on the application, GÜNTHER GmbH has over 40 different, partly high-alloyed materials in a large array of measurements in stock. The tips for the Protection tubes are either closed through hot forming or welded shut with a bottom blank.

Tapered measuring tips may be used in this product line in order to shorten the reaction time. For prolonging the holding time, strengthening the wall thickness and utilization of ceramic inner tubing are possible.

All internationally prevalent precision resistors, detachable process connectors (for example mobile flanges or threaded sleeves) and connection heads are used.

Depending on the connection type (2-wire, 3-wire or 4-wire – in turn depending on the required measurement precision and connector length), resistance thermometers consist of 2, 4 or 6 feed lines (inner conductors), surrounded by a thin metallic protective sheath, usually made of high-grade steel. The inner conductors are firmly press-fitted and insulated in ceramic powder. The precision resistor inside the sensor tip is connected through the inner conductors. The measuring insert in serial-production is fitted with a Pt-100 temperature sensor according to DIN 60751, however versions with Pt-500 or Pt-1000 sensors are possible. The measuring insert is hermetically sealed.

For specialised applications (precision, long-term stability, etc.) we recommend the application of precision resistors with narrowed tolerance.

The resistance values and tolerances of our resistance thermometers are according to DIN EN 60751.





① Connection head (s. page 61)

A	B
AUS	BUS
AUZ	BUZ
AUZH	BUZH
AUSH	BBK

② Process connector (detachable)

Flange
Threaded socket
Flange / Counter flange

③ Outer protection tube

Materials:	
St. 35.8	Mat. No. 1.0305
Stainless steel	Mat. No. 1.4571
X18CrN28	Mat. No. 1.4749
X15CrNiSi2520	Mat. No. 1.4841
Heat-resistant steel	Mat. No. 1.4893

④ Sensor tip

Straight
or tapered to 6 - 15 mm

⑤ Mineral-insulated measuring insert

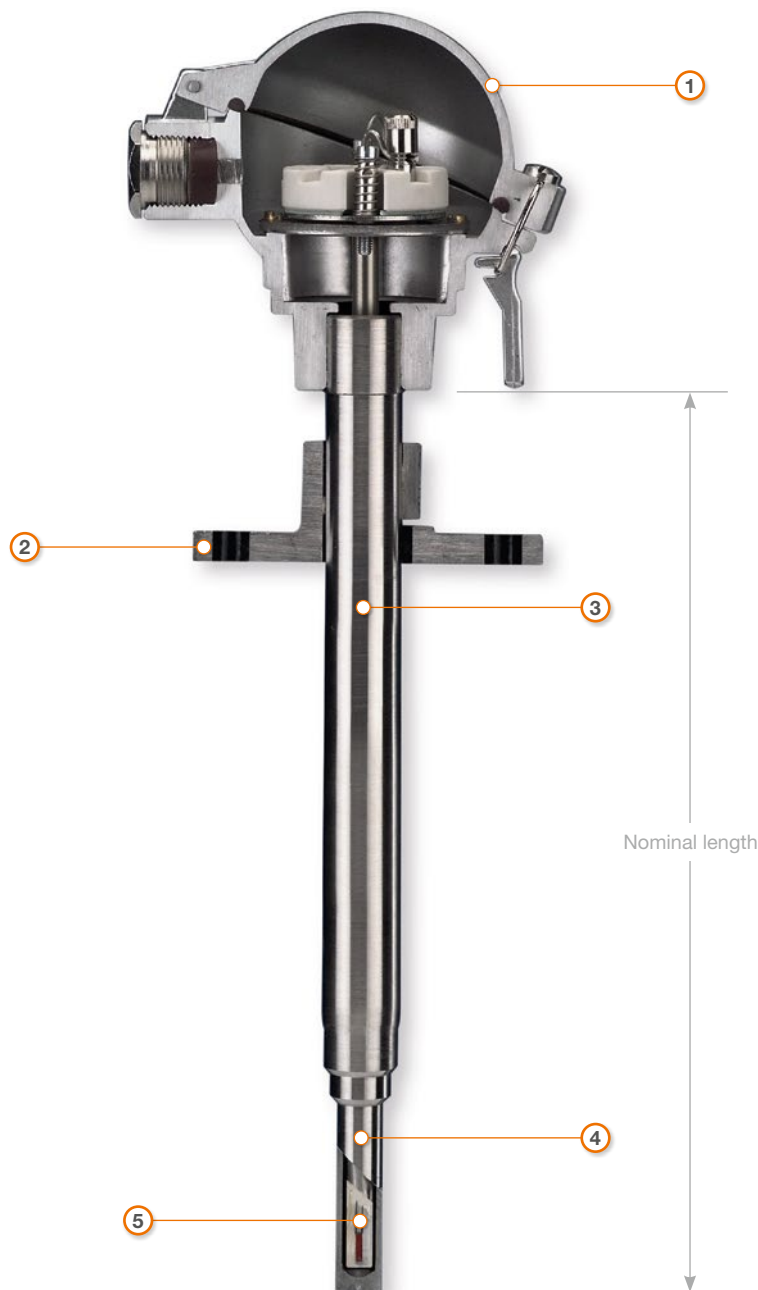
Sheath diameter:	1,5 - 8,0 mm
Connection:	
1 x Pt100 up to 3 x Pt100 Ohm	
2-wire up to 4-wire	

Our resistance thermometers are also available in explosion protected ATEX models. (see page 52)

Further Technical information for this product line is available for download on our website.

[www.guenther.eu/downloads](http://www.guenther.eu/downloads)

Example of a common implementation in this product line



Resistance  
thermometers

Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 52-WOS

### Mineral-insulated resistance thermometers without protection tube



#### Application examples for mineral-insulated resistance thermometers without protection tube:



Plant and machine construction



Automobile industry



Laboratories



Plastic industry

#### Availability:

We offer every current version and diameter of mineral insulated resistance thermometer with mounted plug-and-socket connectors, connection heads, compensation lines with or without specialised contacts, as well as accessories and every type of mounting.

## 52-WOS

### Mineral-insulated resistance thermometers without protection tube

Sensors of this type are used for general temperature measurement up to 600°C, on rare occasions up to 800°C. They are suited for surface temperature measurement as well as measurements of liquids and gases.

Depending on the connection type (2-wire, 3-wire or 4-wire – in turn depending on the required measurement precision and connector length), resistance thermometers consist of 2, 4 or 6 copper feed lines (inner conductors), surrounded by a thin metallic protective sheath, usually made of high-grade steel. The inner conductors are firmly press-fitted and insulated in ceramic powder. The precision resistor inside the sensor tip is connected through the inner conductors.

As a result of their structure, mineral insulated resistance thermometers have the following advantages:

- Small physical dimensions with maximum flexibility for temperature measurement at sites with difficult accessibility (diameter 1,5 – 6,0 mm).
- Short response time for exact measurements of temperature variations
- Optimal protection for the sensor system against corrosion, oxidation, physical damage and chemical contamination as a result of the enclosed structure
- The enclosed structure also facilitates application of these sensors without additional protective fitting

For specialised applications (precision, long-term stability, etc.) we recommend the application of precision resistors with narrowed tolerance. The resistance values and tolerances of our resistance thermometers are according to DIN EN 60751.

**Our resistance thermometers are also available in explosion protected ATEX models. (see page 50)**

**Further Technical information for this product line is available for download on our website.**

**[www.guenther.eu/downloads](http://www.guenther.eu/downloads)**



Visit us online at **[www.guenther.eu](http://www.guenther.eu)**



① Connection components (plug/socket)

LEMO size 0 - 3

Standard

Miniature

High-temp.-standard

High-temp.-miniature

Ceramic-standard

Ceramic-miniature

② Connection head (s. page 61)

with connecting thread

B (M24 x 1,5)

BUS (M24 x 1,5)

BUZ (M24 x 1,5)

BUZH (M24 x 1,5)

BBK (M24 x 1,5)

DL (MA) (M10 x 1)

or with thread diameter of 15,3 mm

③ Process connector (detachable)

