

ABB MEASUREMENT & ANALYTICS | DATA SHEET

# SensyTemp TSP311, TSP321, TSP331

## Temperature sensors



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# Measurement made easy

## Sturdy and versatile

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### Heavy-duty design

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### Modular design

- Measuring inset, thermowell, extension tube, connection head, transmitter

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### Extremely robust connection head

- Aluminum or stainless steel screw-on cap for offshore applications

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### Transmitter in connection head

- Optional LCD indicator
- Optional display function (type AS) or display with configuration function (type A)
- SIL 2 for transmitter

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### Approvals

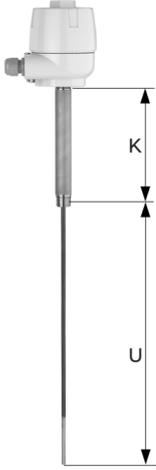
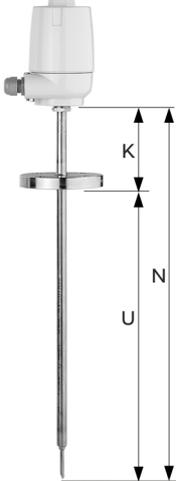
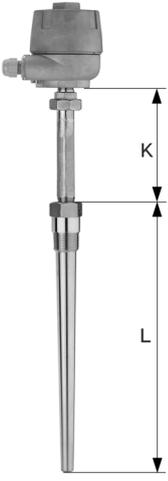
- SIL 2 for sensors with integrated transmitter
- ATEX, IECEx, EAC-Ex (GOST), NEPSI, other approvals on request

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### Areas of application

- Offshore and coastal areas, oil / natural gas production and transport, petrochemical sector, chemical industry, power industry

## Overview of temperature sensors

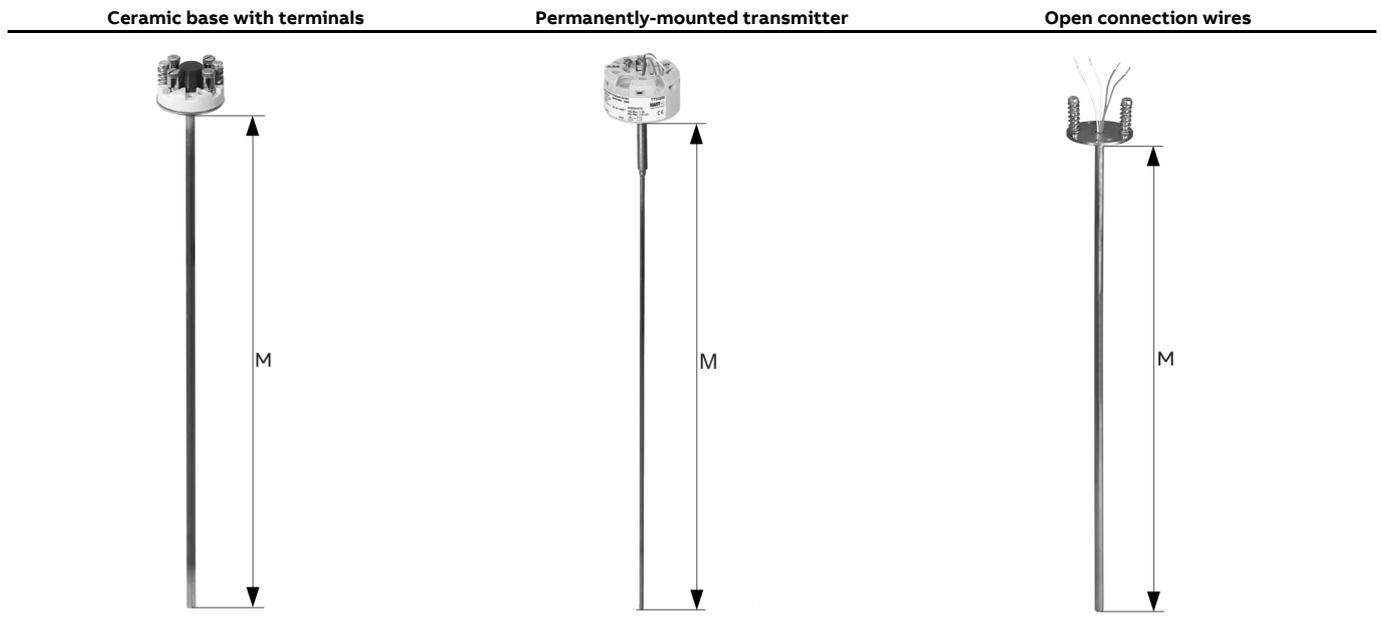
Type	TSP311	TSP321	TSP331
Legend:			
K = Extension tube length			
U = Installation length			
N = Nominal length			
L = Thermowell length			
			
Design	No thermowell, for installation in existing thermowell	Welded protective fitting manufactured from pipe material	Drilled thermowell manufactured from bar stock material
Process connection	Insertion in an existing thermowell. Functional reliability is only assured with an additional thermowell!	Screw-in thread, flange, compression fitting	Welded connections, screw-in thread, flange
Transport temperature / Storage temperature	-20 to 70 °C (-4 to 158 °F)		
Maximum temperature limits	(depending on the sensor and material selected, the lower temperature value in each case counts)		
Sensor	Thin film resistor: 400 °C (752 °F), wire wound resistor: 800 °C (1472 °F), thermocouples type K, N, J, E, L, S: 1600 °C (2912 °F)		
Material	316L / 1.4404	≤ 800 °C (1472 °F)	
(other materials on request)	316Ti / 1.4571	≤ 800 °C (1472 °F)	
	Inconel 600 / 2.4816	≤ 1100 °C (2012 °F)	≤ 1100 °C (2012 °F)
	Hastelloy C276 / 2.4819	—	≤ 1100 °C (2012 °F)
	Monel 400 / 2.4360	—	600 °C (1112°F)
	1.7335	—	≤ 540 °C (1004 °F)
	1.7380	—	≤ 570 °C (1058 °F)
	1.5415	—	≤ 500 °C (932 °F)
	E-CTFE	≤ 120 °C (248 °F)	≤ 120 °C (248 °F)
	Tantalum	≤ 250 °C (482 °F)	≤ 250 °C (482 °F)
Designation of gas connections		maximum 40 to 100 bar (580.15 to 1450.38 psi)	Maximum 700 bar (10152.64 psi)

### Note

The maximum temperatures and pressures specified are maximum values and do not take into consideration process-related stress. The effects of viscosity, medium velocity, pressure and temperature in the process usually cause these values to drop.

## Overview of measuring insets TSA101

### Industrial thermocouples and industrial resistance thermometers



- Flexible and vibration-resistant ABB mineral insulated cable. Sheath material for resistance thermometer made of stainless steel 1.4571 (316Ti) or nickel-basis alloy 2.4816 (alloy 600) for thermocouples.
- Sensors in accordance with IEC 60751 platinum resistance thermometer with measuring ranges of  $-196$  to  $800$  °C ( $-320.8$  to  $1472$  °F) in three tolerance classes or thermocouples in accordance with IEC 60584 and ANSI MC96.1 with measuring ranges of  $-40$  to  $1200$  °C ( $-40$  to  $2192$  °F), respectively in two tolerance classes.
- Type S thermocouple in an accuracy class of 0 to  $1600$  °C ( $32$  to  $2912$  °F).
- Fitted with single- or double sensors.
- Optimum clamping at the measuring inset's holding plate is assured by generous spring travel ( $10$  mm ( $0.39$  inch)) on the part of the clamping springs.
- Measuring inserts are available with outer diameters of  $3$  mm ( $0.12$  in),  $4.5$  mm ( $0.24$  in),  $6$  mm ( $0.24$  in) and for thermocouples also  $8$  mm ( $0.32$  in).  
 $8$  mm ( $0.32$  in) tip with sleeve and  $10$  mm ( $0.39$  in) tip with sleeve

M = Measuring inset length

#### Legend:

TSP311:  $M = U + K + 40$  mm

TSP321:  $M = N + 40$  mm

TSP331:  $M = L + K + 40$  mm

K = Extension tube length

U = Installation length

N = Nominal length

L = Thermowell length

## Installation instructions

The usual way of ensuring that thermal measurements are accurate is to comply with the minimum insertion depth of the temperature sensor. Ideally, the sensor on a thermometer should be located in the center of the pipe.

### Recommended installation length

To avoid heat dissipation errors.

Medium	Installation length
Fluids	8 to 10 × Ø thermowell tip
Gases	10 to 15 × Ø thermowell tip

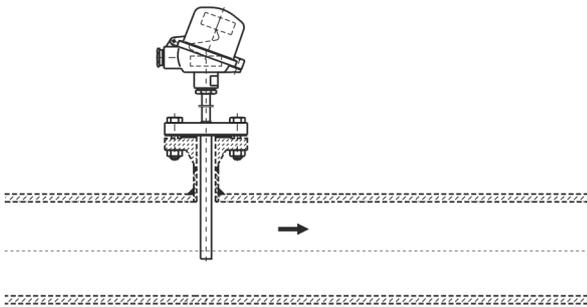


Figure 1: Recommended installation length

### Insufficient nominal diameter

In the case of pipelines with very small nominal diameters, insertion inside an elbow pipe is recommended. The temperature sensor is set in opposition to the flow direction of the medium. Inserting the temperature sensor with an adapter at an angle of < 45° against the flow direction can also distort measurement results.

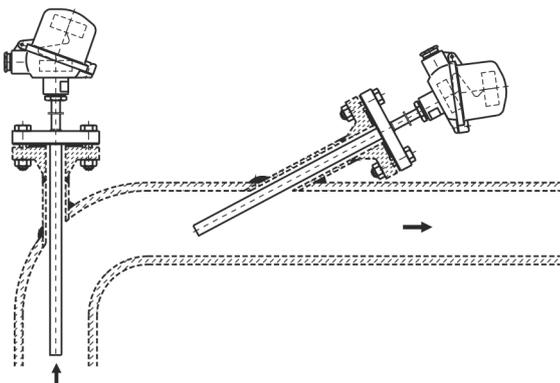


Figure 2: Insufficient nominal diameter

## Specification

### Resistance thermometer

The use of a mineral insulated cable and special installed measuring elements ensure very high vibration resistance of all measuring insets of the TSP temperature sensors. The acceleration values of 30 m/sec<sup>2</sup> (3 g), defined for already increased requirements in accordance with the standard IEC 60751, are exceeded by all measuring inset types for TSP temperature sensors.

The optimally suitable combination of measuring range, diameter, accuracy, and vibration resistance can be taken from the following tables.

