

Application

- Measuring range: 0 .. +1800°C *
- Industrial furnaces
- Heat treatment processes
- Air ducts and gas ducts
- Glass industry, ceramics industry

Features

- Protection tube materials:
mullite C610 (Al₂O₃ 60%)
alumina C799 (Al₂O₃ 99.7%)
- Temperature transmitter can be installed in
the sensor head
- Gas-tight compression fitting (to 0.1 MPa / 1 bar)
- Optionally the head can be installed with a local
temperature display (DANWdie-LED)

The sensor consists of a replaceable insert, a ceramic protective tube (thermowell) and an aluminium connection head where a programmable temperature transmitter with 4-20 mA output signal can be installed.

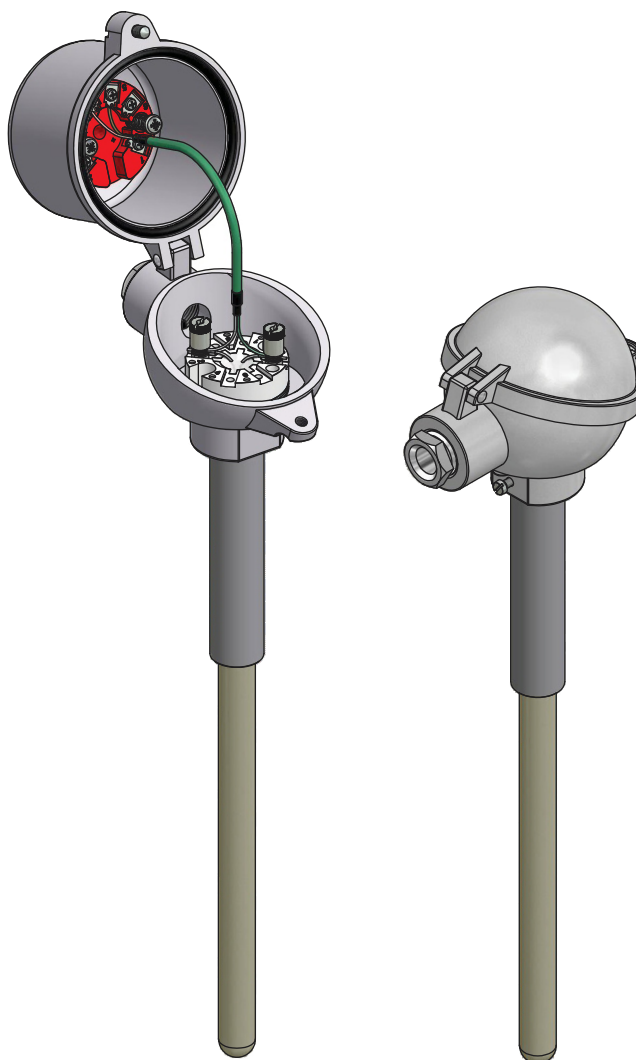
The measuring insert is a replaceable element of the complete sensor, which means that only the insert, instead of the entire sensor, needs to be dismantled for regular inspection or in case of damage.

Immersion length, compression fitting size (optional), material of the protection tube and connection head can be selected depending on the requirements of the application.

Temperature transmitter (option)

Measuring transmitter is mounted in the higher cap of the head.

One of many advantages of the built-in temperature transmitter is the possibility of using standard copper wires to connect the thermometer with the control room, without having to resort to expensive extension leads.



ATEX, EAC Ex versions

Intrinsically safe and Flameproof designs are available for applications in hazardous areas. These models are provided with certificate for „intrinsically safe“ type of protection according to Directive 2014/34/UE (ATEX) and EAC Ex TR-CU 012/2011 (Eurasian Economic Union).

Intrinsically safe (Exi)

data sheet XI-TT4.