Clamp connectors Stainless steel

Pressure ring Teflon

Cutting ring High-grade steel

M 8x1 for sheath diameter 1,0-3,0 mm

G 1/8 A for sheath diameter 1,0-3,0 mm

G 1/4 A for sheath diameter 4,5-8,0 mm

G 1/2 A for sheath diameter 4,5-8,0 mm

④ Mineral-insulated measuring insert

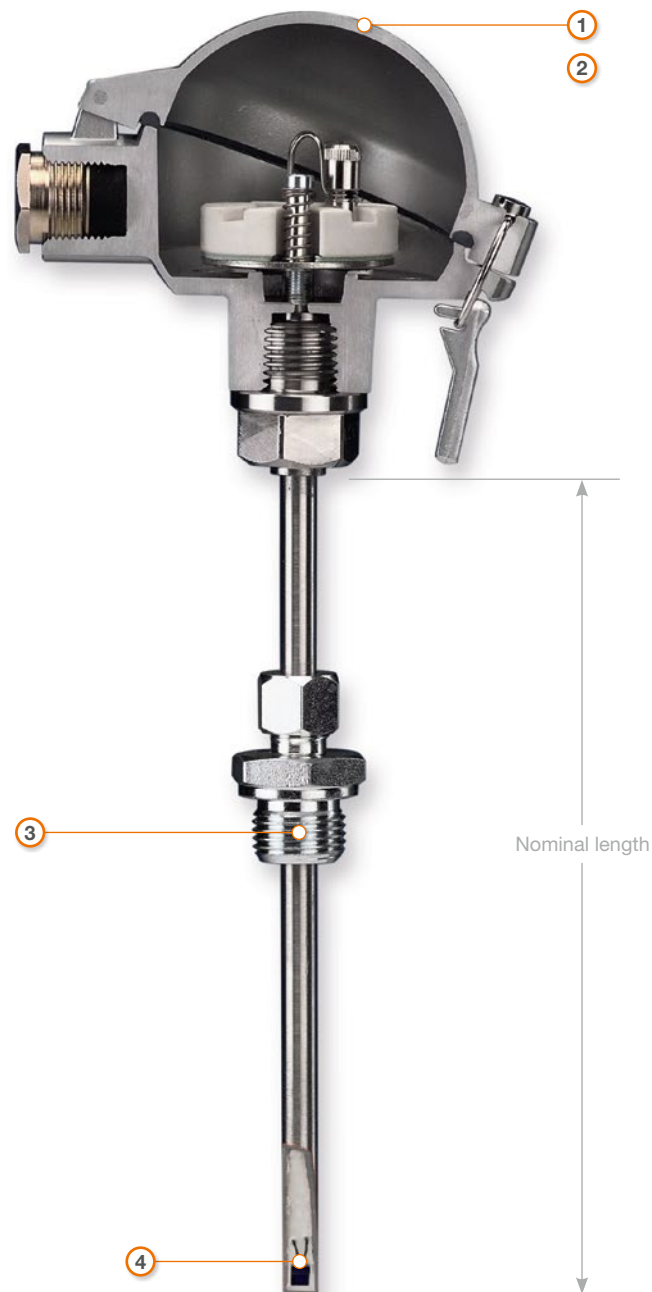
Sheath diameter: 2,0 - 8,0 mm

**Connection:**

1 x Pt100 up to 3 x Pt100 Ohm

2-wire up to 4-wire

Example of a common implementation in this product line



Resistance  
thermometers

Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 53-WHD

### Resistance thermometer with welding thermowell form 4 (former D-sleeve) according to DIN 43772



#### Application examples for resistance thermometers with welding thermowell



Waste recycling / waste incineration



Plant and machine construction



Automobile industry



Chemical industry



Laboratories



Energy production

#### 53-WHD

##### Resistance thermometer with welding thermowell form 4 (former D-sleeve) according to DIN 43772

Resistance thermometers with welding thermowell (53-WHD) are used for temperature measurement in gaseous and liquid media such as air, steam, water, oil, etc. with high current velocities and pressures. The material of the thermowell defines the operation temperature. Specialised thermowells are suitable up to 700 bar of pressure. The instruments of this product line are fitted with exchangeable mineral-insulated measuring inserts.

The main construction component is a thermowell of high-grade or pressure-vessel steel, which is used to weld the thermometer into the respective machine.

Selection of the thermowell is dependent on spatial proportions at the point of installation, as well as demands as dictated by temperature, pressure, current flow and chemical attack.

Standard values for stress capacity can be found in the diagrams of DIN 43772.

In particular the question of chemical stress capacity must be examined carefully for each individual scenario. Often times, only field testing will yield authoritative information, as even minor impurities in the ambient media can have significant impact on the performance of the thermowell within the application environment.

For specialised applications (precision, long-term stability, etc.) we recommend the application of precision resistors with narrowed tolerance.

Resistance values and tolerances of our resistance thermometers are according to DIN EN 60751.





① Connection head (s. page 61)

B (M24 x 1,5)	BUSH
BUS	BUZH
BUZ	NA
BBK	DL / MA

② Connection tube according to DIN 43772

with screw connection:
M24 x 1,5 / M14 x 1,5
M24 x 1,5 / M18 x 1,5
Also available without neck tube

③ Thermowell according to DIN 43772

Cone length:	40 - 125 mm
Shaft length:	50 or 110 mm
Thermowell length:	115 - 260 mm
Diameter:	18 or 24 mm
Material:	1.7335
	1.4571
	1.5415

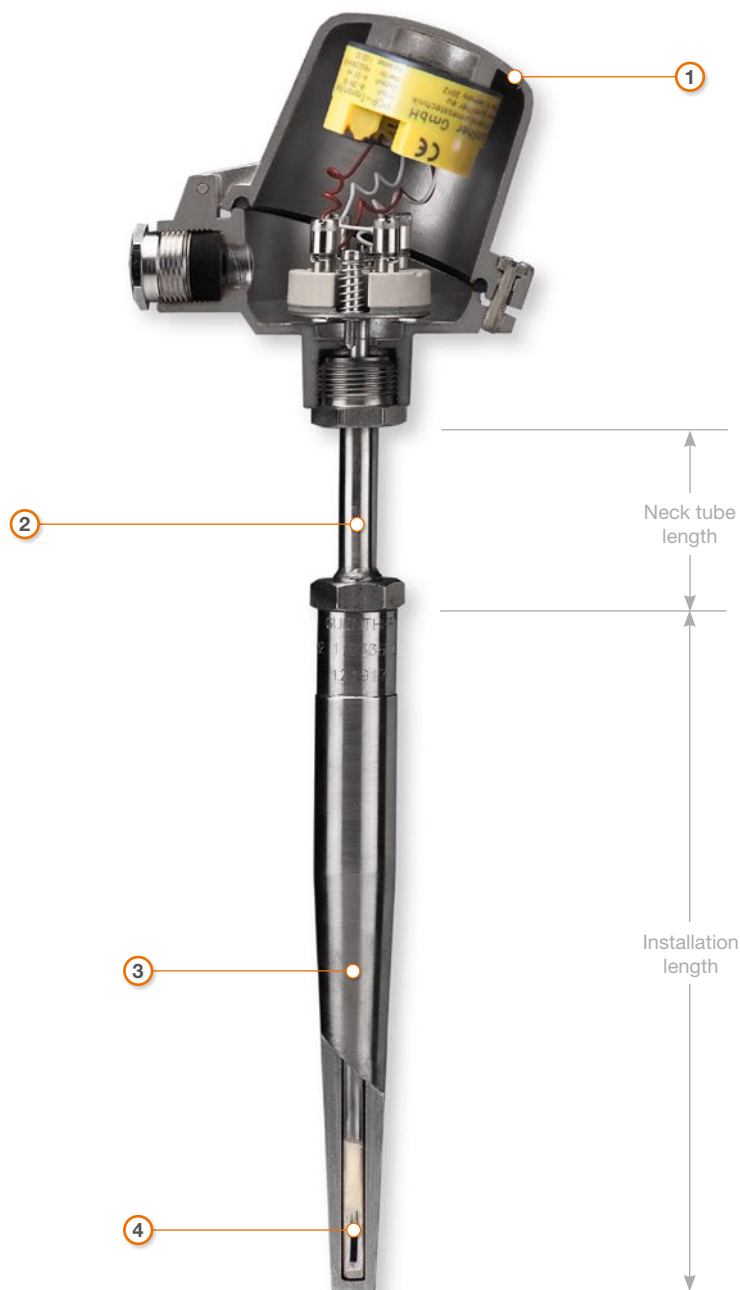
④ Mineral-insulated measuring insert

Sheath diameter:	1,5 - 8,0 mm
<b>Connection:</b>	
1 x Pt100 up to 3 x Pt100 Ohm	
2-wire up to 4-wire	

Our resistance thermometers are also available in explosionproof ATEX models. (see page 50)

Further Technical information for this product line is available for download on our website.  
[www.guenther.eu/downloads](http://www.guenther.eu/downloads)

Example of a common implementation in this product line



Resistance thermometers

Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.  
Please contact us for further information!

## 54-WFL

### Resistance thermometers with welded blank flanges



#### Application examples for resistance thermometers with welded blank flanges



Waste recycling / waste incineration



Plant and machine construction



Automobile industry



Chemical industry



Laboratories



Energy production

#### 54-WFL

#### Resistance thermometers with welded blank flanges

Resistance thermometers with welded blank flanges (54-WFL) are used for temperature measurements in gaseous or fluid media such as air, steam, water or oil.

Distinctive characteristic of these sensors is a blank flange welded to or onto the protection tube, most commonly according to DIN EN 1092, enabling a sealed connection of the sensor with the respective wall of an over- or under-pressure facility as in power plants, for example.

Both the employed protection tube and the blank flanges should consist of the same material if possible.

When particularly quick recognition of temperature changes are required, we recommend the use of sensors with a tapered protection tube tip.

For specialised applications (precision, long-term stability, etc.) we recommend the application of precision resistors with narrowed tolerance.

Resistance values and tolerances of our resistance thermometers are according to DIN EN 60751.

**Our resistance thermometers are also available in explosion protected ATEX models. (see page 50)**

**Further Technical information for this product line is available for download on our website.**  
**[www.guenther.eu/downloads](http://www.guenther.eu/downloads)**



Visit us online at **[www.guenther.eu](http://www.guenther.eu)**



① Connection head (s. page 61)

A	BUSH
B	BUZH
BUS	DL / MA
BUZ	

② Blank flanges according to DIN EN 1092

DN 10 - DN 100	
Material:	
Mat. No. St37-2	Mat. No. 1.4571
Mat. No. C22.8	Alloy C4

③ Protection tube (materials/dimensions)

St. 35.8	Mat. No. 1.0305
Stainless steel	Mat. No. 1.4571
X18CrN28	Mat. No. 1.4749
X15CrNiSi2520	Mat. No. 1.4841
Inconel	Mat. No. 2.4816
Kanthal	
Alloy C4	
Diameter:	6 - 22 mm
Wall:	0,75 - 3 mm

④ Mineral-insulated measuring insert

Sheath diameter:	2,0 - 8,0 mm
Connection:	
	1 x Pt100 up to 3 x Pt100 Ohm
	2-wire up to 4-wire

⑤ Configuration

Straight
or tapered to between 6 and 15 mm

Example of a common implementation in this product line



Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 55-WES

### Resistance thermometers with threaded socket and mineral-insulated measuring insert



#### Application examples for resistance thermometers with threaded socket and mineral-insulated measuring insert:

-  Waste recycling / waste incineration
-  Plant and machine construction
-  Automobile industry
-  Chemical industry
-  Laboratories
-  Energy production
-  Food industry

#### 55-WES

##### Resistance thermometers with threaded socket and mineral-insulated measuring insert

Resistance thermometers with threaded socket and mineral-insulated measuring insert (55-WES) are used for general temperature measurement in low-pressure gaseous, liquid and plastic media environments, depending on the properties of the protection tube and surrounding media, up to a temperature of 800°C.