### Thin film resistor (TF) – base version

	Meas. range	Vibration resistance
Class B	-50 to 400 °C (-58 to 752 °F)	100 m/sec <sup>2</sup> (10 g) at 10
Class A	-30 to 300 °C (-22 to 572 °F)	to 500 Hz
Class AA	0 to 100 °C (32 to 212 °F)	

	Single sensor			Double sensor		
	2-W	3-W	4-W	2-W	3-W	4-W
3.0 mm, class B	●	●	●			
3.0 mm, class A		●	●			
3.0 mm, class AA		●	●			
4.5 mm, class B	●	●	●			
4.5 mm, class A		●	●			
4.5 mm, class AA		●	●			
6.0 mm, class B	●	●	●	●	●	●
6.0 mm, class A		●	●		●	●
6.0 mm, class AA		●	●		●	●

## ... Specification

### Thin film resistor (TF) – increased vibration resistance

	Meas. range	Vibration resistance
Class B	-50 to 400 °C (-58 to 752 °F)	600 m/sec <sup>2</sup> (60 g) at 10
Class A	-30 to 300 °C (-22 to 572 °F)	to 500 Hz
Class AA	0 to 100 °C (32 to 212 °F)	

	Single sensor			Double sensor		
	2-W	3-W	4-W	2-W	3-W	4-W
3.0 mm, class B	●	●	●			
3.0 mm, class A		●	●			
3.0 mm, class AA		●	●			
6.0 mm, class B	●	●	●	●	●	●
6.0 mm, class A		●	●		●	●
6.0 mm, class AA		●	●		●	●

### Wire wound resistor (WW) – extended measuring range

	Meas. range	Vibration resistance
Class B	-196 to 800 °C (-320.8 to 1472 °F)	100 m/sec <sup>2</sup> (10 g) at 10 to 500 Hz
Class A, single WW	-100 to 450 °C (-148 to 842 °F)	
Class A, double WW	0 to 250 °C (32 to 482 °F)	

	Single sensor			Double sensor		
	2-W	3-W	4-W	2-W	3-W	4-W
3.0 mm, class B	●	●	●	●	●	
3.0 mm, class A		●	●		●	
4.5 mm, class B	●	●	●	●	●	
4.5 mm, class A		●	●		●	
6.0 mm, class B	●	●	●	●	●	●
6.0 mm, class A		●	●		●	●

### Wire wound resistor (WW) – extended measuring range, increased vibration resistance

	Meas. range	Vibration resistance
Class B	-196 to 600 °C (-320.8 to 1112 °F)	600 m/sec <sup>2</sup> (60 g) at 10 to 500 Hz
Class A, single WW	-100 to 450 °C (-148 to 842 °F)	
Class A, double WW	0 to 250 °C (32 to 482 °F)	

	Single sensor			Double sensor		
	2-W	3-W	4-W	2-W	3-W	4-W
6.0 mm, class B	●	●	●	●	●	●
6.0 mm, class A		●	●		●	●

### Length specifications for the tip of the measuring inset

The following table shows the minimum immersion length, the temperature-sensitive length and the non-flexible length at the tip of the measuring inset.

Type	minimum immersion length	Temperature-sensitive length	Non-flexible length
Basic design	70 mm (2.75 in)	7 mm (0.28 in)	30 mm (1.18 in)
Increased vibration resistance	70 mm (2.75 in)	10 mm (0.39 in)	40 mm (1.57 in)
Extended measuring range, increased vibration resistance	70 mm (2.75 in)	50 mm (1.97 in)	60 mm (2.36 in)

### Accuracy classes of measurement resistors in accordance with IEC 60751

Both thin film resistors and wire wound resistors in accordance with IEC 60751 can be used across the entire range of application. Subsequently, only the accuracy class of the temperature range used can remain valid.

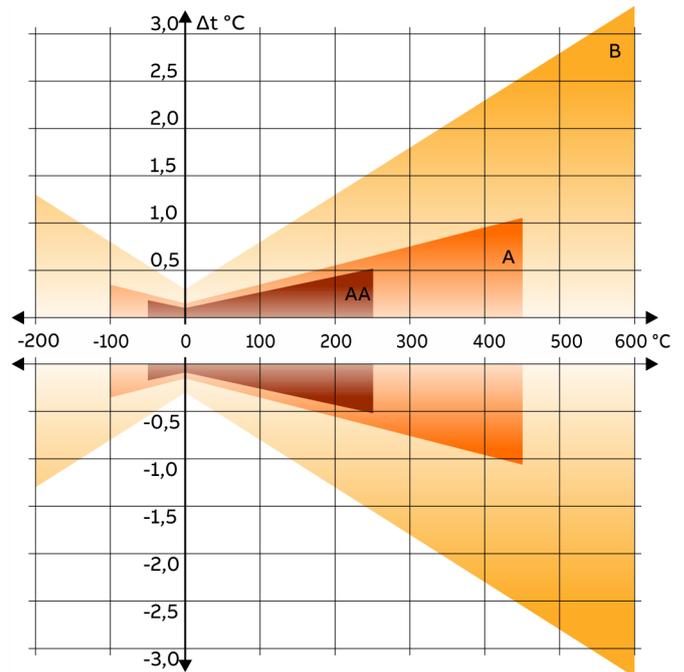
Example: A sensor of class AA is used at 290 °C (554 °F). After this albeit brief application, class A applies for this sensor.

#### Thin film resistor (TF), built-in

Class B	$\Delta t = \pm (0.30 + 0.0050 \times [t])$	-50 to 400 °C (-58 to 752 °F)
Class A	$\Delta t = \pm (0.15 + 0.0020 \times [t])$	-30 to 300 °C (-22 to 572 °F)
Class AA	$\Delta t = \pm (0.10 + 0.0017 \times [t])$	0 to 100 °C (32 to 212 °F)

#### Wire wound resistor (WW), built-in

Class B	$\Delta t = \pm (0.30 + 0.0050 \times [t])$	-196 to 600 °C (-320.8 to 1112 °F)
Class A	$\Delta t = \pm (0.15 + 0.0020 \times [t])$	-100 to 450 °C (-148 to 842 °F)



Colored areas: Temperature range in accordance with IEC 60751 (WW)

Figure 3: Graphical representation of accuracy classes

### Measuring errors with two-wire circuits

The electrical resistance of the copper inner conductor for the measuring inset affects the measured value for two-wire circuits and must be taken into consideration. It depends on the diameter and length of the measuring inset.

If the error cannot be compensated metrologically, the following reference values shall apply:

- Ø Measuring inset 3.0 mm: (0.281 Ω/m ⇒ 0.7 °C/m)
- Ø Measuring inset 6.0 mm: (0.1 Ω/m ⇒ 0.25 °C/m)

It is for this reason that ABB supplies three-wire / four-wire circuits as standard.

## ... Specification

### Thermocouples

The accuracy classes of the thermocouples are in accordance with the IEC 60584 international standard. On request, ABB also supplies in accordance with ANSI MC96.1 and DIN 43710. Since the values of both standards differ from each other only very slightly at low temperatures (up to approx. 300 °C(572 °F)), ABB recommends using thermocouples in accordance with IEC 60584. The tolerance specifications are presented in the table 'Accuracy classes in accordance with IEC 60584'

The following table shows the temperature-sensitive length, the minimum immersion length, and the non-flexible length at the tip of the temperature sensor.

Type	minimum immersion length	Temperature-sensitive length	Non-flexible length
Vibration-resistant up to 600 m/sec <sup>2</sup> (60 g)	70 mm (2.76 in)	7 mm (0.28 in)	30 mm (1.18 in)

	1K	2K	3K	1J	2J	1L*	2L*	1N	2N	1T	2T	1E	2E	1S	2S
3.0 mm, class 2	●	●		●	●	●	●	●	●						
3.0 mm, class 1	●	●		●	●			●	●						
4.5 mm, class 2	●	●													
4.5 mm, class 1	●	●													
6.0 mm, class 2	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
6.0 mm, class 1	●	●		●	●			●	●	●	●	●	●		

\* Tolerance in accordance with DIN 43710

### Accuracy classes in accordance with IEC 60584, DIN 43710 and ANSI MC96.1

IEC 60584	Class (CL)	Temperature range	Maximum measuring error
K (NiCr-Ni), N (NiCrSi-NiSi)	2	-40 to 333 °C (-40 to 631.4 °F)	±2.5 °C (±4.5 °F)
		333 to 1200 °C (631.4 to 2192 °F)	±0.0075 × [t]
	1	-40 to 375 °C (-40 to 707 °F)	±1.5 °C (±2.7 °F)
		375 to 1000 °C (707 to 1832 °F)	±0.004 × [t]
J (Fe-CuNi)	2	-40 to 333 °C (-40 to 631.4 °F)	±2.5 °C (±4.5 °F)
		333 to 750 °C (631.4 to 1382 °F)	±0.0075 × [t]
	1	-40 to 375 °C (-40 to 707 °F)	±1.5 °C (±2.7 °F)
		375 to 750 °C (707 to 1382 °F)	±0.004 × [t]
T (Cu-CuNi)	2	-40 to 133 °C (-40 to 271.4 °F)	±1.0 °C (±1.8 °F)
		133 to 350 °C (271.4 to 662 °F)	±0.0075 × [t]
	1	-40 to 125 °C (-40 to 257 °F)	±0.5 °C (±0.9 °F)
		125 to 350 °C (257 to 662 °F)	±0.005 × [t]
S (Pt10%Rh-Pt)	2	0 to 600 °C (32 to 1112 °F)	±1.5 °C (±2.7 °F)
		600 to 1600 °C (1112 to 2912 °F)	±0.0025 × [t]
E (NiCr-CuNi)	2	-40 to 333 °C (-40 to 631.4 °F)	±2.5 °C (±4.5 °F)
		333 to 900 °C (631.4 to 1652 °F)	±0.0075 × [t]
	1	-40 to 375 °C (-40 to 707 °F)	±1.5 °C (±2.7 °F)
		375 to 800 °C (707 to 1472 °F)	±0.004 × [t]

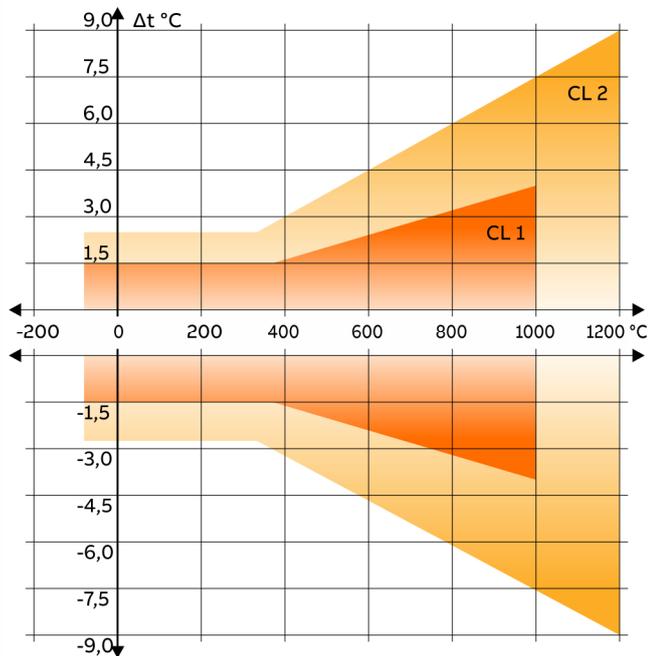


Figure 4: Graphical representation of accuracy classes using type K and N in accordance with IEC 60584 as examples. See tables for other types.

DIN 43710	Temperature range	Maximum measuring error
L (Fe-CuNi)	50 to 400 °C (122 to 752 °F)	±3.0 °C (±5.4 °F)
	400 to 900 °C (752 to 1652 °F)	±0.0075 × [t]

ANSI MC 96.1	Class (CL)	Temperature range	Maximum measuring error
K (NiCr-Ni), N (NiCrSi-NiSi)	Standard	0 to 293 °C (32 to 559.4 °F)	±2.2 °C (±3.96 °F)
		293 to 1250 °C (559.4 to 2282 °F)	±0.0075 × [t]
	Special	0 to 275 °C (32 to 527 °F)	±1.1 °C (±1.98 °F)
		275 to 1250 °C (527 to 2282 °F)	±0.0040 × [t]
J (Fe-CuNi)	Standard	0 to 293 °C (32 to 559.4 °F)	±2.2 °C (±3.96 °F)
		293 to 750 °C (559.4 to 1382 °F)	±0.0075 × [t]
	Special	0 to 275 °C (32 to 527 °F)	±1.1 °C (±1.98 °F)
		275 to 750 °C (527 to 1382 °F)	±0.0040 × [t]

### Insulation resistance of measuring inset

The insulation resistance is measured between the outer sheath and measuring loop. If there are two measuring loops, the insulation resistance between both measuring loops is also measured.

Thanks to a special process used during manufacturing, ABB measuring insets can boast outstanding insulation values even at high temperatures.

#### Insulation resistance $R_{iSO}$

≥ 500 MΩ with a ambient temperature range from 15 to 35 °C (59 to 95 °F)

#### Air humidity

< 80 %

## Thermowells

### Thermowell functions

- Protection against aggressive media, high process pressures, and high medium velocity
- Replacement or recalibration of the sensor element without interrupting the process

Depending on the medium, temperature and process pressure, several different designs and materials are available.