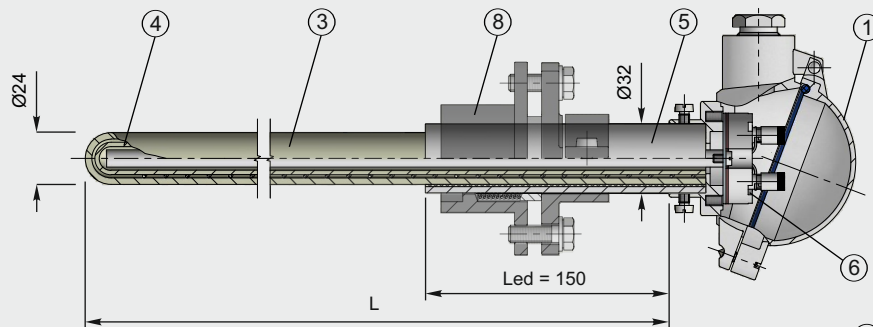
Other versions

This data sheet contains only a small portion of our program of supplying thermoelectric thermometers with a replaceable measuring insert.

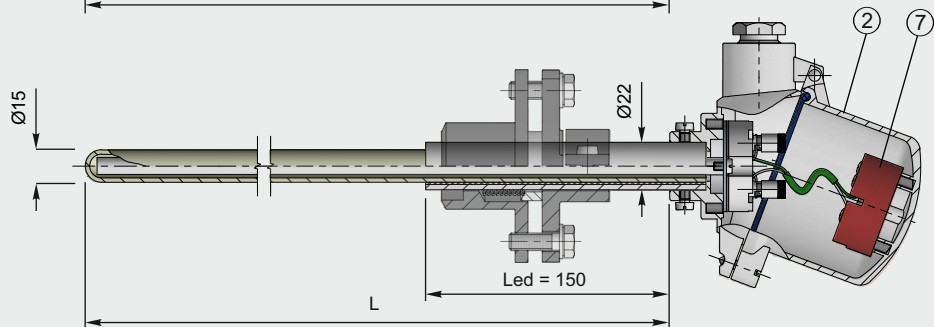
Other versions can be supplied upon customer's request.

Designs

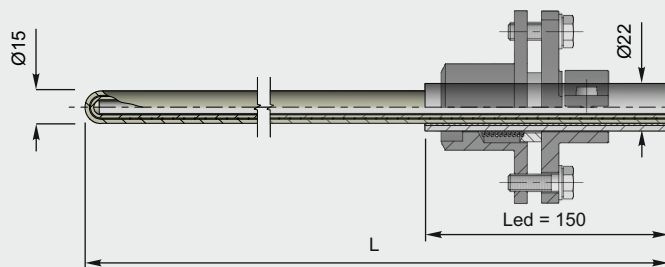
Type TT438
with double ceramic tube $\varnothing 24$ mm



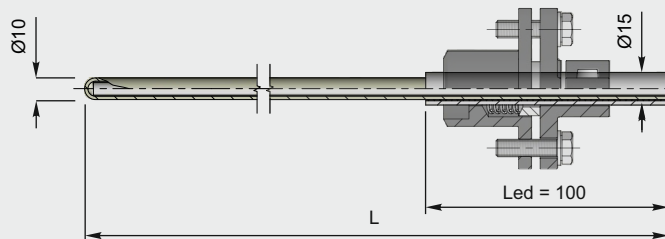
Type TT440
with ceramic tube $\varnothing 15$ mm



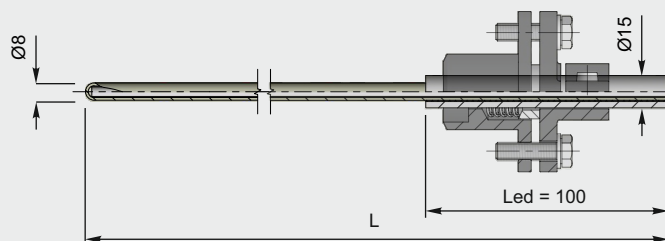
Type TT441
with double ceramic tube $\varnothing 15$ mm



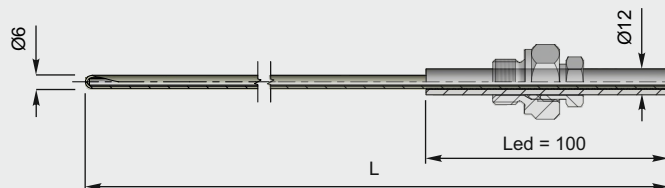
Type TT442
with ceramic tube $\varnothing 10$ mm