A threaded socket is welded to the protection tube, providing for the stability of the process connector in sensors of this product line. Depending on the application, the socket is welded to the protection tube, either directly beneath the connection head or with a gap of 100 or 200mm, for example.

The protection fittings are usually made of a single seamlessly drawn stainless steel tube with a circular blank welded inside. In order to facilitate particularly quick temperature change measurements, we offer sensors with a tapered sensor tip.

For specialised applications (precision, long-term stability, etc.) we recommend the application of precision resistors with narrowed tolerance.

Resistance values and tolerances of our resistance thermometers are according to DIN EN 60751.

**Our resistance thermometers are also available in explosion protected ATEX models. (see page 50)**

**Further Technical information for this product line is available for download on our website.**

**[www.guenther.eu/downloads](http://www.guenther.eu/downloads)**





① Connection head (s. page 61)

B	BUSH
BUS	BUZH
BUZ	NA
BBK	DL / MA

② Process connector (detachable)

G 1 A
G 1/2 A
M18 x 1,5
G 3/4 A
M20 x 1,5
Combined: M24 x 1,5 / G 1/2 A
M10 x 1 / G 1/2 A

③ Outer protection tube materials/dimensions

St. 35.8	Mat. No. 1.0305
Stainless steel	Mat. No. 1.4571
X18CrN28	Mat. No. 1.4749
X15CrNiSi2520	Mat. No. 1.4841
Inconel	Mat. No. 2.4816
Kanthal	
Diameter:	6 - 22 mm
Wall:	0,75 - 3 mm

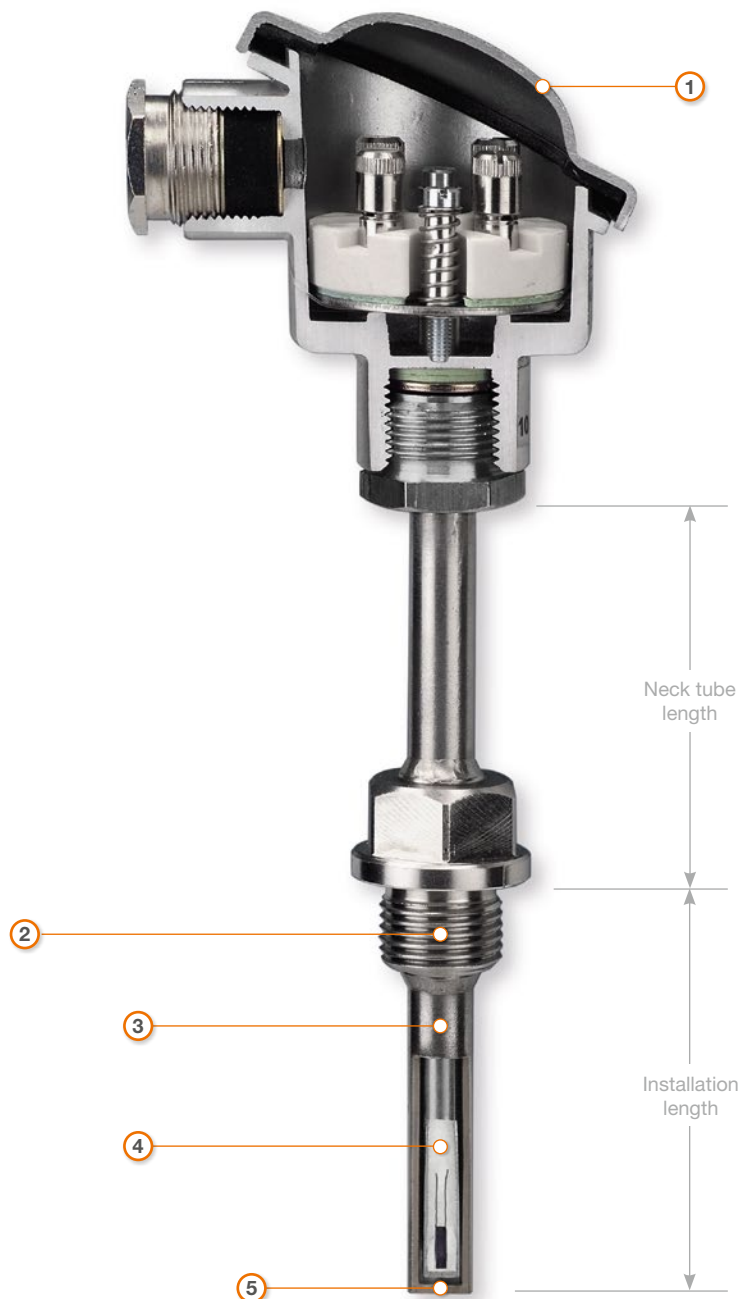
④ Mineral-insulated measuring insert

Sheath diameter:	1,5 - 8,0 mm
<b>Connection:</b>	
1 x Pt100 up to 3 x Pt100 Ohm	
2-wire up to 4-wire	

⑤ Configuration

Straight
or tapered to between 6 and 15 mm

Example of a common implementation in this product line



Resistance  
thermometers

Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 60-TE / 60-WTH

### Thermocouple assemblies and resistance thermometers with bayonet nut connector



#### Application examples for thermocouple assemblies and resistance thermometers with bayonet nut connector:



Plant and machine construction



Heat treatment



Plastic industry

#### 60-TE / 60-WTH

##### Thermocouple assemblies and resistance thermometers with bayonet nut connector

Sensors with bayonet nut connectors are recommended for measuring temperatures inside the blocks of machines, mechanisms and die cast forms, primarily in the plastic industry, at temperatures up to 400°C.

#### Advantages of sensors with bayonet nut connectors

- Reliable construction
- Bending resistant cabling
- Class 1 for type J and type K  
(High measuring precision)

The form of the measuring tip is mostly half-round, planar or with a point angle of 118°. The latter aligns itself very well into a standard bore hole.

The sensors are fitted with a pressure spring that, in combination with the correct installation length, respectively contact pressure at the installation point, protects the cable from deflexion. The installation length is variable, limited by the length of the pressure spring.

The standard inner diameter of the bayonet nut is 12.2 and 15.2 mm. Please note, that we do offer customised versions.

The standard mounted measuring elements are Pt 100:

2-, 3- or 4-wire, accuracy class N according to EN 60751 or thermocouple types J and K in class 1. Double versions or the application of special sensors are also possible.

Further Technical information for this product line is available for download on our website.

[www.guenther.eu/downloads](http://www.guenther.eu/downloads)



Visit us online at [www.guenther.eu](http://www.guenther.eu)



**① Sensor type**

1xPt100-2L  
1xPt100-3L  
1xPt100-4L  
NiCr-Ni/K  
Fe-CuNi/J  
Fe-CuNi/L

**② Sensor tip**

Ø 6 mm    planar  
              118°-angle  
              other  
Ø 8 mm    planar  
              118°-angle  
              other

**③ End termination**

Free ended (non thin-plated)  
Soldered ends  
Ends with cable end sleeves  
Plug / socket (standard)  
Plug / socket (miniature)  
Plug / socket (LEMO)

Example of a common implementation in this product line



Specialized  
temperature sensors

Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 71-KFT / 72-KFW

### Cable thermocouples and cable resistance thermometers



#### Application examples for cable thermocouples and cable resistance thermometers:

- Piping
- Machines and devices
- Heating units
- Ovens
- Freezers
- Liquids

#### 71-KFT / 72-KFW

##### Cable thermocouples and cable resistance thermometers

Sensors of this type are primarily used for temperature measurement in liquid and gaseous media. However, there is a broad palette of configuration and construction options that can be adapted to specific applications. Due to their make-up, these sensors may be used in temperature ranges between  $-200^{\circ}\text{C}$  and  $+400^{\circ}\text{C}$ .

##### Advantages of cable thermocouples and cable resistance thermometers

- Reliable, partly watertight construction
- Broad selection of configuration options

At the point where the sheath meets the cable, the sensors may be equipped with a teflon coating (moisture protection) and/or springs (cable break protection).

Other types of temperature sensors, similar to plug-in resistance thermometers, are referred to by their construction or mounting type, respectively their area of application. For example:

- Surface sensors
- Contact sensors
- Pipe or tube sensors
- Threaded sensors
- Welding sensors
- Acid- and oil-tight versions are realisable

Our resistance thermometers are also available in explosion-proof ATEX models. (see page 50)

Further Technical information for this product line is available for download on our website.