The thermowells are divided into two categories:

- Welded protective fittings manufactured from pipe material for TSPX21
- Drilled thermowells manufactured from bar stock material for TSPX31

Available in accordance with DIN 43772 or ABB standard.

### Use in contact with food

Selected welded and drilled thermowells are permitted for use with food in accordance with EU regulations no. 1935 and no. 2023. In this context, this involves the following thermowells:

Welded thermowells:

- Flange thermowell, straight (DIN 43772, Form 2F)
- Screw-in thermowell, straight (DIN 43772, Form 2G)
- Flange thermowell with stepped tip 9 mm (0.36 in) (ABB Form 2FS/9)
- Screw-in thermowell with stepped tip 9 mm (0.36 in) (ABB Form 2GS/9)

Drilled thermowells:

- Weld-in thermowell manufactured from bar stock material, (DIN 43772, Form 4)
- Flange thermowell manufactured from bar stock material, (DIN 43772, Form 4F)

The following thermowell materials are possible:

- Stainless steel 1.4571 (ASTM 316Ti)
- Ni alloy 2.4819 (Hastelloy C-276)
- Ni alloy 2.4610 (Hastelloy C-4)

Other thermowells and materials available on request.

### Use in highly aggressive media

A special coating of PFA or ECTFE with a standard coat thickness of 0.5 mm (0.02 in) can be applied for the corresponding use.

### Use in highly corrosive applications

For thermowells with flange, a tantalum sheath can be applied for the corresponding usage. The tantalum sleeve is brazed to the flange in two points.

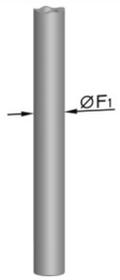
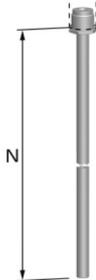
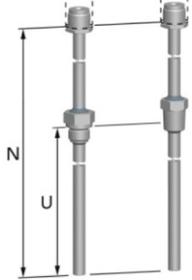
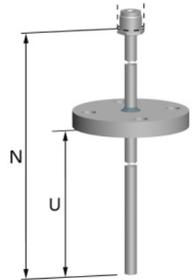
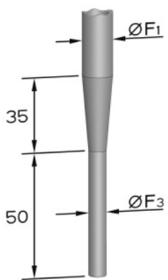
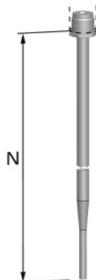
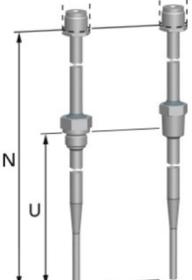
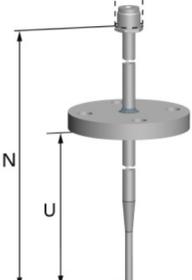
If required, contact your ABB partner.

### Response times in accordance with IEC 60751 and IEC 60584

The thermowell used in each application and the thermal contact between thermowell and measuring inset have an impact on the response times of TSP temperature sensors. In the case of TSPX21 and TSPX31 temperature sensors, the design of the thermowell tip has been adapted to the measuring inset. This maximizes heat transmission. The following table shows typical response times for the SensyTemp TSP series, measured in accordance with IEC 60751 in water with 0.4 m/s and a temperature rise from 25 °C (77 °F) to 35 °C (95 °F).

Thermowell form	Diameter [mm]	In water 0.4 m/s	
		t <sub>0,5</sub>	t <sub>0,9</sub>
<b>Resistance thermometer</b>			
2, 2G, 2F, 2G0	9 × 1	23	64
	11 × 2	25	77
3, 3G, 3F	12 / 9 mm tip	15	38
2S, 2GS, 2FS, 2GS0	12 / 6 mm tip	21	55
<b>Thermocouples</b>			
2, 2G, 2F, 2G0	9 × 1	10	24
	11 × 2	12	28
3, 3G, 3F	12 / 9 mm tip	12	24
2S, 2GS, 2FS, 2GS0	12 / 6 mm tip	6	14
	14 / 6 mm tip	6	14

## Welded thermowells (TSP321)

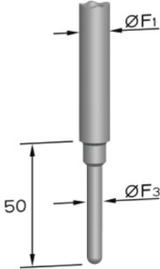
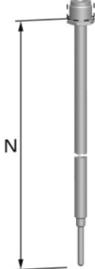
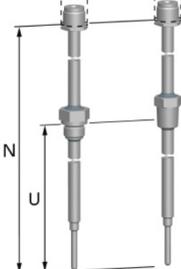
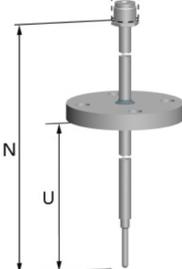
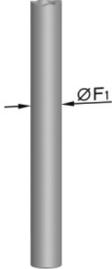
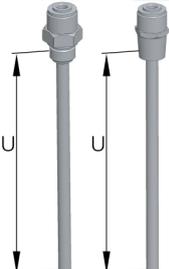
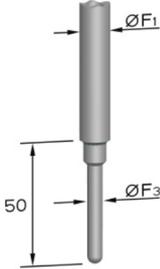
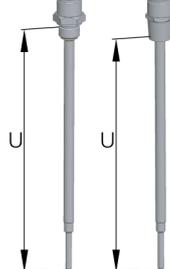
Straight shaft	DIN 43772 – form 2	DIN 43772 – form 2G	DIN 43772 – form 2F
	M24 × 1.5 head connection		
			
1.4571/316Ti	F1 = 12, 14 mm	F1 = 9, 11, 12, 14 mm	F1 = 11, 12, 14 mm
1.4404/316L	F1 = 12, 14 mm	F1 = 12, 14 mm	F1 = 12, 14 mm
2.4819/C-276	—	F1 = 13.7 mm*	F1 = 13.7 mm**
Measuring inset	Ø 6 mm	Ø 6 mm	Ø 6 mm
Tapered tip***	DIN 43772 – form 3	DIN 43772 – form 3G	DIN 43772 – form 3F
	M24 × 1.5 head connection		
			
1.4571/316Ti	F1/F3 = 12/9, 16/10 mm	F1/F3 = 12/9 mm	F1/F3 = 12/9, 16/10 mm
1.4404/316L	F1/F3 = 12/9 mm	F1/F3 = 12/9 mm	F1/F3 = 12/9 mm
Measuring inset	Ø 6 mm	Ø 6 mm	Ø 6 mm

\* Only with G½A, ½" NPT thread

\*\* Flange 1.4571/316Ti, flange disc 2.4819/C-276

\*\*\* With a diameter of the tapered tip of 9 mm, the bottom plug is welded in accordance with the NAMUR recommendation. The effective diameter is approx. 10 mm.

## ... Thermowells

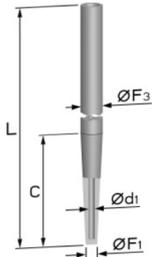
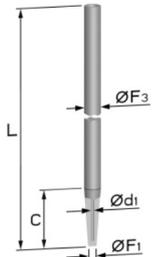
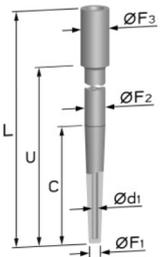
Stepped tip	ABB – form 2S	ABB – form 2GS	ABB – form 2FS
M24 × 1.5 head connection			
			
1.4571/316Ti	F1/F3 = 12/6, 14/6 mm	F1/F3 = 11/6, 12/6, 14/6 mm	F1/F3 = 11/6, 12/6, 14/6 mm
1.4404/316L	F1/F3 = 12/6, 14/6 mm	F1/F3 = 12/6, 14/6 mm	F1/F3 = 12/6, 14/6 mm
2.4819/C-276	—	F1/F3 = 13.7/6 mm*	F1/F3 = 13.7/6 mm**
Measuring inset	Ø 3 mm	Ø 3 mm	Ø 3 mm
Straight shaft, without extension tube	ABB – form 2G0	Recessed tip, without extension tube	ABB – form 2GS0
M24 × 1.5 head connection		M24 × 1.5 head connection	
			
1.4571/316Ti	F1 = 9, 11, 12 mm*	1.4571/316Ti	F1/F3 = 11/6, 12/6 mm*
Measuring inset	Ø 6 mm	Measuring inset	Ø 3 mm

\* Only with G½A, ½" NPT thread

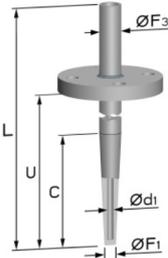
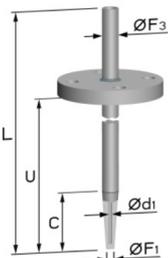
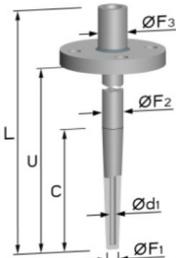
\*\* Flange 1.4571/316Ti, flange disc 2.4819/C-276

Other diameters and materials available on request.

## Drilled thermowells (TSP331)

Weld-in thermowell	DIN 43772 – form 4	DIN 43772 – form 4	ABB – form PW
Extension tube connection	M18 × 1.5	M14 × 1.5	½ in NPT
			

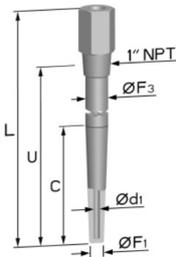
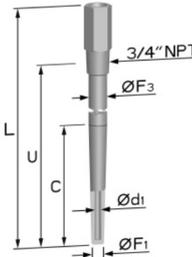
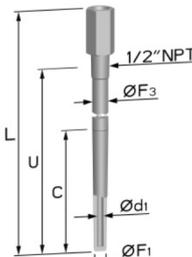
Material	1.4404/316L; 1.4571/316Ti; 1.7335/13CrMo4-5; 1.5415/15Mo3 1.4876/Incoloy® 800; 2.4360/Monel® 400 2.4816/Inconel® 600; 2.4819/C-276						
F3/F2/F1	d1	24h7/12.5 mm	7 mm	18h7/9 mm	3.5 mm	32/23/13.5 mm	7 mm
Measuring inset		Ø 6 mm		Ø 3 mm		Ø 6 mm	

Flange thermowell	DIN 43772 – form 4F	DIN 43772 – form 4FS	ABB – form PF
Extension tube connection	M18 × 1.5	M14 × 1.5	½ in NPT
			

Material	1.4404/316L; 1.4571/316Ti 1.4404/316L; 1.4571/316Ti 1.4876/Incoloy® 800; 2.4360/Monel® 400* 2.4816/Inconel® 600; 2.4819/C-276*						
F3/F2/F1	d1	24/12.5 mm	7 mm	18/9 mm	3.5 mm	32/23/13.5 mm	7 mm
Measuring inset		Ø 6 mm		Ø 3 mm		Ø 6 mm	

\* 1.4876/Incoloy® 800; 2.4360/Monel® 400; 2.4816/Inconel® 600; 2.4819/C-276 with flange in 1.4571/316Ti and flange disc

## ... Thermowells

Screw-in thermowell	ABB – form PS		ABB – form PS		ABB – form PS		
Extension tube connection	½ in NPT; WAF 36		½ in NPT; WAF 27		½ in NPT; WAF 27		
							
<b>Material</b>	1.4404/316L; 1.4571/316Ti; 1.4876/Incoloy® 800; 2.4360/Monel® 400; 2.4816/Inconel® 600; 2.4819/C-276						
<b>F3/F1</b>	<b>d1</b>	25/16 mm	7 mm	20/13.5 mm	7 mm	17/13.5 mm	7 mm
<b>Measuring inset</b>		Ø 6 mm		Ø 6 mm		Ø 6 mm	

Other diameters and materials available on request.