Type TT443
with ceramic tube $\varnothing 8$ mm

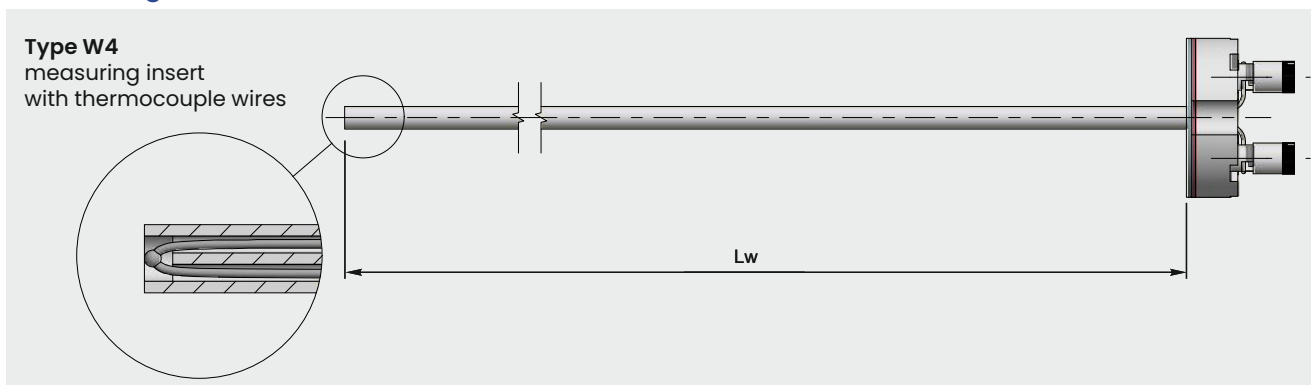


Type TT444
with ceramic tube $\varnothing 6$ mm



- | | | |
|-----------------------------------|-----------------------------------|-------------------------------------|
| ① - Connection head DAN type | ④ - Inner ceramic protection tube | ⑦ - Temperature transmitter |
| ② - Connection head DANW type | ⑤ - Holding tube | ⑧ - Process connection (accessorie) |
| ③ - Outer ceramic protection tube | ⑥ - Measuring insert | |

Measuring insert



Basic values of thermocouples type K, N, R, S, B according to PN-EN 60584 / IEC 584

Temperature		°C	900	1000	1100	1200	1300	1400	1500	1600	1700	1800
Nominal value	Type K	mV	37.33	41.28	45.12	48.84	-	-	-	-	-	-
	Type N	mV	32.37	36.26	40.09	43.85	-	-	-	-	-	-
	Type R	mV	9.21	10.51	11.85	13.23	14.63	16.04	17.45	18.85	-	-
	Type S	mV	8.45	9.59	10.76	11.95	13.16	14.37	15.58	16.78	-	-
	Type B	mV	3.96	4.83	5.78	6.79	7.85	8.96	10.10	11.26	12.43	13.59

Tolerance

The PN-EN 60584 Standard defines the formulas for calculating acceptable measure tolerance. More information available in the general thermocouple thermometer sheet.

Type K (NiCr-Ni), Type N (NiCrSi-NiSi)

Class	Temperature range	Tolerance
1	-40 °C .. +375 °C	± 1.5 °C
	+375 °C .. +100 °C	± 0.0040 x t
2	-40 °C .. +333 °C	± 2.5 °C
	+333 °C .. +1200 °C	± 0.0075 x t

Type R (PtRh13-Pt), S (PtRh10-Pt)

Klasa	Temperature range	Tolerance
1	0 °C .. +1100 °C	± 1.0 °C
	+1100 °C .. +1600 °C	± [1 + 0.003 (t-1100)]
2	0 °C .. +600 °C	± 1.5 °C
	+600 °C .. +1600 °C	± 0.0025 x t