[www.guenther.eu/downloads](http://www.guenther.eu/downloads)





### ① Sensor Tip

Pt100 Class A  
Pt100 Class B  
Pt100 Class B 1/3  
Pt100 Class B 1/5  
Pt100 Class B 1/10  
Pt1000 Class A  
Pt1000 Class B  
NiCr-Ni/K  
Fe-CuNi/J  
Fe-CuNi/L  
Cu-CuNi / T  
Cu-CuNi / U  
Platinum  
Nickel (Ni 100, ...)  
NTC/PTC

### ② Configuration

Room sensor (non-watertight)  
Heat shrunk insulated measuring point (watertight)

#### ② Metal sheath (Std.: High-grade steel)

Metal sheath with threaded socket  
Ceramic sheath

#### ① Pipe / tube clamp

#### ③ Small welding plate

#### ④ Touch sensor

#### ⑤ Screw threaded sensor

#### ⑥ Non standard construction (e.g. magnet)

### ③ End termination

Free ended (Non thin-plated)

Soldered ends

Ends with cable end sleeves

Standard plug / socket connector

Miniature plug / socket connector

HT-Standard plug / socket connector

HT-Miniature plug / socket connector

Ceramic Standard plug / socket connector

LEMO plug / socket connectors Sz. 0 to Sz. 3

Example of a common implementation in this product line



Specialized  
temperature sensors

Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## 74-WTH

### Resistance thermometers with machine connectors



#### Application examples:

- Tanks and containers
- Machine and plant construction
- Technological processes
- Energy production and distribution
- Food and beverage industry

#### 74-WTH

##### Resistance thermometers with machine connectors

This type of resistance thermometers with threaded sockets are used for temperature measurement of liquids in regions with vibrations and challenging surrounding media up to a temperature of 200°C.

##### Advantages of resistance thermometers with machine connectors:

- Resistant to Vibrations
- Quick connection of cables and sensors
- Constructed in stainless steel (sealed, hygienic, etc.)

The most common application areas among others are machine construction, industrial, food and beverage systems. The electric machine connector M12x1 guarantees high-level protection (IP65) and comfortable connection of cables and sensors using a 4-pin plug.

Pt 100 2-wire measuring elements are standard implementation, tolerance class B according to EN 60751. It is possible, however, to implement Pt 500, Pt 1000 or specialised sensors (also as double version). Furthermore if needed a transducer may be fitted inside the connection head.

Further Technical information for this product line is available for download on our website.

[www.guenther.eu/downloads](http://www.guenther.eu/downloads)



Visit us online at [www.guenther.eu](http://www.guenther.eu)



### ① Machine connector

M12 without transducer
Angled plug acc. to DIN EN 175301
without transducer
Only 1xPt100 2-L sensor:
M12 with transducer
Angled plug acc. to DIN EN 175301
with transducer

### ② Process connector (detachable)

Without
Threading G 1/2 A
Threading G 1/4 A
Threading G 3/8 A
Threading M18 x 1,5
Threading M20 x 1,5
Sheath DN 25 KF
Other

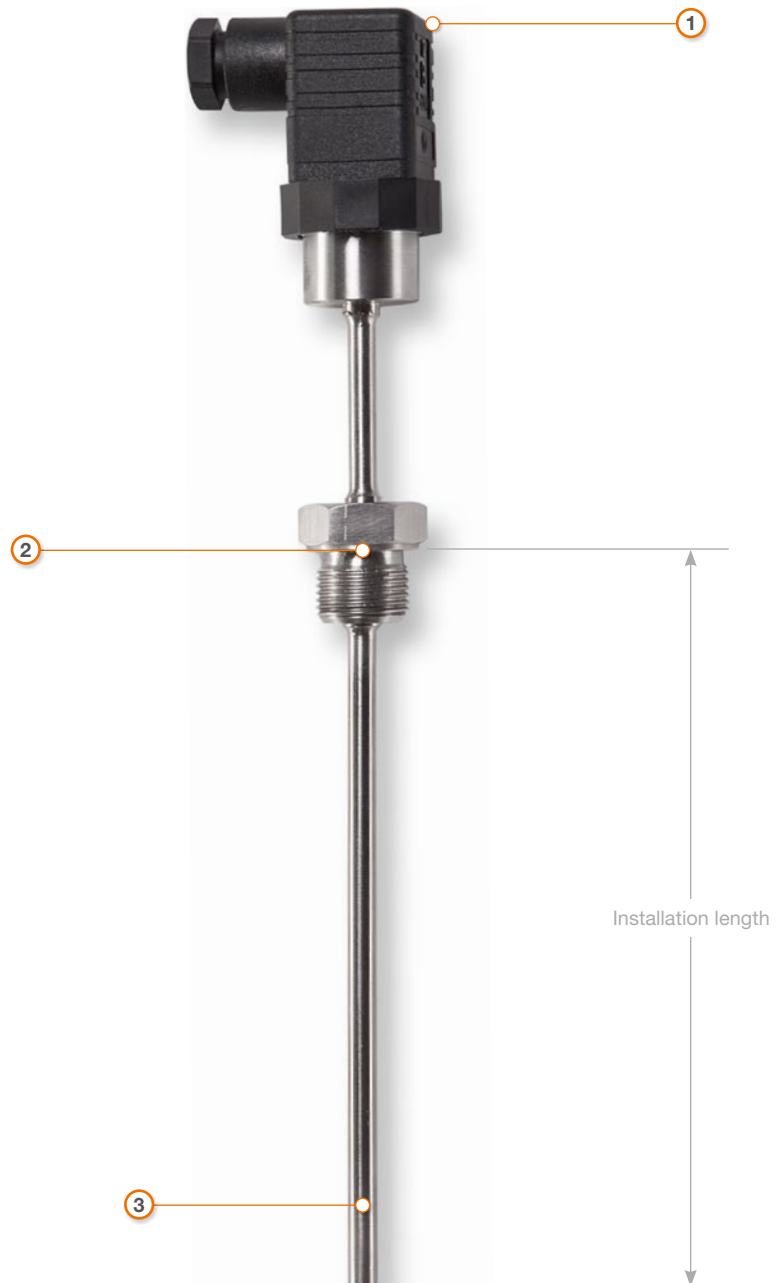
### ③ Measuring Insert

Pt100 Class A
Pt100 Class B
Pt100 Class AA
Pt100 Class B 1/5
Pt100 Class B 1/10
Pt1000 Class A
Pt1000 Class B
Nickel (Ni 100, ...)
NTC/PTC

#### Connection:

1 x 2 wire	1 x 4 wire
1 x 3 wire	2 x 2 wire

Example of a common implementation in this product line



Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

## Explosionproof temperature sensors



### Explosionproof sensors by GÜNTHER

Since early 2012, we have been producing various explosionproof resistance thermometers and thermocouples certified to the ATEX (ATmospheres EXplosibles) directive 2014/34/EU for temperature measurements in liquid and gaseous as well as dusty media.

Our Explosionproof temperature sensors are designed as resistance thermometers or thermocouples and come to use in the classical industries of chemistry, petrochemistry, mechanical and systems engineering, food industry, crude oil and gas mining. They convert the temperature at the measured site into an electrical value (voltage, resistance) and serve to measure, register and control temperatures in the range of  $-196\text{ °C}$  to approx.  $+1800\text{ °C}$  in connection with the corresponding downstream units.

**All GÜNTHER ex-sensors are built so that they cannot serve as an ignition source – even if any errors occur.**



Visit us online at [www.guenther.eu](http://www.guenther.eu)



## Product series and ignition protection types

The temperature sensors of the ignition protection type Ex i (product series R1/T1 to R8/T8) are certified for connection to intrinsically safe circuits of category "ia".

The sensors of series R1/T1 to R4/T4 comprise a protective fitting with various process connections, a connection head and an exchangeable measuring insert.

The temperature sensors of series R5/T5 and R6/T6 comprise measuring inserts with connection head or connection box and various process connections. They are designed either with simple Protection tubes or as mineral-insulated lines with cable connections.

Product series R7/T7 includes ex-sensors of a continuous or offset Protection tube.

Sensors of the product group R8/T8 contain mineral-insulated temperature sensors with connected supply line.

Recently, GÜNTHER has been offering temperature sensors of ignition protection type Ex d with pressure-resistant encapsulation in different builds (series R9/T9), as well as sensors of ignition protection type Ex nA / Ex tc.

### Setup and equipment

The resistance thermometers have common resistors of platinum or nickel installed. These temperature sensors are produced according to DIN EN 60751 and available in all common tolerance classes in two-, three- or four-conductor technology. Designs with two measuring circuits are possible as well.

The thermocouples are equipped with T, J, K, E, S, R, B and N elements according to DIN EN 60584 in tolerance class 1 as simple or double measuring circuit, which makes them suitable for use in potentially explosive areas with gas or dust.

Depending on application and measuring task, the temperature sensors can be equipped with various process connections, lines and connection heads. For this, our sensors are optimally designed for customer-specific requirements and also available ex stock on short notice.



GÜNTHER Ex-sensors come to use in the classical industries of chemistry, petrochemistry, mechanical and systems engineering, food industry, crude oil and gas mining.

Specialized  
temperature sensors

Areas of use of our Explosionproof temperature sensors

ZONE 2/22  
Gas/Dust



Ex i



Series R1/T1



Series R2/T2



Series R3/T3



Series R4/T4



Series R5/T5



Series R6/T6

Approved for zones / hazard areas

(0/1), 1, 2  
(20/21), 21, 22

1, 2  
21, 22

1, 2  
n.a.