### Standard lengths

Welded thermowells mm (in)		
Form	N = 230 (9.055)	U = 100 (3.94)
2; 2G; 2F;	N = 290 (11.42)	U = 160 (6.30)
3; 3G; 3F;	N = 380 (14.96)	U = 250 (9.84)
2S; 2GS; 2FS	N = 530 (20.87)	U = 400 (15.75)
Drilled thermowells mm (in)		
Form 4	L = 140 (5.51)	C = 65 (2.56)
	L = 200 (7.87)	C = 65 (2.56)
	L = 200 (7.87)	C = 125 (4.92)
	L = 260 (10.24)	C = 125 (4.92)
	L = 410 (16.14)	C = 275 (10.83)
Form 4S	L = 110 (4.33)	C = 65 (2.65)
	L = 140 (5.51)	C = 65 (2.65)
Form PW; PF; PS	U = 100 (3.94), 150 (5.91), 200 (7.87), 250 (9.84), 300 (11.81), 350 (13.78)	L = U + 65 (2.56)
Form 4F	U = 130 (5.12), L = 200 (7.87)	C = 65 (2.56)
	U = 190 (7.48), L = 260 (10.24)	C = 125 (4.92)
	U = 340 (13.39), L = 410 (16.14)	C = 275 (10.83)
Form 4FS	U = 130 (5.12), L = 200 (7.87)	C = 65 (2.65)

### Pressure and vibration resistance of thermowell

The permissible compressive loads for thermowells at various temperatures are illustrated in the following figures (thermowells conforming to DIN 43772). The curves can also be applied to identical thermowell models.

#### Thermowell form 2 (material 1.4571)

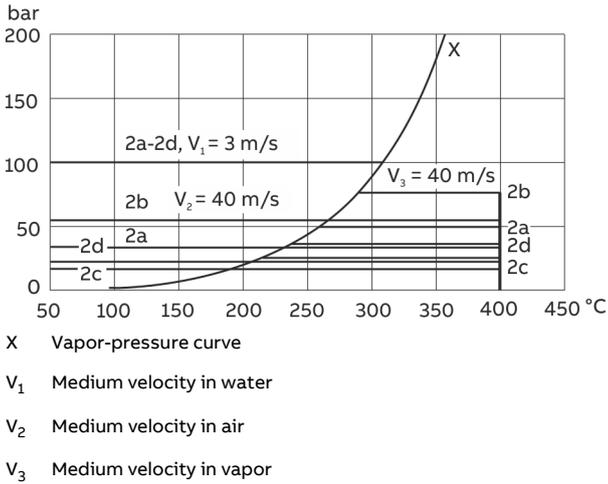


Figure 5: Thermowell Form 2

Curve	Installation length (mm)	Thermowell diameter (mm)
2a	250	11
2b	250	14
2c	400	11
2d	400	14

#### Thermowell form 3 (material 1.4571)

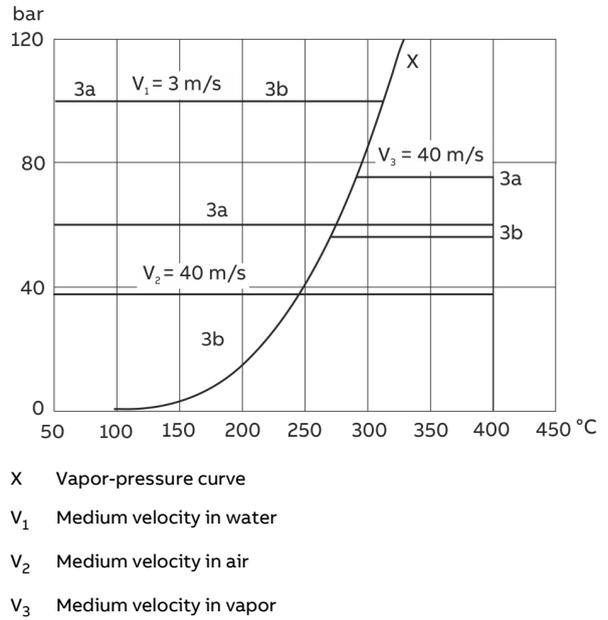
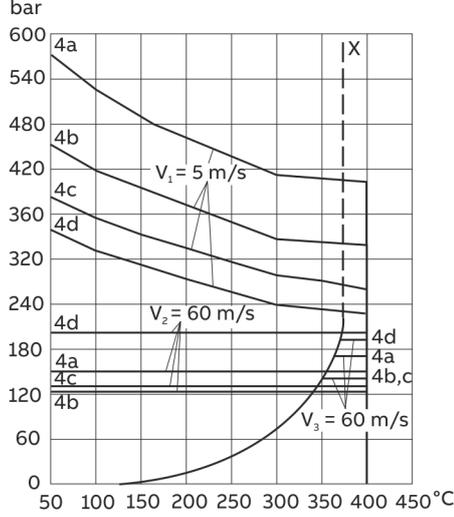


Figure 6: Thermowell Form 3

Curve	Installation length (mm)	Thermowell diameter (mm)
3a	225	12/9
3b	285	12/9

### ... Thermowells

Thermowell form 4 (material 1.4571)



- X Vapor-pressure curve
- V<sub>1</sub> Medium velocity in water
- V<sub>2</sub> Medium velocity in air
- V<sub>3</sub> Medium velocity in vapor

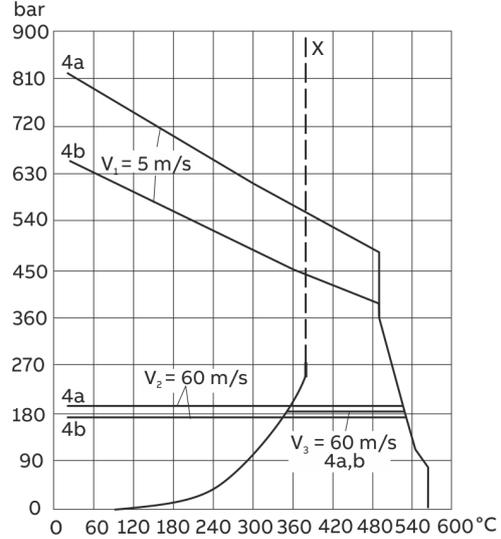
Figure 7: Thermowell Form 4

Curve	Installation length (mm)	Thermowell diameter (mm)
4a	65	18
4b	125	24
4c	125	26
4d	125	32

**Note**

The diagrams above have been taken from DIN 43772. They are based on the Dittrich calculation model. They do not take possible vibration caused by vortex excitation of the flowing medium into account. ABB's standard thermowells are sufficiently robust for most industrial applications provided that design, material, and length are properly selected. Most thermowell failures are caused by flow-related vibration. For this reason, ABB offers a stress analysis for ABB thermowells, based on the respective usage parameters.

Thermowell form 4 (material 1.7335 and 1.7380))



- X Vapor-pressure curve
- V<sub>1</sub> Medium velocity in water
- V<sub>2</sub> Medium velocity in air
- V<sub>3</sub> Medium velocity in vapor

Figure 8: Thermowell Form 4

Curve	Installation length (mm)	Thermowell diameter (mm)
4a	65	18
4b	125	24

The stress analysis conforms to ASME PTC 19.3-2010. It is based on recognized theoretical methods and is intended to support thermowell selection for critical applications. It is not, however, a guarantee against failure of the thermowell. Given the relatively unreliable computational estimation of the natural frequency of a thermowell and taking the numerous influencing factors into account, experimental testing is recommended in critical cases. For more detailed information about thermowell loads and calculation methods, please see DIN 43772.

## Process connections

### SensyTemp TSP321 temperature sensor

Plug-in thermowells, welded	Sliding connection
DIN 43772 – form 2, straight shaft	G½ in A, ½ in NPT
DIN 43772 – form 3, tapered tip	
ABB – form 2S, stepped tip	

#### Note

In principle, ABB supplies compression fittings made from stainless-steel 1.4571 without material certification in accordance with EN 10204.

Screw-in thermowells, welded	Fixed connection
DIN 43772 – form 2G, straight shaft	G¾ in A, G½ in A, G¾ in A, G1 in A, ½ in NPT, ¾ in NPT, 1 in NPT
DIN 43772 – form 3G, tapered tip	M20 × 1,5, M27 × 2,
ABB – form 2GS, stepped tip	½ in BSPT, ¾ in BSPT, 1 in BSPT
ABB – form 2G0, without extension tube	G½ in A, ½ in NPT
ABB – form 2GS0, without extension tube	
Stepped tip	

Flange thermowells, welded	Flange in accordance with EN 1092-1	Flange in accordance with ASME B16.5 TW	Tri-clamp flange
	Form B1/B2 sealing surface*	Form RF sealing surface*	BS4825
DIN 43772 – form 2F, straight shaft	DN 15, PN 10 to PN 40	Nominal diameter 1 in., Nominal pressure 150, 300, 600 lbs.	On request
	DN 20, PN 10 to PN 40		
DIN 43772 – form 3F, tapered tip	DN 25, PN 10 to PN 40, PN 63 to PN 100	Nominal diameter 1 ½ in, nominal pressure 150, 300, 600, 900/1500 lbs.	
	DN 32, PN 16 to PN 40, PN 63 to PN 100		
	DN 40, PN 10 to PN 40, PN 63 to PN 100		
ABB – form 2FS, stepped tip	DN 50, PN 6, PN 25 to PN 40	150, 300, 600, 900/1500 lbs.	
	PN 63 to PN 100		
	DN 80, PN 16		
	DN 100, PN 40		

\* Others available on request

## ... Process connections

### SensyTemp TSP331 temperature sensor

Weld-in thermowells, drilled			
Weld-in thermowells are available as DIN 43772 form 4 and ABB form PW. Other forms are available on request.			
Screw-in thermowells, drilled		Screw-in thread	
DIN 43772 – form 6 and ABB – form PS		G½ in A, ½ in NPT, ¾ in NPT, 1 in NPT, M20 × 1,5	
Flange thermowells, drilled	Flange in accordance with EN 1092-1 Form B1/B2 sealing surface*	Flange in accordance with ASME B16.5 TW Form RF sealing surface*	Tri-clamp flange BS4825
DIN 43772 – form 4F, F2 = 18 mm, 24 mm, 26 mm, thermowell manufactured from bar stock material	DN 25, PN 10 to PN 40, PN 63 to PN 100 DN 32, PN 16 to PN 40	Nominal diameter 1 in., Nominal pressure 150, 300, 600 lbs.	On request
ABB – form PF, thermowell manufactured from bar stock material	DN 40, PN 10 to PN 40, PN 63 to PN 100 DN 50, PN 6, PN 25 to PN 40, PN 63 to PN 100	Nominal diameter 1 ½ in, nominal pressure 150, 300, 600, 900 / 1500 lbs. DN 80, PN 16 Nominal diameter 2 in, Nominal pressure 150, 300, 600, 900/1500 lbs.	

\* Others available on request

#### Note

Other process connections are available on request. If required, contact your ABB partner.

### Extension tubes

The extension tube is the component between thermowell and connection head. It is used to bridge any existing insulation or serves as a cooling section between the temperature-sensitive electronics of the transmitter in the connection head and the process.

#### Impact of process and ambient temperature on the connection head

In addition to the ambient temperature, the impact of process temperature on the connection head and an optional integrated transmitter should generally be observed, and this especially in potentially explosive atmospheres.

At high process temperatures, excessive heat transfer to the connection head must be prevented by adjusting the length of the neck and using a suitably long extension tube. Additional improvement can be achieved by using suited insulation.

The neck length is defined as the distance between the surface of the process-media carrying system parts and the lower edge of the connection head in accordance with the following figure. It is greater or equal to the extension tube length. The neck length therefore represents the cooling section between the connection head and the process.