Temperature	Tolerance	
	Class 1	Class 2
350°C	± 1.5°C	± 2.63°C
500°C	± 2.0°C	± 3.75°C
600°C	± 2.4°C	± 4.50°C
700°C	± 2.8°C	± 5.25°C
800°C	± 3.2°C	± 6.00°C
900°C	± 3.6°C	± 6.75°C
1000°C	± 4.0°C	± 7.50°C
1100°C	-	± 8.25°C
1200°C	-	± 9.00°C

Temperature	Tolerance	
	Class 1	Class 2
350°C	± 1.0°C	± 1.5°C
500°C	± 1.0°C	± 1.5°C
600°C	± 1.0°C	± 1.5°C
700°C	± 1.0°C	± 1.8°C
800°C	± 1.0°C	± 2.0°C
900°C	± 1.0°C	± 2.3°C
1000°C	± 1.0°C	± 2.5°C
1100°C	± 1.0°C	± 2.8°C
1200°C	± 1.3°C	± 3.0°C
1300°C	± 1.6°C	± 3.3°C
1400°C	± 1.9°C	± 3.5°C
1500°C	± 2.2°C	± 3.8°C
1600°C	± 2.5°C	± 4.0°C

Type B (PtRh30-PtRh6)

Class	Temperature range	Tolerance
2	+600 °C .. +1700 °C	$\pm 0.0025 \times t $

Temperature	Tolerance Class 2
600°C	$\pm 1.5^\circ\text{C}$
700°C	$\pm 1.8^\circ\text{C}$
800°C	$\pm 2.0^\circ\text{C}$
900°C	$\pm 2.3^\circ\text{C}$
1000°C	$\pm 2.5^\circ\text{C}$
1100°C	$\pm 2.8^\circ\text{C}$
1200°C	$\pm 3.0^\circ\text{C}$
1300°C	$\pm 3.3^\circ\text{C}$
1400°C	$\pm 3.5^\circ\text{C}$
1500°C	$\pm 3.8^\circ\text{C}$
1600°C	$\pm 4.0^\circ\text{C}$
1700°C	$\pm 4.3^\circ\text{C}$

Periodic inspections

Above +1200°C noble-metal elements are not prone to oxidation and corrosion due to their high resistance.

Platinum-based elements, such as Pt-Pt10Rh (type S) and Pt6Rh-Pt30Rh (type B), are the most popular ones.

Nevertheless, even PtRh type thermocouples do not guarantee flawless measure, particularly over long periods of time and without thorough inspections.

Considerable measurement errors or even a premature breakdown can occur.

Thermocouple wire diameters

Thermocouple wire diameter of the thermoelement depends on design of the sensor and can be: $\varnothing 0.35$ or $\varnothing 0.50$ mm.

The standard diameter of a noble-metal thermoelement wire is $\varnothing 0.50$ mm, which allows for longer lifespan of the sensor.

Wires with other diameters are available upon customers request.

Thermocouple	Wire diameter
J (Fe-CuNi) K (NiCr-Ni)	$\varnothing 0.50$, $\varnothing 2$ mm or mineral insulated insert (W2..)
R (PtRh13%-Pt) S (PtRh10%-Pt)	$\varnothing 0.35$, $\varnothing 0.50$ mm
B (PtRh30%-PtRh6%)	$\varnothing 0.35$, $\varnothing 0.50$ mm

Causes of contamination

There are three main causes of a shift in thermoelectric voltage:

- the change in the chemical composition of the two wire endings due to diffusion in the hot junction
- the change in composition of one or both wire endings due to selective evaporation of one of the alloys
- the change in composition of one or both wire endings due to absorption of environmental contaminants.

For this reason it is recommended to use gas-tight high alumina ceramics C799 at temperatures above +1400°C.

Ceramic protection tubes

Thermoelements need to be protected against factors such as: pressure, flow, corrosion and other mechanical and chemical hazards. This is made by protective tubes that extend the lifespan of the thermometer. We unified the wide range of designs made using different materials.

Depending on the application of the sensor, TERMOAPARATURA WROCŁAW offers a wide assortment of protective tubes suitable for various tasks.