# ZONE 2/22

Gas/Dust

# ZONE 1/21

Gas/Dust

Ex i

Ex d

Ex i, Ex nA, Ex tc

Specialized  
temperature sensors



Series R7/T7

Series R8/T8



Series R9/T9



Series RX/TX



Series RN/TN

Approved for zones / hazard areas

0, (0/1), 1, 2  
20, (20/21), 21, 22


1, 2  
21, 22

2  
22

## Product series R1/T1 to R3/T3 (Ex i)

For the temperature sensors of series R1-R3 or T1-T3, the medium-contacting Protection tubes (zone 0 or 20) are delivered with walls  $\geq 1$  mm in order to ensure safe zone separation. The Protection tubes serve to protect the jacket measuring inserts from chemical and physical influences. Selection of suitable Protection tubes also increases the necessary mechanical stability. The reaction time at the measuring point can be reduced by narrowing Protection tube tips. The process connections used for these series are screw-in sockets with various connection threads or blind flanges, with dimensions in correspondence with an international or national standard. For welding sleeves, the zones must be separated professionally by the customer when welding them in.



 II 1/2G Ex ia IIC T6...T1 Ga/Gb

 II 1/2D Ex ia IIIC TX Da/Db



 II 2G Ex ia IIC T6...T1 Gb

 II 2D Ex ia IIIC TX Db

## Product series R4/T4 (Ex i)

Temperature sensors of series R4/T4 are equipped with protective tubes of different wall thicknesses. The individual adjustment of the Protection tubes to the measuring insert makes it possible to achieve short reaction times.

These are always closed Protection tubes on which either no, movable or firmly welded process connections are installed. Moving stop flanges, threaded sleeves and screw connections, as well as firmly welded-on blind flanges, caps or screw-in sockets are available as standard process connections. The process connections do not serve as zone separation for series R4/T4. These temperature sensors can be used in zone 1 (Gas Ex) and zone 21 (Dust Ex).





## Product series R5/T5 (Ex i)

The temperature sensors of series R5 (resistance thermometer) and T5 (thermocouple) are essentially made of a measuring insert that protrudes from the connection head without any additional Protection tube. We supply dimensions with diameters 3 mm, 4.5 mm and 6 mm ex works.

Possible process connections are movable clamping or V-ring screw connections, or fixed threaded sockets with or without a neck tube. The process connections do not serve as zone separation. This series can only be used in zone 1 (Gas Ex).



 II 2G Ex ia IIC T6...T1 Gb

Specialized  
temperature sensors

## Product series R6/T6 (Ex i)

Temperature sensors of series R6/T6 were developed as cable sensors with different diameters for zone 1 (Gas Ex) and are available as tube construction or mineral-insulated design.

Their small sizes that enable a wide range of possible process connections and their high flexibility permit temperature measurements in places that are difficult to access.



 II 2G Ex ia IIC T6...T1 Gb

### Product series R7/T7 and R8/T8 (Ex i)

Built similarly to the sensors of product group R6/T6, these temperature sensors are additionally approved for zones 0, 0/1 and 20, 20/21 respectively. They have a continuous or offset protective tube, straight or angled, with connected mineral-insulated line. Possible zone separations are clamped screw connections IP67 approved for this purpose with metric or imperial connection threads.



 II 1G Ex ia IIC T6-T1 Ga

 II 1/2G Ex ia IIC T6-T1 Ga/Gb

 II 1D Ex ia IIIC TX Da

 II 1/2G Ex ia IIIC TX Da/Db



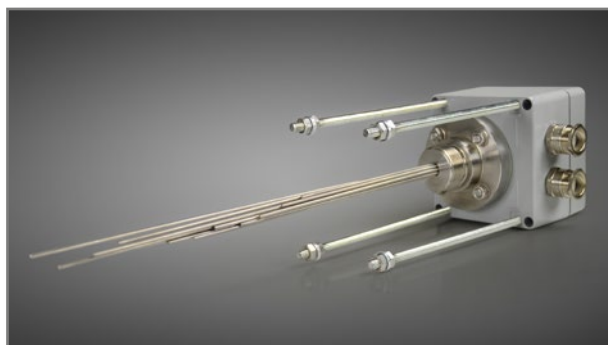
### Product series R9/T9 (Ex d)

The temperature sensors of series R9 and T9 are characterised by a pressure-resistant encapsulation and supply accurate measuring results for temperatures up to 1800 °C. The measuring insert protrudes from the pressure-resistant head, (the measuring point is not in the ex area) with a protective fitting that can be made e.g. of ceramic or metal depending on requirements. However, this is not part of the type testing and therefore can also be made by the customer. The sensors R9/T9 are approved for use in potentially explosive areas of zones 1 and 21.





## Product series RN/TN (Ex nA), RT/TT (Ex tc) and RX/TX (Ex i)



**Ex** II 3G Ex nA IIC T6...T1 Gc

**Ex** II 3D Ex tc IIIB Tx °C Dc

Similarly built as product series R1/T1 to R9/T9, the sensors of series RN/TN produce no sparks, light arcs or hot surfaces in unimpaired operation. They meet the requirements to ignition protection type "nA" according to DIN EN 60079-15 and are suitable for use in zone 2 (Gas). Series RT/TT meets the requirements of ignition protection type "tc" according to DIN EN 60079-31 and suitable for use in Zone 22 (Dust).

GÜNTHER also supplies customised solutions and special builds of series RX/TX according to the requirements of ignition protection type "i" according to DIN EN 60079-11. This means simple, passive equipment for use in zone 1 (Gas) without type testing certificate. However, a manufacturer's declaration with information on the relevant indices is produced for this.

They can be delivered as tube-skin temperature sensors (sensors with expansion loop) or multipoint thermocouples (stage thermocouples) with multiple measuring points, with or without Protection tube.



### Thermoelectric and compensation cables

#### Compensation cables

Compensation cables are the link from thermocouple assembly to reference junction. The wires consist of alternative materials, not identical to the individual appendant thermocouples, yet possessing the same thermoelectric properties within the permissible temperature range according to DIN EN 60584-3.

Following the law of homogenous circuits, the material between measurement and reference junctions must not vary.

Theoretically the thermocouple could lead all the way to the reference junction, which, mainly due to cost reasons, is not practised.

Compensation cables have either solid or not wires and are produced with various strand counts, shielding and insulation.

They are marked with code letter C, which is placed after the code letter for the appendant thermocouple, e.g. SC for a platinum thermocouple type S.

#### Thermoelectric cables

Thermoelectric cables are made of the same material as the appendant element.

By joining the wire at one end, thermoelectric cables become thermocouples, something that is practiced in drag measurement, for example.

Thermoelectric cables are available as litz or solid wires with various types of insulation. They are marked with the letter "X", which is placed after the code letter of the thermocouple, e.g. "KX" thermocouple for NiCr-Ni-element, type K.



## Coding of thermoelectric and compensation cables

Colour coding of thermoelectric and compensation cables is standardised in DIN EN 60584-3. Standardisation contributes to minimising the danger of confusion and current reversal.

The maximum operating temperature is defined by the insulating material, therefore the corresponding data sheets should be observed.

### Temperature resistances for different insulating materials of compensation and thermoelectric cables

PVC	105°C	MFA	235°C
TPE-0	130°C	PFA	260°C
ECTFE	135°C	E-Glass Fibre	400°C
ETFE	155°C	R-Glass Fibre	700°C
Silicone	180°C	Silica	1000°C
FEP	205°C	Nextel	1200°C

## Tolerances and deviation limits

Wires for thermoelectric and compensation cables are standardised in DIN 43713. Thermoelectric voltages within the permitted temperature range correspond to the thermoelectric voltages of thermocouples according to DIN EN 60584-1.

Tolerances for thermoelectric and compensation cables are defined in DIN EN 60584-3 (s. Tolerances according to EN 60584-2, p. 73).

There are two classes of accuracy:

The narrower class 1 is for thermoelectric cables only, referring to cables with original materials.

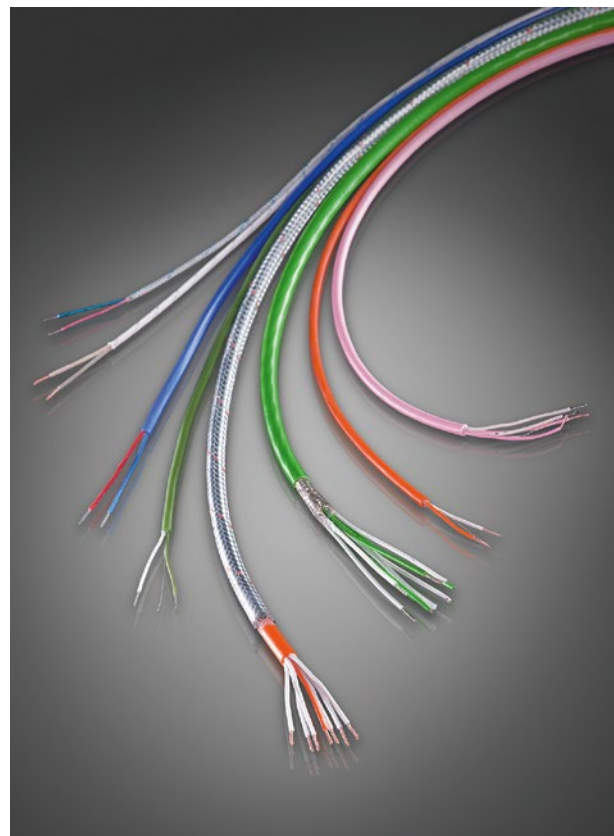
Class 2 is for thermoelectric and compensation cables made of alternative materials.

GÜNTHER thermoelectric and compensation cables are consistent with the colour coding of DIN EN 60584-3, except of thermoelectric cables type U and type L, which are colour coded according to DIN EN 60584-3. Tolerances are consistent with accuracy class 2 according to DIN 43722 (see Colour coding for thermoelectric and compensation cables, page 72).