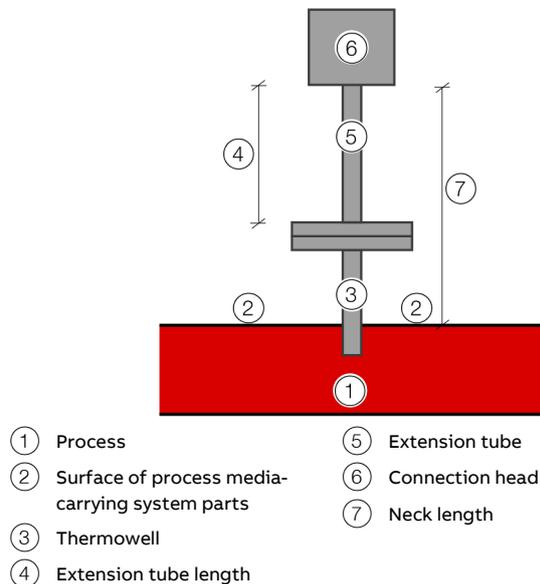


Figure 9: Definition of the neck length

**Affect of neck length on the temperature in the connection head**

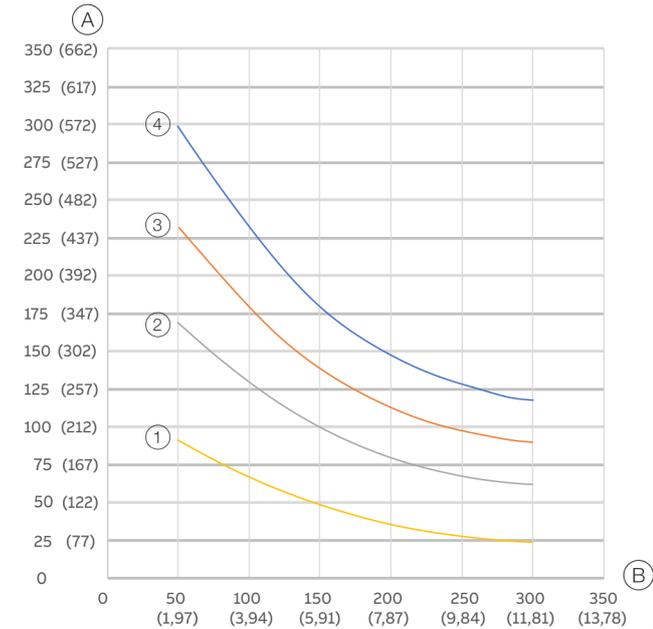
The temperature increase in the connection head as a function of the neck length for **operation without insulation** is shown below.

With regard to the heating behavior, there are three different groups of connection heads in different versions:

- Group 1: BEG, BBK head shape and similar head shapes
- Group 2: BUZ, BUS, AGS head shape and similar head shapes
- Group 3: AGL head and similar versions made from aluminum

The minimal neck length is a result of the maximum permissible temperature on or in the connection head. Depending on the selected version of the temperature sensor, this results in a minimum extension tube length.

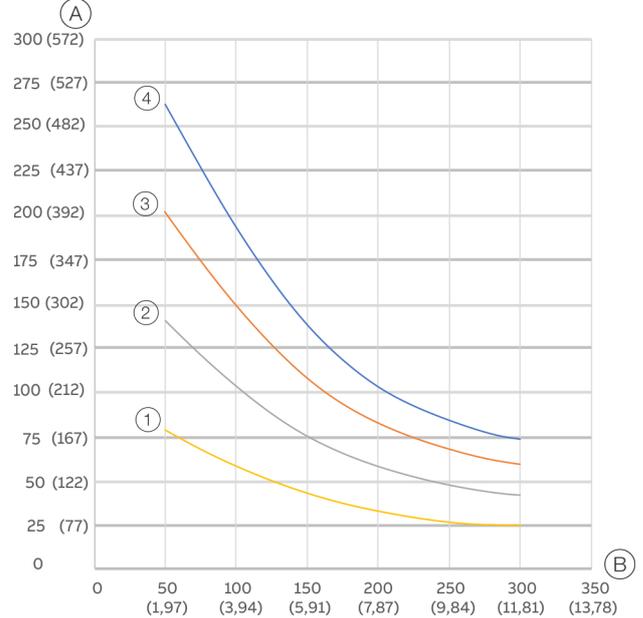
**Group 1: BEG, BBK head shape and similar head shapes**



- (A) Temperature rise in connection head °C (°F)
  - (B) Neck length mm (in)
- Surface temperature of process media-carrying system parts °C (°F), see Figure 9 on page 18**
- ① 250 (482)
  - ② 450 (842)
  - ③ 620 (1148)
  - ④ 800 (1472)

Figure 10: BEG, BBK head shape and similar head shapes

**Group 2: BUZ, BUS, AGS head shape and similar head shapes**

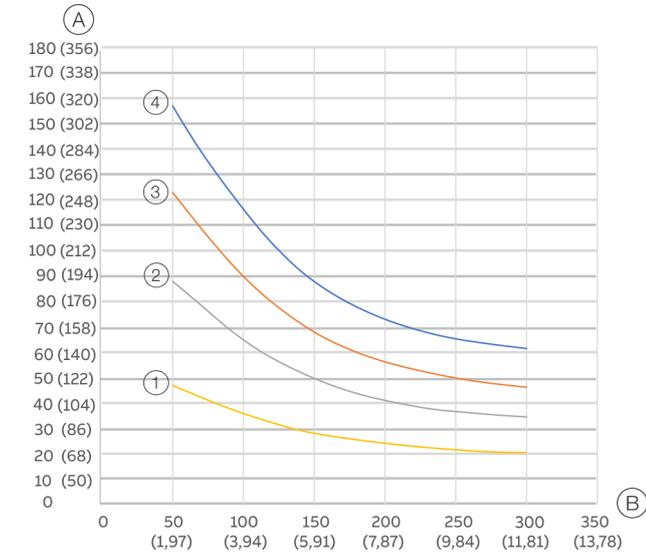


- (A) Temperature rise in connection head °C (°F)
  - (B) Neck length mm (in)
- Surface temperature of process media-carrying system parts °C (°F), see Figure 9 on page 18**
- ① 250 (482)
  - ② 450 (842)
  - ③ 620 (1148)
  - ④ 800 (1472)

Figure 11: BUZ, BUS, AGS head shape and similar head shapes

## ... Process connections

### Group 3: AGL head and similar versions made from aluminum



- (A) Temperature rise in connection head °C (°F)
  - (B) Neck length mm (in)
- Surface temperature of process media-carrying system parts °C (°F), see Figure 9 on page 18**
- ① 250 (482)
  - ② 450 (842)
  - ③ 620 (1148)
  - ④ 800 (1472)

Figure 12: AGL head and similar versions made from aluminum

### Note

- When determining the required extension tube length, you also need to guarantee that the maximum permissible ambient temperature for the device is considered correctly and is not up-scaled. The temperature range of -40 to 80° C (-40 to 176 °F) permissible in the area of electrical connections must be maintained for temperature classes T6...T1.
- The operator must make sure that the maximum permissible temperature of the transmitter electronics in the connection head is not up-scaled in intrinsically safe devices.

## Extension tube models

	Cylindrical screw-in thread	Conical screw-in thread	½" NPT - ½" NPT, not separable (nipple)	½" NPT - ½" NPT separable (nipple union)	½" NPT - ½" NPT separable (nipple-union-nipple)
Head connection	M24 × 1.5		½" NPT		
Thermowell connection	G¾", G½" M14 × 1.5; M18 × 1.5; M20 × 1.5;	½" NPT			
Extension tube diameter (Standard)	14 mm (0.55 in)				
Material	1.4571/316Ti				

## Connection heads

### Functions of the connection head

- Housing for a transmitter or a terminal block
- Protection of the connection area against adverse environmental influences

When the connection cable is fed into the connection head, a special cable guide cable automatically positions it inside the connection area. The flat base of the housing ensures optimum access to the connection area. A second cable entry is available as an option.

### Ambient temperature at connection head

Connection head without transmitter and without cable gland	-40 to 120 °C (-40 to 248 °F)
---	-------------------------------

Connection head with transmitter	-40 to 85 °C (-40 to 185 °F)
----------------------------------	------------------------------

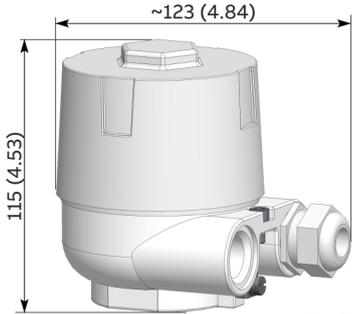
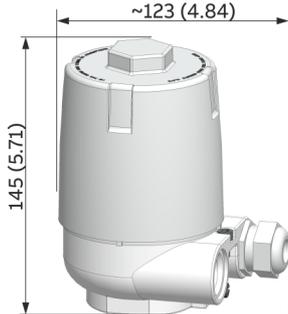
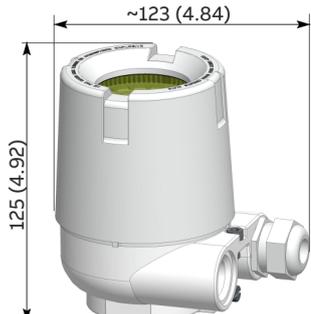
Connection head with LCD indicator	-20 to 70 °C (-4 to 158 °F)
------------------------------------	-----------------------------

#### Note

When using the device in potentially explosive atmospheres, restrictions of the ambient temperature range are possible. The notes in the corresponding declarations of conformity and type examination certificate should be complied with.

The plastic cable gland for cable outer diameters of 4 to 13 mm (0.16 to 0.51 inch) used as standard is suited for a temperature range of -40 to 70 °C (-40 to 158 °F). For temperatures outside this range, an appropriate cable gland can be installed.

The metal cable gland for Ex-d (flameproof enclosure) used as a standard for cable outer diameters of 3.2 to 8.7 mm (0.13 to 0.34 inch) covers a permissible temperature range of -40 to 120 °C (-40 to 248 °F).

Head form	AGL / AGS	AGLH / AGSH	AGLD / AGSD
			
Material	AGL: Aluminum, epoxy-coated AGS: Stainless steel (1.4404/316L)	AGLH: Aluminum, epoxy-coated AGSH: Stainless steel (1.4404/316L)	AGLD: Aluminum, epoxy-coated AGSD: Stainless steel (1.4404/316L)
Cover locking system	Screw-on cap		
Cable gland	M20 × 1.5, optional cable entry ½" NPT, without screwed connection		
IP rating	IP 66 / IP67		
Transmitter mounting	On the measuring inset	On the mounting bracket (mounting on the measuring inset available as an option)	On the measuring inset

Dimensions in mm (in)

## Transmitter

Installing a transmitter has the following advantages:

- Cost savings due to reduced wiring costs
- Amplification of the sensor signal directly at the measuring point and conversion to a standard signal (thereby increasing the signal's interference immunity).
- Option to install an LCD indicator in the connection head.
- SIL 2 with accordingly classified transmitter.

The output signal of a temperature sensor is determined by the selection of the corresponding transmitter. When using ABB transmitters, self-heating can be ignored.

The following output signals are available:

### Transmitter type

#### TTH200 HART®

4 to 20 mA, HART®



#### TTH300 HART®

4 to 20 mA, HART®



#### TTH300 PA

PROFIBUS PA®



#### TTH300 FF

FOUNDATION Fieldbus® H1



### Note

Further information on the transmitters listed above can be found in the data sheets DS/TTH200 and DS/TTH300.

## Type A and type AS LCD indicator

AGLD and AGSD connection heads are fitted with a digital LCD indicator. A suitable transmitter is connected via an add-on interface cable.

An LCD indicator with type AS display function suited for a combination with a TTH200. If the TTH300 transmitter is selected, the type A LCD indicator can also be used to configure the transmitter.

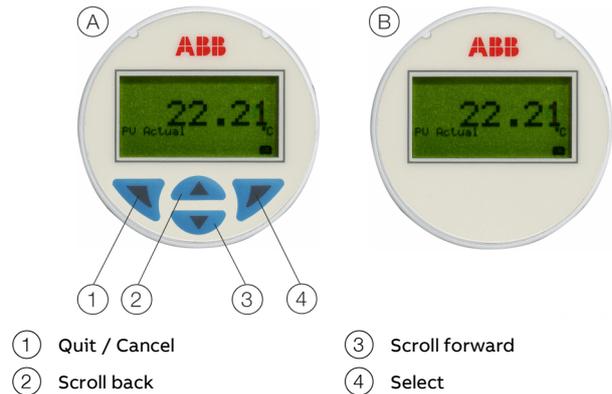


Figure 13: (A) LCD indicator Type A (B) LCD indicator Type AS

## Functional safety (SIL)

The SensyTemp TSP temperature sensor with SIL-certified transmitters installed at the factory are available with conformity in accordance with IEC 61508 for use in safety relevant applications up to SIL 3 (redundant).