If the offered sheath materials are not suitable for the task, we will offer different protective tube materials upon request.

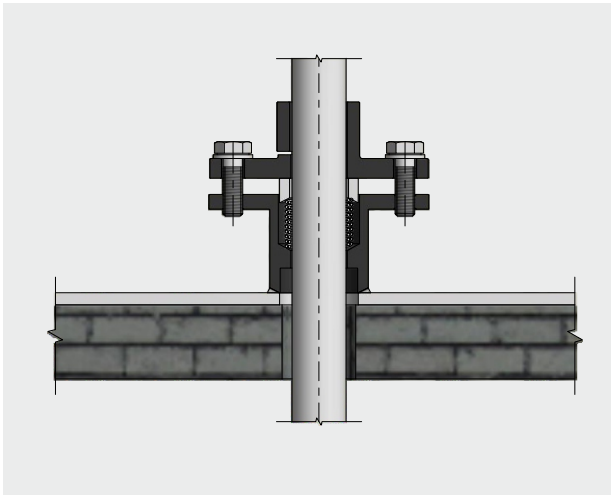
Material	Max. temperature	Advantages	Disadvantages	Application
C530 (Al ₂ O ₃ 73-75%)	1600 °C	Resistant to temperature shock	Low resistance to mechanical load	Electric furnaces up to 1300°C or others
C610 (Al ₂ O ₃ 60%)	1500 °C	Gas-tight, average thermal shock resistance, high flame resistance	Low resistance to mechanical load, low Al ₂ O ₃ content	Gas-tight furnaces, diffusion furnaces
C799 (Al ₂ O ₃ 99.7%)	1800 °C	Gas-proof, acid resistant, steam resistant, very high flame resistance	Low resistance to mechanical load, low resistance to temperature shock	Gas-tight furnaces up to 1800°C (liquid glass tanks), chemical industry, manufacturing of concrete

Example of installation

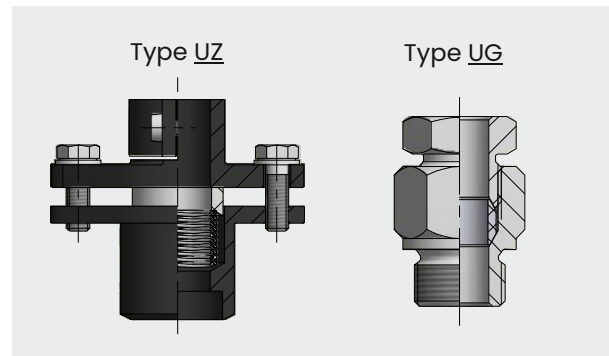
Sensors with ceramic protective tube can be mounted with flanged mounting bracket or threaded compression fitting. In both cases immersion depth of the sensor can be adjusted by moving the fitting along the metal holding tube.

Immersion adjustment limits are set by the length of the holding tube used to clamp the thermocouple onto it, in order to make it gas-tight.

To make a flange connection gas-tight it is necessary to use the complete mounting bracket with the body (type UZ11).



Mounting bracket / Compression fitting



More detailed information available on separate data sheets "UZ" and "UG" type.

Ceramic protection tube mounting instructions

High alumina ceramics C799 is characterised by low resistance to rapid temperature changes. Thus, special attention needs to be paid during mounting or dismantling the sensor.

Temperature shock adversely affects the structure of sheath material, which can damage the tube. For this reason, thermocouples with ceramic sheaths need to be carefully immersed in the process.

Moreover, ceramic tubes need to be protected against mechanical load. The sensor can be exposed to such load i.e. during it being mounted in the horizontal position. Depending on the sheath diameter and shape, and immersion length additional protection against unwanted bending should be provided.

This instruction also extends to temperature sensors with metal protection tubes.