For thermocouples type U and type L, the tolerance according to DIN 43719 of  $\pm 3^\circ\text{C}$  applies.



We have over 200 types of compensation and thermoelectric cables available from stock.



For thermocouple type B, copper wires may be used within a temperature range of up to  $100^\circ\text{C}$ . For this reason, DIN EN 60584-3 contains no tolerance values for these compensation cables. If compensation cables for type B are required for temperatures above  $100^\circ\text{C}$ , the application of specialised compensation cables is necessary. These cables are available upon request.

## Individual parts



### Individual parts

GÜNTHER GmbH has in excess of 40.000 individual and building components available from stock. As a result, we are able to respond precisely to the application scenarios and requests of our customers and internationally deliver our products quickly and reliably.

On the following pages, we will offer a small overview of the most common individual parts from our product line, alongside the corresponding Technical information. Individual solutions such as, for example materials, process connectors, accessories, etc. not listed here, are often realisable.

Please contact us for further information!

Note: Apart from buying and trading precious metals for our sensors, we offer our customers the option of opening a precious metals account.



Visit us online at [www.guenther.eu](http://www.guenther.eu)



## Connection heads



### Head type A

Large, slanted head with unsecured, removable cover (bolted)

Matching fit: connection socket type A

Tube connection	Protection rating
Threading M24 x 1,5	IP 54
Bore hole (in mm): 22,8 / 24,8 / 26,8 / 28,8 / 32,8	IP 53



### Head type AUZ / AUS

Spherical head with hinged cover and cylinder-head screw / quick-release fastener

Matching fit: connection socket type A

Tube connection	Protection rating
Threading M24 x 1,5	IP 65
Bore hole (in mm): 22,8 / 24,8 / 26,8 / 28,8 / 32,8	IP 54



### Head type AUZH / AUSH

Elevated hinged cover for inclusion of a transducer  
with cylinder-head screw / quick-release fastener

Matching fit: connection socket type A

Tube connection	Protection rating
Threading M24 x 1,5	IP 65
Bore hole (in mm): 22,8 / 24,8 / 26,8 / 28,8 / 32,8	IP 54



### Head type B

Small, slanted head with with unsecured, removable cover (bolted)

Matching fit: connection socket type B

Tube connection	Protection rating
Threading M24 x 1,5	IP 54
Bore hole (in mm): 10,8 / 15,8	IP 53



### Head type BUZ / BUS

Spherical head with hinged cover and cylinder-head screw / quick-release fastener

Matching fit: connection socket type B

Tube connection	Protection rating
Threading M24 x 1,5	IP 65
Bore hole (in mm): 12,8 / 15,8	IP 54



### Head type BUZH / BUSH

Elevated hinged cover for inclusion of a transducer with cylinder-head screw / quick-release fastener

Matching fit: connection socket type B

Tube connection	Protection rating
Threading M24 x 1,5	IP 65
Bore hole (in mm): 12,8 / 15,8	IP 54



### Head type DL

Small spherical head with screw cap

Matching fit: connection socket type S

Tube connection	Protection rating
Inner threading M10 x 1	IP 54
Outer threading M20 x 0,75	IP 54
Bore hole (in mm): 6,1	IP 54



### Head type NA

Small spherical head with hinged cover

Matching fit: connection socket type B

Tube connection	Cable inlet
Threading M24 x 1,5	M20 x 1,5 mm
Bore hole (in mm): 15,8	M20 x 1,5 / M22 x 1,5 mm





### Head type L

Cylindrical head with slip lid

Matching fit: connection socket type S

Tube connection	Cable inlet
Clamp socket Ø 8,2 mm	PG 7

## Transducers



These universal temperature transmitters (transducers) are mounted inside the connection head of a thermocouple assembly. Their purpose is to convert different incoming signals from measuring points in thermocouple assemblies or resistance thermometers into stable and standardised signals. Depending on the outgoing signal, the amperage lies between 4 – 20 mA.

In the past, transmitters were constructed with analogue technology. Today, digital technology has established itself, offering better measuring precision along with increased flexibility. Additionally, digital transmitters support expanded surrounding temperatures, typically in the range between -40°C and +85°C.

Every version is manually adjustable or computer programmable and is also consistent with the HART® protocol. Furthermore, all transducers meet the certification requirements for GL, UL, SIL2 and ATEX.

### Socket connectors



Socket connectors (plugs, sockets) are applicable in thermocouple assemblies and resistance thermometers. The contacts consist of the same material as the respective thermocouple or compensation material.

#### Advantages of the mechanical structure of plug- and socket-connectors

- Contact pins and sockets are free of thermoelectric current
- Protection from voltage reversal due to different sized pins
- Solid contact pins and spring mounted sockets
- Central cover attachment eases installation
- Internally separated wire channels prohibit short circuiting
- Screw Terminals facilitate quick connection

There are three different categories of plug- and socket-connectors:



#### ① Standard plug / socket

Plastic casing filled with glass fibre

**Maximum thermal load:** 200°C

**Colour coding of the casing:**

Every international colour coding is available

DIN IEC, DIN 43710, ANSI, NFE, BS, JIS, etc.



#### ② Standard High-temperature plug / socket

Special temperature-resistant plastic casing for high ambient temperatures

**Maximum thermal load:** 350°C

**Colour coding of the casing:**

Casing colour brown with element identification mark



#### ③ Standard ceramic plug / socket

Ceramic casing for extremely high ambient temperatures

**Maximum thermal load:** 650°C

**Colour coding of the casing:**

Casing colour white with element identification mark





## Stop and counter flanges



Flanges are used for the attachment of the thermal sensor to the wall of the installation location. The counter flange is welded to the wall of the installation location and so offers an uncomplicated and gas tight mounting point for the stop flange.

GÜNTHER GmbH offers a broad variety of flanges in different sizes (for Protection tubes with diameters 15, 22, 26 and 32 mm) and materials (e.g. cast iron, steel, etc.).



**We are frequently able to fulfill requests for individualised shapes, respectively materials upon request.**

**Please contact us for further information!**



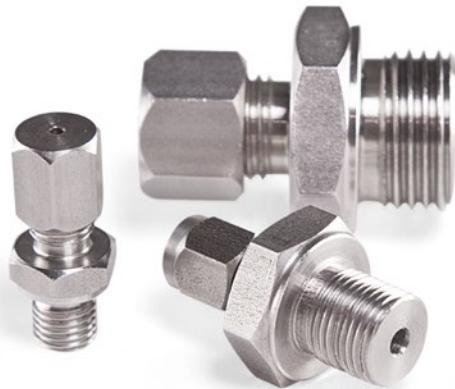
### Threaded sockets



Threaded sockets are used for gas-tight installation of thermocouple assemblies and resistance thermometers, usually with a larger Protection tube diameter.

Sockets with nominal diameters between 15 and 32 mm, with connecting threads of G ½ A up to G 1 ¼ A, as well as various construction materials are always available from stock.

### Clamp connectors

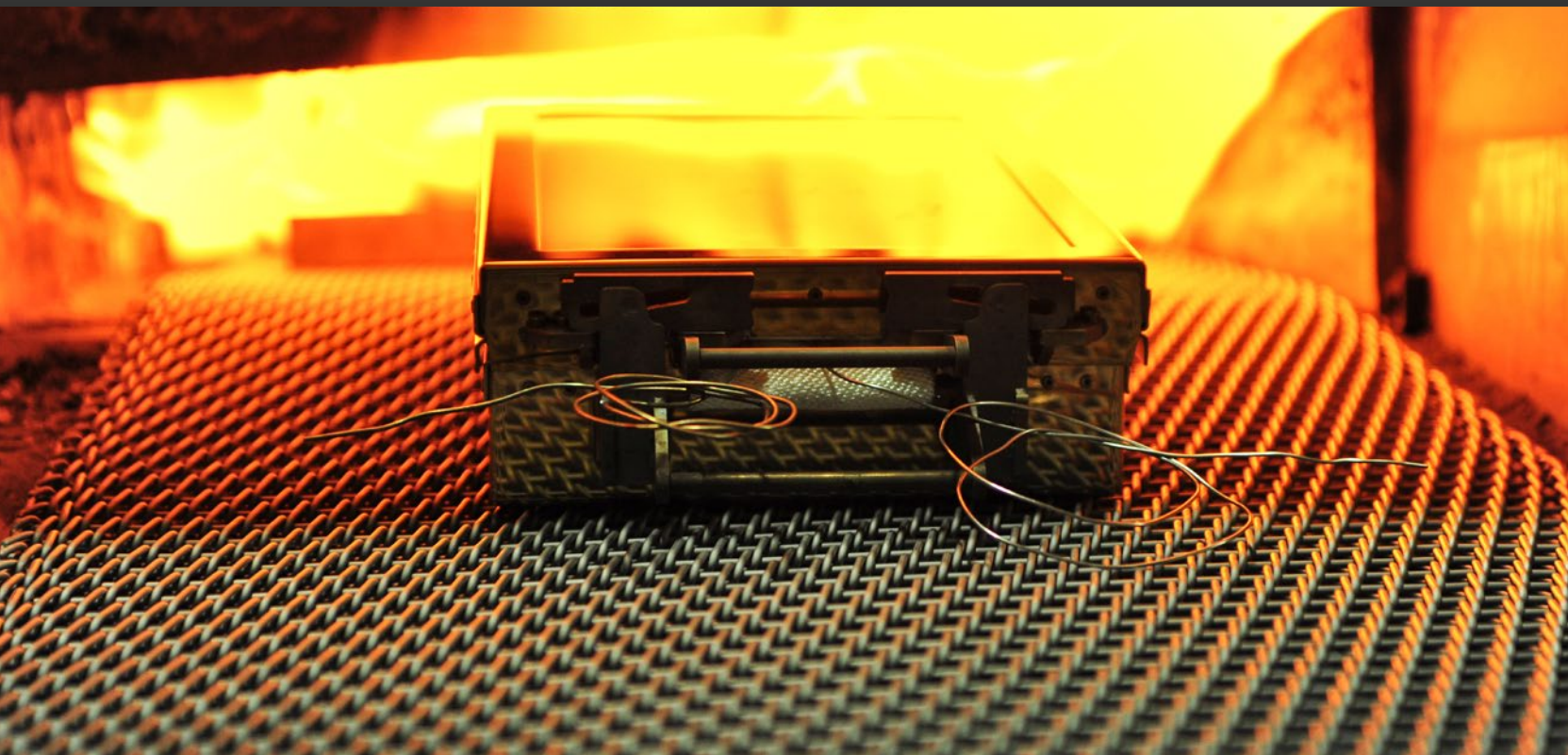


Clamp connectors are also used for gas-tight installation of thermocouple assemblies and resistance thermometers.