When using a transmitter the device fulfills the requirements in accordance with SIL 2.

When using redundantly operated transmitters, the requirements in accordance with SIL 3 can be fulfilled.

Notices regarding functional safety of the TTx300 and TTx200 temperature transmitters can be found in the corresponding SIL-Safety Manual.

Information about temperature sensors without built-in electronics can be found in the operating instruction.

## Use in potentially explosive atmospheres in accordance with ATEX and IECEx

### Approvals

TSP3X1 temperature sensors are equipped with a wide range of approvals.

These range from metrological approvals to Ex-approvals for individual countries, ATEX certificates applicable throughout the EU and in Switzerland up to internationally recognized IECEx documents.

Specifically, these are:

- ATEX Ex i                      PTB 01 ATEX 2200 X
  - ATEX Ex d                      PTB 99 ATEX 1144 X
  - Dust explosion ta (Zone 20)      BVS 06 ATEX E 029
  - Ex na / Ex ec (Zone 2),      Manufacturer's declarations  
Dust ignition  
protection tc (Zone 22)
  - IECEx Ex i                      IECEx PTB 11.0111 X
  - IECEx Ex d                      IECEx PTB 12.0039 X
  - Dust explosion ta (Zone 20)      IECEx BVS 17.0065 X
  - GOST / EAC Ex i, Ex d
  - NEPSI Ex i, Ex d
  - Other approvals on request
- Additional information on the Ex-Certification of the devices and a list of standards including the dates of their issue with which the device is in conformity can be found in the (EU type) examination certificates or the manufacturer's declarations (at [www.abb.com/temperature](http://www.abb.com/temperature)).
  - Depending on the design, a specific marking in accordance with ATEX or IECEx applies.
  - The TSP3X1 temperature sensors are also available with several types of protection, such as Ex i and dust ignition protection (model TSP3X1-A4).  
In devices with several types of protection, observe the information in the 'Product identification' chapter in the operating or commissioning instruction before commissioning.

### Conditions for use in potentially explosive atmospheres

The operator assumes responsibility for the proper installation when replacing the measuring inset in a thermometer in accordance with the valid approval conditions. You need to provide ABB the data provided on the old sensor so that ABB can check the conformity of the ordered design with the initial delivery and the valid approvals.

### Thermal resistance

The following table lists thermal resistances for measuring insets with diameters of < 6.0 mm (0.24 in) and ≥ 6.0 mm (0.24 in). The values have been specified subject to the conditions 'Gas with a flow velocity of 0 m/s' and 'Measuring inset without or with an additional thermowell'.

Thermal resistance $R_{th}$	Measuring inset	Measuring inset
$\Delta t = 200 \text{ K/W} \times 0.038 \text{ W} = 7.6 \text{ K}$	$\varnothing < 6 \text{ mm}$	$\varnothing \geq 6 \text{ mm}$
	(0.24 in)	(0.24 in)
Without thermowell		
Resistance thermometer	200 K/W	84 K/W
Thermocouple	30 K/W	30 K/W
With thermowell		
Resistance thermometer	70 K/W	40 K/W
Thermocouple	30 K/W	30 K/W

K/W = kelvin per watt

### Temperature rise in the event of a fault

In the event of a fault, the temperature sensors will exhibit a temperature rise  $\Delta t$  as appropriate for the applied power. This temperature rise  $\Delta t$  must be taken into account when determining the maximum process temperature for each temperature class.

### Note

In the event of a fault (short-circuit), the dynamic short-circuit current that occurs in the measurement circuit for a matter of milliseconds is not relevant with regard to temperature rise.

The temperature rise  $\Delta t$  can be calculated using the following formula:  $\Delta t = R_{th} \times P_o$  [K/W x W]

- $\Delta t$  = Temperature rise
- $R_{th}$  = Thermal resistance
- $P_o$  = Output power of an additional connected transmitter

### Example:

Resistance thermometer diameter approximately 3 mm (0.12 in) without thermowell:

$$R_{th} = 200 \text{ K/W}$$

Temperature transmitter TTxx00  $P_o = 38 \text{ mW}$ , see also **Output power  $P_o$  with ABB transmitters** on page 24.

$$\Delta t = 200 \text{ K/W} \times 0.038 \text{ W} = 7.6 \text{ K}$$

## ... Use in potentially explosive atmospheres in accordance with ATEX and IECEx

Therefore, at transmitter output power  $P_o = 38$  mW the temperature rise in the event of a fault is approximately 8 K. This results in maximum feasible process temperatures  $T_{\text{medium}}$ , as presented in Table **Maximum process temperature T<sub>medium</sub> in Zone 0 and Zone 1** on page 24 .

### Note

For a higher output power  $P_o$  in case of a malfunction of more than 38 mW, but also for a generally higher output power of a connected transmitter of more than 38 mW, the temperature rise  $\Delta t$  must be recalculated.

### ATEX and IECEx 'Ex i' intrinsic safety

#### Note

For compliance with the maximum permissible temperature of the transmitter in the connection head for devices in intrinsically safe design, see section **Impact of process and ambient temperature on the connection head** on page 18.

In the zone of the electrical connections, the permissible ambient temperature range is  $-40$  to  $80^\circ\text{C}$  ( $-40$  to  $176^\circ\text{F}$ ). Suited thermowells in accordance with PTB 01 ATEX 2200 X or IECEx PTB 11.0111 X should be used.

### Electrical power limit Ex i

The TSP temperature sensors may only be operated in certified intrinsically safe category 'ia' or 'ib' circuits in the intrinsically safe Ex i type of protection.

The following electric values must not be up-scaled in the measurement current circuit of the temperature sensor:

$U_i$ (input voltage)	$I_i$ (input current)
30 V	101 mA
25 V	158 mA
20 V	309 mA

$P_i$  (inner power) = max. 0.5 W

Notice: for the internal power  $P_i$  of the sensor and the output power  $P_o$  of the connected transmitter, the following must apply:  $P_i \geq P_o$ .

Likewise the following must apply:  $U_i \geq U_o$  and  $I_i \geq I_o$ .

$L_i$  (inner inductance of the sensor): negligible

$C_i$  (inner capacitance of the sensor): negligible

The output values of a connected transmitter, both when mounting in the connection head and when mounting in the field, must not up-scale these electric values. The output values of ABB temperature transmitters (TTx300 and TTx200) are below these maximum values.

### Output power $P_o$ with ABB transmitters

Transmitter type	$P_o$
TTH200, TTF200, TTR200 HART	$\leq 29$ mW*
TTH300, TTF300 HART	$\leq 29$ mW**
TTH300, TTF300 PA	$\leq 38$ mW
TTH300, TTF300 FF	$\leq 38$ mW

\* as of HW-Rev. 1.12, previously  $P_o \leq 38$  mW

\*\* as of HW-Rev. 2.00, previously  $P_o \leq 38$  mW

The type examination certificates for the corresponding transmitter types contain all further information necessary to verify intrinsic safety ( $U_o$ ,  $I_o$ ,  $P_o$ ,  $L_o$ ,  $C_o$ , etc.).

### Maximum process temperature $T_{\text{medium}}$ in Zone 0 and Zone 1

To calculate the temperature classes for T3, T4, T5 and T6, deduct 5 K in each instance from the maximum surface temperature; for T1 and T2, deduct 10 K in each instance from this surface temperature.

For temperature  $T_{\text{medium}}$ , the temperature rise in the event of a fault of 8 K as calculated as an example in **Conditions for use in potentially explosive atmospheres** on page 23.

Temperature class	-5 K	-10 K	$T_{\text{medium}}$
T1 (450 °C (842 °F))	—	440 °C (824 °F)	432 °C (809.6 °F)
T2 (300 °C (572 °F))	—	290 °C (554 °F)	282 °C (539.6 °F)
T3 (200 °C (392 °F))	195 °C (383 °F)	—	187 °C (368.6 °F)
T4 (135 °C (275 °F))	130 °C (266 °F)	—	122 °C (251.6 °F)
T5 (100 °C (212 °F))	95 °C (203 °F)	—	87 °C (188.6 °F)
T6 (85 °C (185 °F))	80 °C (176 °F)	—	72 °C (161.6 °F)

### Flameproof (enclosure) 'Ex d'

SensyTemp temperature sensors TSP300 can be used with the 'Ex d - flameproof (enclosure)' type of protection in the following zones:

- With suited thermowell and connection head in Zone 1 / 0 (zone separation, thus measuring inset in Zone 0).
- With connection head but without thermowell, in Zone 1

Observe the connection conditions listed in the PTB 99 ATEX 1144 X or IECEx PTB 12.0039 X type examination certificate, in this regard also see the connection instructions in the operating instruction.

For the TSP300 with 'Ex d – flameproof (enclosure)' type of protection, the self-heating of the sensor in the event of a fault and if needed also during operation should be considered, see **Thermal resistance** on page 23.

The temperature class and the maximum permissible temperature of the measuring medium must be determined accordingly.

### Temperature data

Maximum permissible ambient temperature  $T_{amb}$  on the connection head\*:

Temperature class	Without transmitter	With transmitter
T1 ... T4	–40 to 120 °C (–40 to 248 °F)	–40 to 85 °C (–40 to 185 °F)
T6	–40 to 75 °C (–40 to 167 °F)	–40 to 67 °C (–40 to 152 °F)

\* Ambient temperatures can be limited depending on the temperature resistance of the cable entry used.

### Note

With an ambient temperature  $T_{amb}$  lower than –20 °C (–4 °F) and higher than 70 °C (158 °F), the readability of a display can longer be guaranteed.

Maximum permissible process temperature  $T_{medium}$ :

Temperature class	Use in Zone 0	Use in Zone 1
T1	358 °C (676.4 °F)	438 °C (820.4 °F)
T2	238 °C (460.4 °F)	288 °C (550.4 °F)
T3	158 °C (316.4 °F)	193 °C (379.4 °F)
T4	106 °C (222.8 °F)	128 °C (262.4 °F)
T5	78 °C (172.4 °F)	93 °C (199.4 °F)
T6	66 °C (150.8 °F)	78 °C (172.4 °F)

### Electric Data

The SensyTemp TSP300 (and TSP100) temperature sensors are available without integrated transmitters (e.g. for operation with ABB TTF200 or TTF300 transmitters) and with ABB TTH200 or TTH300 integrated transmitters.

In the 'Ex d – flameproof (enclosure)' type of protection, the following electric data for the supply circuit and the measurement current circuit must be observed.

### Supply circuit

Maximum voltage	$U_S = 30\text{ V}$
Maximum current	$I_S = 32\text{ mA}$ , limited by the upstream fuse (rated fuse current 32 mA)

### Measurement current circuit

Maximum voltage	$U_O = 6.5\text{ V}$
Maximum current	$I_O = 17.8\text{ mA}$
Maximum output power	$P_O = 29\text{ mW}$ (TTF200, TTH200)* $P_O = 38\text{ mW}$ (TTF300, TTH300)**

\* as of HW-Rev. 1.12, previously 38 mW

\*\* TTF300 HART, TTH300 HART as of HW-Rev. 2.00: 29 mW

The maximum output power  $P_O$  leads to a maximum temperature rise of 8 K, see **Thermal resistance** on page 23. For a higher output power  $P_O$ , the temperature rise must be recalculated.

## ... Use in potentially explosive atmospheres in accordance with ATEX and IECEx

### Dust explosion protection (protection through enclosure)

SensyTemp TSP300 temperature sensors can be used with the dust explosion protection type of protection in the following zones:

- Without transmitter or with TTH200 transmitter and without LCD indicator in Zone 20.
- With TTH300 transmitter or with integrated LCD indicator in Zone 21.

#### Note

Temperature sensors for use in Zone 20 are delivered without cable glands.

The connection conditions listed in the type examination certificate BVS 06 ATEX E 029 or IECEx BVS 17.0065 X should be observed.