Installation of a ceramic protection tube during furnace operation

Mounting temperature:

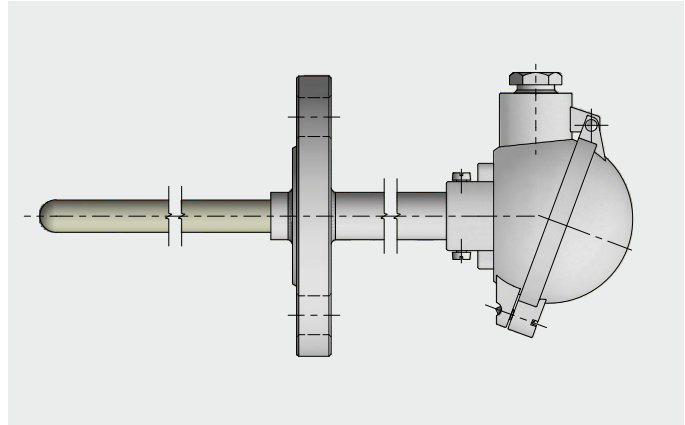
1600°C immersion speed: 1-2 cm/min

1200°C immersion speed: 10-20 cm/min

Non-standard designs

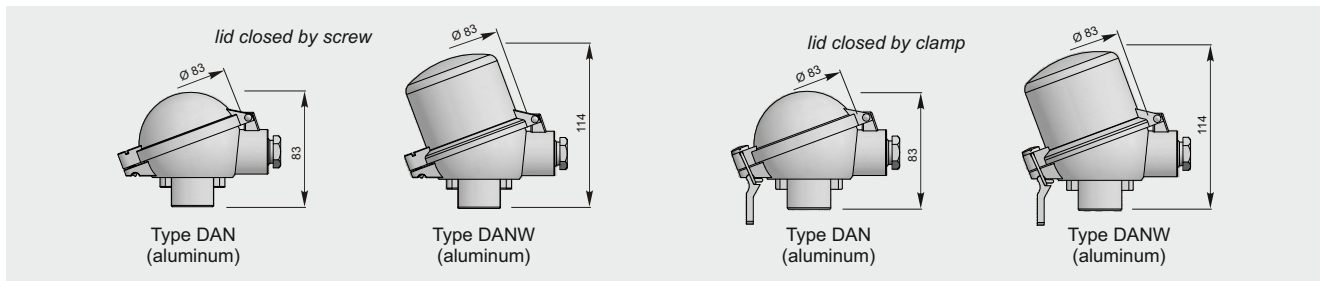
We offer high-temperature thermocouples of various structural designs, such as:

- holding tubes with a welded connection flange
- ceramic tubes sputtered with platinum/platinum and rhodium
- sensors with ceramic plugs



Types of connection heads

This sensor can be equipped with one of the following connection heads. For more information on connection heads see the "Accessories" section.



Connection head DANWdie with local LED display

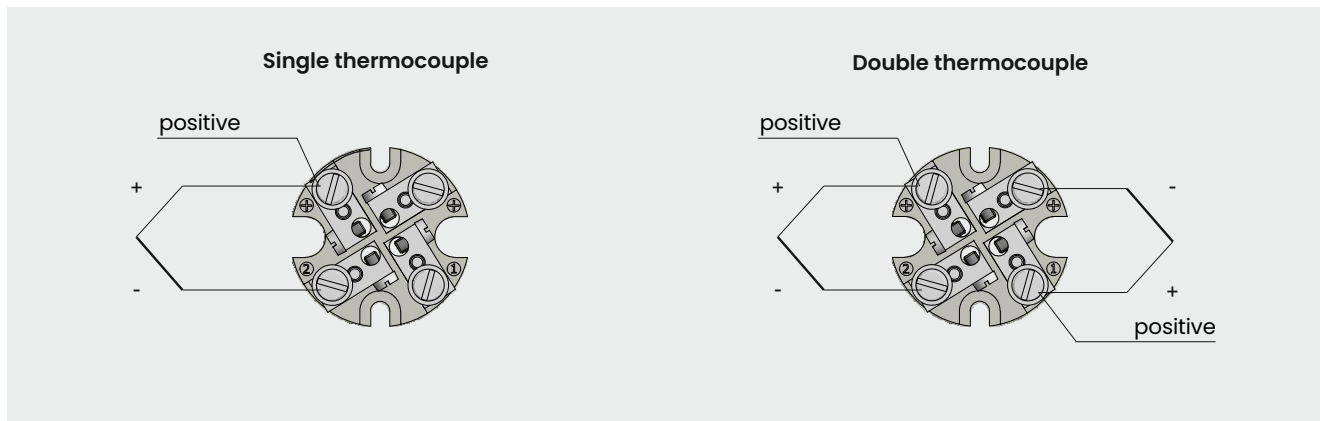
The display is mounted in connection head cover with glass window which allows preview of measuring temperature. 4 digits with a height of 9.5 millimeter ensure clear reading of values.