Normally, these will have smaller dimensions, usually clamping nominal diameters between 1 and 12 mm, with connecting threads from G ½ A to G 1 ¼, or with metric fine thread.

For these, we also always have various materials, as well as different designs with additional teflon pressure ring or stainless steel cutting ring, available from stock.





## GÜNTHER Service

GÜNTHER Service mostly comprises a measuring and consulting service for our customers in order to verify the temperature uniformity (TUS measurement) and system accuracy (SAT measurement) of an industrial furnace. GÜNTHER works according to the international standards of the automotive and aerospace industry (according to AMS2750 and CQI-9), as well as customer-specifically based on individual requirements. Additionally, GÜNTHER service includes supplementary services such as training, consulting, repairs and spare part deliveries.

Our service verifies compliance with customer-specific directives, supports process safety, preventively avoids mistakes and thus ensures your products' quality.

### Consulting/training

We advise and train our customers in all areas of temperature measurement. Our specialists will inform you about the proper selection of temperature sensors and their handling, TUS and SAT measurements and temperature measurements in general.

### Calibration of thermocouples

We calibrate thermocouples for system review with a works test certificate based on the national standard. We can issue a DAkkS certificate on request.

### Measuring the customer's furnaces

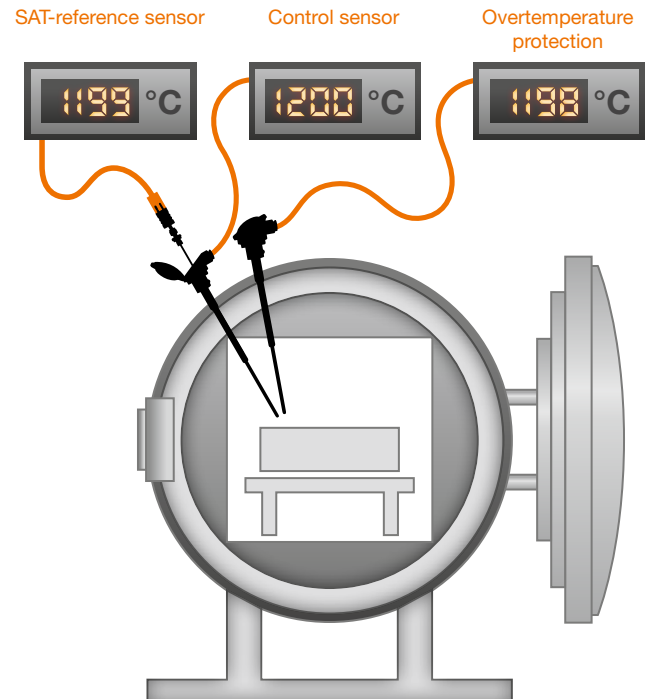
Our measurements meet standards such as CQI-9 and AMS2750. The TUS measured values are saved in calibrated data loggers, protected from falsification, and evaluated in a detailed test report. We also inspect your controllers and can perform SAT measurements at the customer's site.

### Repair of defective thermocouples

We can replace defective elements on site or, where possible, repair them at your site. The associated spare parts and production components are, like all our customised products, available on short notice.

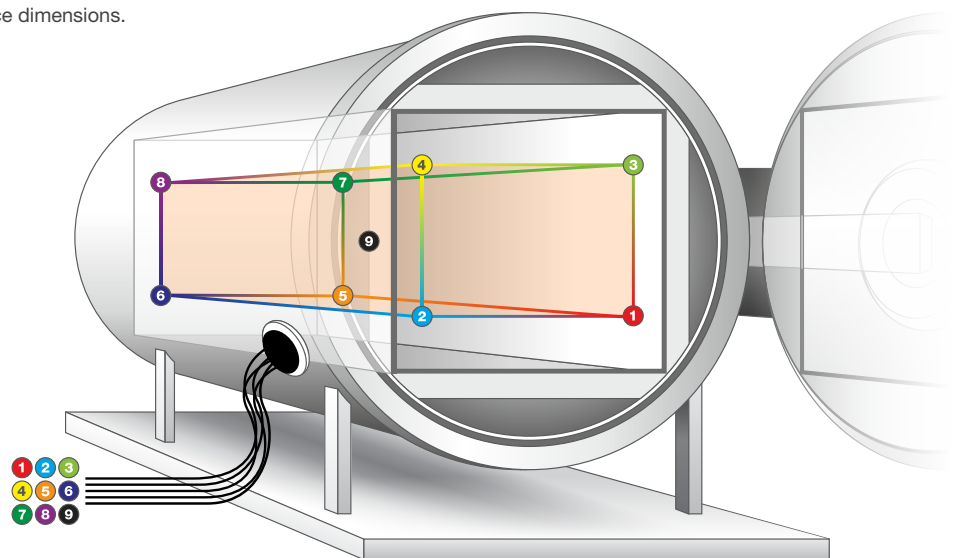
## System-accuracy measurement (SAT measurement)

The SAT measurement is a comparison measurement in which the installed thermocouple (control sensor) is counter-checked for deviations with a specifically calibrated reference sensor. It should be performed as close as possible to the sensor to be tested, ideally by a test hole within the control sensor as it can be found integrated in most GÜNTHER temperature sensors. This way, the comparison measurement will take place specifically in the measuring point of the control sensor, which ensures accurate values for a precise evaluation.



## Temperature comparison measurement (TUS measurement)

For TUS measurements, separate thermocouples are installed in the furnace in order to monitor an even temperature (see below – vacuum furnace with TUS-elements in the qualified work zone). Number, installation position and installation type of the temperature sensor are determined by the furnace dimensions.



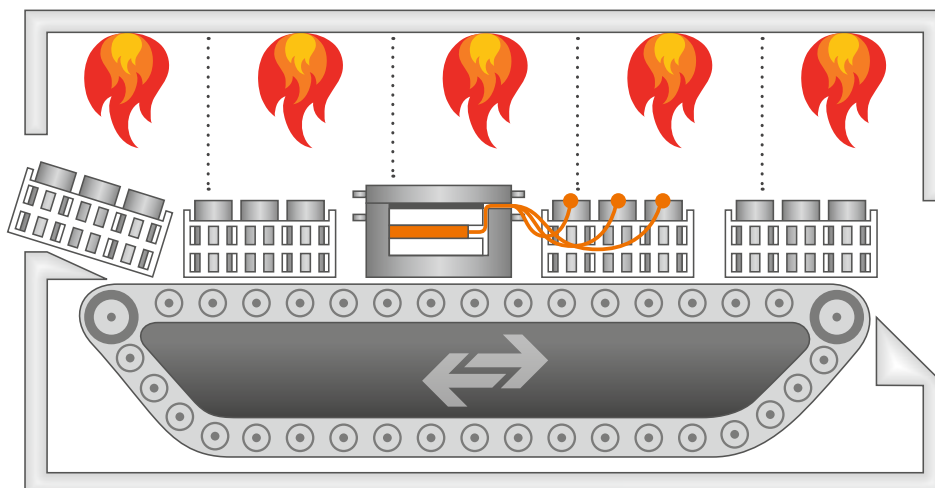


If no thermocouples can be inserted into the furnace from the outside, special heat-protection containers with integrated data loggers are available that can remain inside the furnace for a certain time. This way, various locations of the furnace are checked to ensure an even temperature and the results are saved in the data logger protected from falsification. After the measurement, we will give you the evaluations in a detailed test report.



Data logger with connected temperature sensors

Special heat protection containers permit drag measurements directly at the product or the batch.



## Our GÜNTHER thermocouples

We produce our thermocouples with different thermocouple numbers (1, 2 and 3 pairs). They are often equipped, e.g., with a lockable test hole through which a SAT-reference sensor can be inserted. In order to keep trigger times as low as possible, we produce thermocouples with the smallest possible protective tube diameters or several Protection tubes side by side. A number of gas-tight process connections is available for vacuum or insert gas applications.