The power feed can come from a power supply unit with an intrinsically-safe output current circuit of type of protection 'Ex ia' or 'Ex ib', or can also be non-intrinsically safe. In the case of non-intrinsically safe power feed, the maximum voltage in the supply circuit is  $U_s = 30 \text{ V}$  and the maximum current  $I_s = 32 \text{ mA}$ , limited by an upstream fuse (rated fuse current 32 mA).

The output circuit of the transmitter (sensor circuit) should be limited to a maximum permissible power loss in the measuring inset (sensor) of  $P_i = 0.5 \text{ W}$ .

The maximum power loss  $P_i = 38 \text{ mW}$  leads to a maximum temperature rise of 8 K, see **Thermal resistance** on page 23. For a higher power  $P_i$ , the temperature rise must be recalculated.

If in the dust explosion protection type of protection, the transmitter is supplied with power from a power supply unit which is designed as intrinsically safe in the 'Ex ia' or 'Ex ib' type of protection, a limitation of the power supply circuit by an upstream fuse is not required. In this case, the electric data of the transmitter used should be observed for the intrinsic safety type of protection. For ABB transmitters (TTH200, TTH300, TTF200, TTF300 and TTR200), see the 'Electric Data – Transmitter' section and the 'Type of protection intrinsic safety Ex ia IIC (Part 1)', '(... Part 2)' and '(... Part 3)' tables in the instructions of the respective devices.

For the highest value of thermal data for connection to an intrinsically-safe power supply unit of type of protection 'Ex ia / Ex ib'; refer to the "Thermal Data" table.

#### Note

When using two transmitters and / or measuring insets, the sum of the voltages, currents and outputs must not up-scale the values specified in the type examination certificate.

## Thermal data

	Approved ambient temperature at connection head	Approved process temperature at thermowell	Maximum temperature at the process connection on the connection head side	Maximum surface temperature at the connection head	Maximum surface temperature at the thermowell
Category 1D or Category 1/2D with intrinsically-safe transmitter with Ex ia type of protection installed	-40 to 85 °C (-40 to 185 °F)	-40 to 85 °C (-40 to 185 °F)	85 °C (185 °F)		133 °C (271.4 °F)
		-40 to 200 °C (-40 to 392 °F)*	164 °C (327.2 °F)		200 °C (392 °F)
	-40 to 85 °C (-40 to 185 °F)	-40 to 300 °C (-40 to 572 °F)*	251 °C (483.8 °F)		300 °C (572 °F)
		-40 to 400 °C (-40 to 752 °F)*	346 °C (654.8 °F)	120 °C (248 °F)	400 °C (752 °F)
Category 1D or Category 1/2D with installed transmitter with fuse protection by means of external fuse	-40 to 85 °C (-40 to 185 °F)	-40 to 85 °C (-40 to 185 °F)	85 °C (185 °F)		133 °C (271.4 °F)
		-40 to 200 °C (-40 to 392 °F)*	164 °C (327.2 °F)	133 °C (271.4 °F)**	200 °C (392 °F)
	-40 to 85 °C (-40 to 185 °F)	-40 to 300 °C (-40 to 572 °F)*	251 °C (483.8 °F)	150 °C (302 °F)***	300 °C (572 °F)
		-40 to 400 °C (-40 to 752 °F)*	346 °C (654.8 °F)		400 °C (752 °F)
Category 1D or category 1/2D Ex ia intrinsically-safe measuring loop, remote or non-intrinsically-safe transmitter by means of external fuse in the power feed circuit of the remote transmitter	-40 to 85 °C (-40 to 185 °F)	-40 to 85 °C (-40 to 185 °F)	85 °C (185 °F)	85 °C (185 °F)	133 °C (271.4 °F)
	-40 to 120 °C (-40 to 248 °F)	-40 to 200 °C (-40 to 392 °F)	200 °C (392 °F)	120 °C (248 °F)	200 °C (392 °F)
	-40 to 120 °C (-40 to 248 °F)	-40 to 300 °C (-40 to 572 °F)	251 °C (483.8 °F)	120 °C (248 °F)	300 °C (572 °F)
	-40 to 120 °C (-40 to 248 °F)	-40 to 400 °C (-40 to 752 °F)	346 °C (654.8 °F)	120 °C (248 °F)	400 °C (752 °F)

\* The user must take suited measures to make sure that the maximum permissible ambient temperature of 85 °C (185 °F) at the connection head is not up-scaled. In addition, the **Impact of process and ambient temperature on the connection head** on page 18 should be complied with.

\*\* Fitted with a transmitter with and without display.

\*\*\* Fitted with two transmitters.

### Non-sparking and increased safety as well as dust explosion protection

External measures must be made for the power supply circuit in order to prevent the rated voltage from being up-scaled by more than 40 % in the event of transient disturbances.

With the integrated TTH200 or TTH300 transmitter and temperature class T6, the maximum permissible ambient temperature is 56 °C (132.8 °F).

For the relation between ambient temperature and process temperature, see **Impact of process and ambient temperature on the connection head** on page 18. The lower limit of the ambient temperature is -40 °C (-40 °F).

Process temperature: max. 400 °C (752 °F) for II 3G  
max. 300 °C (572 °F) for II 3D

## Tests and certificates

In order to increase the safety and accuracy of the process, ABB offers various mechanical and electrical tests. The results are confirmed with certificates in accordance with EN 10204.

The following certificates are issued:

- Declaration of compliance 2.1 for order conformity
- Test report 2.2 for the following tests:
  - Material of wetted parts
  - Batch values of the thermocouple
  - Insulation resistance measurement at room temperature
- Inspection certificate 3.1 for the following tests:
  - Material confirmation for wetted parts
  - Visual, dimensional and function checks of temperature sensor
  - Helium leak test on the thermowell
  - X-ray test of thermowell for bore hole concentricity on request
  - X-ray test of weld seams
  - Ultrasonic test for bore hole concentricity
  - Dye penetration test at the weld seams of the thermowell
  - Compression test on the thermowell
  - Reference measurement at the measuring inset
- Inspection certificate 3.2 available on request

For measurements requiring extremely high accuracy, ABB offers a calibration of the temperature sensor in its own DAkkS-calibration laboratory.

With a DAkkS-calibration, a separate calibration certificate is provided for each temperature sensor.

Reference measurements and DAkkS-calibrations are conducted on the measuring inset, if necessary, with a transmitter.

In order to obtain accurate measurement results, a minimum length of the mineral insulated cable of the measuring inset should be adhered to:

- At very low temperatures (< -70 °C (-94 °F)): 300 mm
- At low to medium temperatures: 100 to 150 mm
- At temperatures over 500 °C (932 °F): 300 to 400 mm

Greater lengths allow additional measurement methods and simplify the measuring process. If you require any further information, please contact your local ABB partner.

In case of a reference measurements and DAkkS-calibration, the individual sensor characteristic of the temperature sensor can also be calculated and a suitable transmitter can be accordingly programmed using a freestyle characteristic. The measuring accuracy of the temperature sensor can be considerably improved by adjusting the transmitter to the sensor characteristics. To this end, the measurement must be conducted with at least three temperatures.

## Ordering Information

### NOTE

Order codes cannot be combined at will. Your ABB partner will be happy to answer any questions you might have regarding installation feasibility. All documentation, declarations of conformity, and certificates are available in ABB's download area.

### SensyTemp TSP311

Base model	TSP311	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
SensyTemp TSP311 Temperature Sensor, without thermowell, for heavy duty applications											
<b>Explosion Protection / Approvals</b>											
Without		Y0									
Intrinsic Safety ATEX II 1 G Ex ia IIC T6...T1 Ga or II 2 G Ex ib IIC T6...T1 Gb or II 1/2 G Ex ib IIC T6...T1 Ga/Gb		A1									
ATEX Dust Explosion Protection: Zone 20: II 1D Ex ta IIIC T133 ... T400 Da, Zone 20/21: II 1/2 D Ex ta/tb IIIC T133 ... T400 Da/Db		A3*									
ATEX Dust Explosion Protection resp. Intrinsic Safety (IS): Zone 20 / Zone 0: II 1D Ex ta IIIC T133 ... T400 Da resp. II 1 G Ex ia IIC T6...T1 Ga (Not for application in explosive hybrid mixtures)		A4*									
Flameproof enclosure ATEX II 1/2 G Ex db IIC T6/T4 Ga/Gb		A5									
Non-sparking and increased safety as well as dust explosion protection ATEX II 3 G Ex nA IIC T6...T1 Gc, ATEX II 3 G Ex ec IIC T6...T1 Gc und ATEX II 3 D Ex tc IIIB T133°C Dc		B1**									
ATEX Dust Explosion Protection resp. Flameproof Enclosure: Zone 20 / Zone 1/0: II 1D Ex ta IIIC T133 ... T400 Da resp. II 1/2 G Ex db IIC T6/T4 Ga/Gb (Not for application in explosive hybrid mixtures)		B5*									
ATEX Dust Explosion Protection: Zone 21: II 2D Ex tb IIIC T133 ... T400 Db		D5***									
ATEX Dust Explosion Protection resp. Intrinsic Safety (IS): Zone 21 / Zone 0: II 2D Ex tb IIIC T133 ... T400 Db resp. II 1 G Ex ia IIC T6...T1 Ga (Not for application in explosive hybrid mixtures)		D6***									
ATEX Dust Explosion Protection resp. Flameproof Enclosure: Zone 21 / Zone 1/0: II 2D Ex tb IIIC T133 ... T400 Db resp. II 1/2 G Ex db IIC T6/T4 Ga/Gb (Not for application in explosive hybrid mixtures)		D8***									
Intrinsic Safety IECEx ia IIC T6...T1 Ga		H1									
Intrinsic Safety IECEx ib IIC T6...T1 Gb or IECEx ib IIC T6...T1 Ga/Gb		H2									
Flameproof enclosure IECEx db IIC T6/T4 Ga/Gb		H5									
IECEx Dust Explosion Protection: Zone 20: Ex ta IIIC T133 ... T400 Da, Zone 20/21: Ex Ta/tb IIIC T133 ... T400 Da/Db		J9*									
IECEx Dust Explosion Protection: Zone 21: Ex tb IIIC T133 ... T400 Db		J5***									
Intrinsic Safety acc. NAMUR NE 24 and ATEX II 1 G Ex ia IIC T6...T1 Ga		N1									
GOST Russia - metrological approval		G1									
GOST Russia - metrological approval and EAC-Ex, Ex i - Zone 0		P2									
GOST Russia - metrological approval and EAC-Ex, Ex d		P3									
GOST Russia - metrological approval and EAC-Ex, dust ignition proof		P4									
GOST Kazakhstan - metrological approval		G3									
GOST Kazakhstan - metrological approval and EAC-Ex, Ex i - Zone 0		T2									
GOST Kazakhstan - metrological approval and EAC-Ex, Ex d		T3									
GOST Kazakhstan - metrological approval and EAC-Ex, dust ignition proof		T4									

\* not with TTH300, not with LCD indicator, transmitter with HART protocol only

\*\* Use in explosive hybrid mixtures (where explosive dusts and gases are present simultaneously) is not currently permitted in accordance with EN 60079-0 and EN 60079-31