Programming of measure range can be performed via three buttons placed on the back of display panel.

Mounted temperature transmitter 4..20mA on measuring insert is necessary for proper use. It also works with temperature transmitters with HART® protocol.



Electrical connection on ceramic block



Ordering code

1 2 3 4 5 6 7 8 9 10
 TT4 - - - - - - - - -

1	<input type="text"/>	Version	
		AP	Single thermocouple, with 4..20 mA temperature transmitter
		APW	Single thermocouple, 4..20 mA temperature transmitter and local LED display*
		2	Double thermocouple
* only with connection head DANWdie			
2	<input type="text"/>	Design	
		38	with outer ceramic tube Ø24 mm and inner tube Ø15 mm
		40	with outer ceramic tube Ø15 mm
		41	with outer ceramic tube Ø15 mm and inner tube Ø8 mm
		42	with outer ceramic tube Ø10 mm
		43	with outer ceramic tube Ø8 mm
3	<input type="text"/>	Thermocouple type	
		K	Type K (NiCr-Ni)
		N	Type N (NiCrSi-NiSi)
		R	Type R (PtRh13%-Pt)
		S	Type S (PtRh10%-Pt)
4	<input type="text"/>	Connection head	
		DAN	Type DAN Aluminum Cable gland: M20x1.5 IP53
		DANW	Type DANW Aluminum Cable gland: M20x1.5 IP53
		xxx	other, please specify
5	<input type="text"/>	Closing method of connection head	
		1	closing by screw
		3	closing by clamp
6	<input type="text"/>	Protection tube material	
		C610	Mullite C610 (Al O 60%) 2 3
		C799	Alumina C799 (Al O 99.7%)
7	<input type="text"/>	Length L [mm]	
		500	500 mm
		710	710 mm
		1000	1000 mm
		1400	1400 mm
		2000	2000 mm
		xxx	other, please specify
8	<input type="text"/>	Tolerance	
		1	Class 1 according to PN-EN 60584-2
		2	Class 2 according to PN-EN 60584-2
9	<input type="text"/>	Measuring range of temperature transmitter	
		0..100	input signal for 4..20mA: 0..100°C
		xxx	other, please specify
10	<input type="text"/>	Type of temperature transmitter	
		PR5334A3B	Output signal 4..20 mA
		PR5335A	Output signal 4..20 mA, with HART® protocol
		PR5350A	Output signal Profibus® PA / Foundation Fieldbus
11	<input type="text"/>	Length L LED	
		xxx	150 mm (standard for TT438..441) or 100 (standard for TT442..444) other, please specify

Example

Temperature sensor TT440-S-DAN-1-C610-1000-1

(sensor 1xK, connection head type DAN closed by screw, length L=500mm, ceramic tube mullite C610, diameter Ø15 mm, class 1).

Temperature sensor APTT440-S-DANW-1-C799-1000-1-0..1600-PR5334A3B

(sensor 1xS with 4..20mA temperature transmitter, connection head type DANW closed by screw, length L=1000mm, ceramic tube alumina C799, diameter Ø15, class 1, transmitter type PR5334A3B).

Temperature sensor APWTT440-S-DANWdie-1-C799-710-1-0..1600°C-PR5335A

(sensor 1xS with 4..20mA temperature transmitter, connection head type DANWdie with local LED display, closed by screw, length L=710mm, ceramic tube alumina C799, diameter Ø15, class 1, temperature transmitter PR5335A).