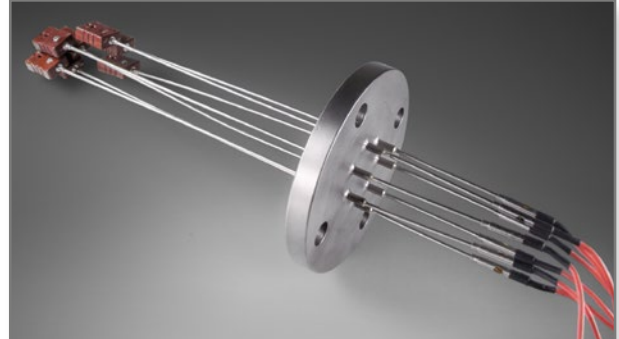


Lockable vacuum thermocouple with clamp screw connection with the SAT element

## Our GÜNTHER thermocouples

The thermocouples we install are of the highest quality and always correspond to the accuracy class according to DIN EN 60584. Directives AMS2750 and CQI-9 pose special challenges to the quality of thermocouples and partially demand stricter limit compliances than the applicable DIN EN 60584 demands for class 1. GÜNTHER always has a large range of raw material in stock that meets these requirements.

Process connections such as clamp screw connections, flanges and sleeves, as well as compensation lines, plug connectors and other accessories, are available on short notice ex stock. We produce gas-tight process feedthroughs specifically adjusted to your system, usually with bilateral plug connections, for process-safe routing of the supply lines for the batch thermocouples placed in the furnace to the outside.



Vacuum feedthrough with welded-in thermocouple extension

## Calibration of the thermocouples

Our DAkkS-certified lab calibrates the thermocouples. We can calibrate temperatures between -80 °C and 1600 °C with a factory test certificate. We are DAkkS-accredited in the area of -80 °C to 1300 °C.

We also offer the option of making your elements of calibrated batches and will gladly issue the corresponding batch protocol for you.

## Training

We offer training in the area of AMS and CQI-9:

- What is a thermocouple and how does it work?
- Calibration of a thermocouple (DAkkS and certificate of calibration)
- Information on SAT and TUS measurements
- All about AMS2750 and CQI-9










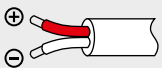


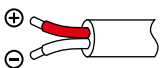

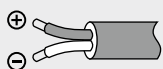

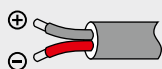
















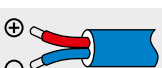




<p align="center"><b>IBEU Institut für Sicherheitstechnik GmbH</b>          An-Institut der TU Bergakademie Freiberg</p>		
<p><b>[1] ACCEPTANCE NOTIFICATION OF QUALITY ASSURANCE          PRODUCTION PROCESS - Translation</b></p>		
[2]	Equipment or protective systems intended for use in potentially explosive atmospheres as well as components intended for use in these products, Directive 2014/34/EU	
[3]	Notification number <b>IBEXU16ATEXQ022   Issue 0</b>	
[4]	Product-category(ies): <b>Resistance thermometer and thermocouple elements          electrical equipment of equipment-group II,          Category 1 / 2 G, 1 / 2 D, 2 G and 2 D with          (pres. of protection I, G II</b>	
[5]	Manufacturer: <b>Günther GmbH Temperatumesstechnik</b>	
[6]	Address: <b>Bauhofstraße 12          90571 Schwagb          GERMANY</b>	
[7]	Production site(s): <b>Günther GmbH Temperatumesstechnik, Werk 1          Bauhofstraße 12          90571 Schwagb          GERMANY           Günther GmbH Temperatumesstechnik, Werk 2          Gewerbestr. 30          63589 Linsengericht          GERMANY</b>	
[8]	IBEU Institut für Sicherheitstechnik GmbH, notified body number 0637 in accordance with Article 17 of Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014, certifies that the manufacturer maintains a quality assurance system for production, final product inspection and testing of the named product-category(ies) at the named production site(s) that fulfils the requirements given in Annex IV to the Directive.	
[9]	This notification is based on the confidential audit report IB-16-6-065 of 2017-09-12. The notification is valid until 2019-11-29. This notification can be withdrawn if the manufacturer no longer satisfies the requirements of Annex IV. Results of surveillance audits are part of this notification.	
[10]	According to Directive 2014/34/EU the products mentioned under [4] should be marked with the identification number 0637 of IBEU, the notified body that was involved in the production control phase, optionally in conjunction with the CE marking.	
IBEU Institut für Sicherheitstechnik GmbH Fuchsmühlweg 7 09599 Freiberg, GERMANY		Tel:    + 49 (0) 37 31 / 38 05 0 Fax:    + 49 (0) 37 31 / 38 05 10
By order   Dipl.-Ing. [FH] Henker		 (Notified Body number 0637)
		Certificates without signature and seal are invalid. Certificates may only be modified, amended and unchanged in case of disputes, the German text is definitive.
		Freiberg, 2017-09-12

7/17/10/23 | 0

Page 1/1  
 IBEXU16ATEXQ022 | 0



## Colour coding for thermoelectric and compensation cables, as well as thermal socket connectors

Thermocouple Type	DIN EN 60584-2	DIN 43714	ANSI MC 96.1
NiCr-Ni / K	 + green / - white Mantle: green	 + red / - green Mantle: green	 + yellow / - red Mantle: yellow
NiCrSi-NiSi / N	 + pink / - white Mantle: pink		
Pt10Rh-Pt / S	 + orange / - white Mantle: orange	 + red / - white Mantle: white	 + black / - red Mantle: green
Pt13Rh-Pt / R	 + orange / - white Mantle: orange	 + red / - white Mantle: white	 + black / - red Mantle: green
Pt30Rh-Pt6Rh / B	 + grey / - white Mantle: grey		 + grey / - red Mantle: grey
Fe-CuNi / J	 + black / - white Mantle: black		 + white / - red Mantle: black
Cu-CuNi / T	 + brown / - white Mantle: brown		
W5Re-W26Re / C			
W5Re-W20Re / A			
W3Re-W25Re / D			
Fe-CuNi / L		 + red / - blue Mantle: blue	
Cu-CuNi / U		 + red / - brown Mantle: brown	





## Tolerances according to DIN EN 60584-1 (reference junction 0°C)

	Range	Class 1	Range	Class 2
NiCr-Ni / K NiCrSi-NiSi / N	-40 ... 1000°C	± 1,5°C or 0,004*(t)	-40 ... 1200°C	± 2,5°C or 0,0075*(t)
Fe-CuNi / J	-40 ... 750°C	± 1,5°C or 0,004*(t)	-40 ... 750°C	± 2,5°C or 0,0075*(t)
Pt10Rh-Pt / S Pt13Rh-Pt / R	0 ... 1600 °C	± 1,0°C or [1,0+0,003(t-1100)]°C	0 ... 1600 °C	± 1,5°C or 0,0025*(t)
Pt30Rh-Pt6Rh / B	---	---	600 ... 1700°C	± 1,5°C or 0,0025*(t)
Cu-CuNi / T	-40 ... 350°C	± 0,5°C or 0,004*(t)	-40 ... 350°C	± 1,0°C or 0,0075*(t)
NiCr-CuNi / E	-40 ... 800°C	± 1,5°C or 0,004*(t)	-40 ... 900°C	± 2,5°C or 0,0075*(t)
W5Re-W26Re / C	---	---	426 ... 2315°C	± 0,1*(t)
W5Re-W20Re / A	---	---	1000 ... 2500°C	± 0,1*(t)

The higher value is valid (t = Numerical Temperature Value in °C)

## Properties of the most common ceramic types

	Unit	Porous ceramic	TE-porcelain	Aluminum oxide
Type according to DIN	-	C530	C610	C799
Thermal shock resistance	-	very good	moderate to good	moderate
Impermeability	-	porous	gas-tight	gas-tight
Maximum constant temperature	°C	1650	1600	1850
Al <sub>2</sub> O <sub>3</sub> -content	%	73-75	60	99,7
Volume weight	g*cm <sup>3</sup>	2,35	2,6	3,8-3,93
3-Point bending strength	MPa	35	120	300
C-Module	GPa	60	110	370



## **GÜNTHER GmbH**

**Temperaturmesstechnik**

**Bauhofstraße 12**

**90571 Schwaig**

**Deutschland**

**Tel.** +49 (0)911 / 50 69 95-0

**Fax** +49 (0)911 / 50 69 95-55

**Web** [www.guenther.eu](http://www.guenther.eu)

**E-Mail** [info@guenther.eu](mailto:info@guenther.eu)

## **GUENTHER Polska Sp. z o.o.**

**ul. Wrocławska 24B**

**55-095 Długołęka**

**Polska**

**Tel.** +48 (0)71 / 352 70 70

**Fax** +48 (0)71 / 352 70 71

**Web** [www.guenther.com.pl](http://www.guenther.com.pl)

**E-Mail** [biuro@guenther.com.pl](mailto:biuro@guenther.com.pl)

## **S.C. GUENTHER**

**Tehnica Măsurării S.R.L.**

**Calea Aurel Vlaicu 28-32**

**310159 Arad**

**Romania**

**Tel.** +40 (0) 257 / 33 90 15

**Fax** +40 (0) 257 / 33 90 15

**Web** [www.guenther.eu](http://www.guenther.eu)

**E-Mail** [romania@guenther.eu](mailto:romania@guenther.eu)

## **LANGKAMP Technology**

**Molenvliet 8**

**3961 MV Wijk bij Duurstede**

**Nederland**

**Tel.** +31 / 343 / 595410

**Fax** +31 / 343 / 595411

**Web** [www.langkamp-technology.nl](http://www.langkamp-technology.nl)

**E-Mail** [info@langkamp-technology.nl](mailto:info@langkamp-technology.nl)

As of: 05/2019

Pictures • Source: Phönix TM (pages 67, 69), Fotolia (pages 50, 51, 57)

Rest of the pictures and catalog design: suave Design



Notes

Grid of dots for notes.



## Notes

A large grid of small dots for taking notes, consisting of 20 rows and 40 columns.







**GÜNTHER**