\*\*\* transmitter with HART protocol only

Continued see next page

## ... Ordering Information

Base model	TSP311	XX									
<b>Explosion Protection / Approvals (Continuation)</b>											
GOST Belarus - metrological approval		M5									
GOST Belarus - metrological approval and EAC-Ex, Ex i - Zone 0		U2									
GOST Belarus - metrological approval and EAC-Ex, Ex d		U3									
GOST Belarus - metrological approval and EAC-Ex, dust ignition proof		U4									
NEPSI Intrinsic Safety type of protection: Ex ia IIC T6 Ga		S1									
NEPSI Flameproof (enclosure) type of protection: Ex db IIC T6/T4 Ga/Gb		S2									
<b>Extension Tube Length</b>											
Without Extension Tube					Y0						
K = 150 mm (6 in)					K1						
Customer specific length					Z9						
<b>Thermowell Connection</b>											
No extension / Connection head with thread M24 × 1,5						W1					
No extension / Connection head with thread ½ in NPT						W2					
No extension / Connection head with lock nut M24 × 1,5						W3					
Double nipple thread G ½ A						W4					
Double nipple ½ in NPT						W5					
Extension tube with Cylindrical thread G ½A						G1					
Extension tube with Cylindrical thread G ¾A						G2					
Extension tube with Cylindrical thread G ⅝A						G3					
Extension tube with Cylindrical thread M14 × 1,5						M1					
Extension tube with Cylindrical thread M18 × 1,5						M2					
Extension tube with Cylindrical thread M20 × 1,5						M3					
Extension tube with Cylindrical thread M24 × 1,5						M4					
Extension tube with Cylindrical thread M27 × 2						M5					
Extension tube with conygal thread ½ in NPT						N1					
Nipple / ½ in NPT / ½ in NPT						N2					
Nipple-Union / ½ in NPT / Union ½ in NPT						N3					
Nipple - Union - Nipple / ½ in NPT / ½ in NPT						N4					
Extension with Male nut, thread G ½ in						U6					
Extension tube with adjustable compression fitting G ½ A						A1					
Extension tube with adjustable compression fitting ½ in NPT						A2					
Others						Z9					
<b>Immersion Length</b>											
U = 140 mm (5.6 in)							U2				
U = 200 mm (8 in)							U4				
U = 260 mm (10.3 in)							U6				
Customer specific length							Z9				

Continued see next page

Base model	TSP311	XX	XX	XX	XX	XX	XX
<b>Measuring Inset Type</b>							
RTD, TF, Basic application, measuring range -50 to 400 °C (-58 to 752 °F), 10 g		S1					
RTD, TF, Extended vibration resistance, measuring range -50 to 400 °C (-58 to 752 °F), 60 g		S2					
RTD, WW, Extended measuring range -196 to 600 °C (-321 to 1112 °F), 10 g		D1					
RTD, WW, Extended vibration resistance, extendend measuring range -196 to 600 °C (-321 to 1112 °F), 60 g		D3					
RTD, adjustable to German calibration regulations, sign of app. 000/308 - without calibration		E1					
RTD, custody preliminary, adjustable to German calibration regulations, sign of app. 000/308 - with calibration -10 °C and +50 °C		E2					
Thermocouple		T1					
Others		Z9					
<b>Measuring Inset Diameter</b>							
3 mm			D3				
4.5 mm			D4				
6 mm			D6				
8 mm			D8				
8 mm, tip with sleeve, DIN 43735 Sleeve 80 mm (RTD), 20 mm (TC)			H8				
10 mm, tip with sleeve Sleeve 80 mm (RTD), 20 mm (TC)			H1				
Others			Z9				
<b>Sensor Type and Wiring</b>							
1 × Pt100, 2-wire				P1			
1 × Pt100, 3-wire				P2			
1 × Pt100, 4-wire				P3			
2 × Pt100, 2-wire				P4			
2 × Pt100, 3-wire				P5			
2 × Pt100, 4-wire (with integrated transmitter only one Pt100 is connected)				P6			
1 × Pt1000, 2-wire				P8			
1 × Pt1000, 3-wire				P7			
1 × Pt1000, 4-wire				P9			
1 × Typ K (NiCr-NiAl)				K1			
2 × Typ K (NiCr-NiAl)				K2			
3 × Typ K (NiCr-NiAl)				K3			
1 × Typ J (Fe-CuNi)				J1			
2 × Typ J (Fe-CuNi)				J2			
1 × Typ L (Fe-CuNi)				L1			
2 × Typ L (Fe-CuNi)				L2			
1 × Typ N (NiCrSi-NiSi)				N1			
2 × Typ N (NiCrSi-NiSi)				N2			
1 × Typ T (Cu-CuNi)				T1			
2 × Typ T (Cu-CuNi)				T2			
1 × Typ E (NiCr-CuNi)				E1			
2 × Typ E (NiCr-CuNi)				E2			
1 × Typ S (Pt10Rh-Pt)				S1			
2 × Typ S (Pt10Rh-Pt)				S2			
Others				Z9			

Continued see next page

## ... Ordering Information

Base model	TSP311	XX	XX	XX
<b>Sensor Accuracy</b>				
Accuracy Class B, IEC 60751		B2		
Wire Wound, Double, Accuracy Class A, IEC 60751, Range 0 to 250 °C (32 to 482 °F)		D2		
Wire Wound, Accuracy Class A, IEC 60751, Range -100 to 450 °C (-148 to 842 °F)		D1		
Thin Film, Accuracy Class A, IEC 60751, Range -30 to 300 °C (-22 to 572 °F)		S1		
Thin Film, Accuracy Class AA, IEC 60751, Range 0 to 100 °C (32 to 212 °F)		S3		
Thermocouple, Accuracy Class 2, IEC 60584		T2		
Thermocouple, Accuracy Class 1, IEC 60584		T1		
Thermocouple, Standard Accuracy ANSI MC96.1		T4		
Thermocouple, Special Accuracy ANSI MC96.1		T3		
Thermocouple, Accuracy according to DIN 43710		T5		
Others		Z9		
<b>Connection Head Type / Material</b>				
AGL / Aluminium, screwed cover			L1	
AGLH / Aluminium, high cover, screwed			L2	
AGLD / Aluminium, screwed cover with display			L4	
AGS / Stainless steel, screwed cover			S1	
AGSH / Stainless steel, high cover, screwed			S2	
AGSD / Stainless steel, screwed cover with display			S4	
Others			Z9	
<b>Transmitter</b>				
Without transmitter, sensor with ceramic terminal block - spring loaded				Y1
Without transmitter, sensor with flying leads and metal plate - spring loaded				Y2
TTH300-HART, programmable, output signal 4 to 20 mA, dual input				H4
TTH300-HART, Ex version, programmable, output signal 4 to 20 mA, dual input				H5
TTH300-PA, programmable, output PROFIBUS PA, dual input				P6
TTH300-PA, Ex version, programmable, output PROFIBUS PA, dual input				P7
TTH300-FF, programmable, output FOUNDATION Fieldbus H1, dual input				F6
TTH300-FF, Ex version, programmable, output FOUNDATION Fieldbus H1, dual input				F7
TTH200-HART, programmable, output signal 4 to 20 mA				H6
TTH200-HART, Ex version, programmable, output signal 4 to 20 mA				H7

## Additional ordering information SensyTemp TSP311

	XX	XX	XX
<b>Transmitter Measuring Range</b>			
Standard measuring range	A0		
Customer-specific measuring range	AZ		
<b>Declarations and certificates</b>			
Declaration of compliance according EN 10204-2.1, with the order			C4
Test report according EN 10204-2.2 for batch values, MIC-TC			C5
Test report according EN 10204-2.2 for measuring of insulaionsresistance at ambient temperature			CN
Inspection certificate according EN 10204-3.1, visual, dimensional and functional test			C6
Inspection certificate according EN 10204-3.1, helium leakage test			C7
Inspection certificate according EN 10204-3.1, sensor tolerance			CC
SIL2 declaration of conformity in accordance with IEC 61508 for sensor with integrated transmitter, HART			CS
Inspection certificate according EN 10204-3.1, sensor calibration, single RTD			CD
Inspection certificate according EN 10204-3.1, sensor calibration, double RTD			CE
Inspection certificate according EN 10204-3.1, sensor calibration, single thermocouple			CF
Inspection certificate according EN 10204-3.1, sensor calibration, double thermocouple			CG
DAkkS sensor calibration, single RTD, calibration certificate per thermometer			CH
DAkkS sensor calibration, double RTD, calibration certificate per thermometer			CJ
DAkkS sensor calibration, single thermocouple, calibration certificate per thermometer			CK
DAkkS sensor calibration, double thermocouple, calibration certificate per thermometer			CL
Others			CZ
<b>Number of Calibration Test Points</b>			
1 point			P1
2 points			P2
3 points			P3
4 points			P4
5 points			P5

## ... Ordering Information

Additional ordering information SensyTemp TSP311 (Continuation)	XX	XX	XX
<b>Temperatures for Sensor Calibration</b>			
Standard calibration: 0 °C (32 °F)	V1		
Standard calibration: 100 °C (212 °F)	V2		
Standard calibration: 400 °C (752 °F)	V3		
Standard calibration: 0 °C and 100 °C (32 °F and 212 °F)	V4		
Standard calibration: 0 °C and 400 °C (32 °F and 752 °F)	V5		
Standard calibration: 0 °C, 100 °C and 200 °C (32 °F, 212 °F and 392 °F)	V7		
Standard calibration: 0 °C, 200 °C and 400 °C (32 °F, 392 °F and 752 °F)	V8		
Standard calibration: Customer specific temperatures	V6		
DAkKS calibration: 0 °C (32 °F)	D1		
DAkKS calibration: 100 °C (212 °F)	D2		
DAkKS calibration: 400 °C (752 °F)	D3		
DAkKS calibration: 0 °C and 100 °C (32 °F and 212 °F)	D4		
DAkKS calibration: 0 °C and 400 °C (32 °F and 752 °F)	D5		
DAkKS calibration: 0 °C, 100 °C and 200 °C (32 °F, 212 °F and 392 °F)	D7		
DAkKS calibration: 0 °C, 200 °C and 400 °C (32 °F, 392 °F and 752 °F)	D8		
DAkKS calibration: Customer specific temperatures	D6		
<b>Extension Tube Options</b>			
Extension tube welded with measuring inset, gas tight		N3	
Extension tube oil tight up to 3bar		N4	
Mounting bracket		N5	
<b>Threaded Connection Options</b>			
Adjustable compression fitting G ¼, stainless steel material			K1
Adjustable compression fitting G ¼, stainless steel material, olive material PTFE			K2
Adjustable compression fitting G ½, stainless steel material			K3
Adjustable compression fitting G ½, stainless steel material, olive material PTFE			K4
Adjustable compression fitting M18 × 1.5, stainless steel material			K5
Adjustable compression fitting ½ in NPT, stainless steel material			K6
Adjustable compression fitting ½ in NPT, stainless steel material, olive material PTFE			K7
Spring loaded adjustable compression fitting G ½, stainless steel material			K8
Spring loaded adjustable compression fitting M18 × 1.5, stainless steel material			K9
Others			KZ

Additional ordering information SensyTemp TSP311 (Continuation)	XX	XX	XX	XX	XX
<b>Measuring Inset: Option</b>					
Hot junction grounded	J1				
2 insets paired from 0 to 100 °C (32 to 212 °F), max. deviation 0.1 K	J3				
Improvement Sensor Accuracy to 0.5 Cl. A, 0 to 100°C, U>100 mm	J8				
Improvement Sensor Accuracy to 0.5 Cl. A, 0 to 400°C, U>250 mm	J9				
<b>Measuring Inset: Transmitter Mounted</b>					
Transmitter mounted on inset, without ceramic block	J2				
<b>Measuring Inset: Other Options</b>					
Others			JZ		
<b>Connection Head Options</b>					
Second transmitter mounted in connection head (same type as first one)					H1
Cover of connection head with chain attached to the lower part					H8
Connetion head with capstan screw for sealing					H9
Others					HZ
<b>Cable Entry Options</b>					
1 × M20 × 1.5, without cable gland					U1
1 × ½ in NPT, without cable gland					U2
2 × M20 × 1.5, without cable gland					U4
2 × ½ in NPT, without cable gland					U5
2 × M20 × 1.5, with cable gland skintop, temperature range -40 bis +70 °C (-40 bis +158 °F)					U7
1 × M20 × 1.5, with Ex-d cable gland					UA
2 × M20 × 1.5, with Ex-d cable gland					UC
Harting Han 7D plug and socket connection					UG
Harting Han 8D (8U) plug and socket connection					UH
M12 plug for PROFIBUS PA					UJ
7/8 in plug for FOUNDATION Fieldbus					UK
1 × ½ in NPT-PE ADE 4F Capri Codec					UF
1 × ½ in NPT Capri Codec, with strain relief					UL
1 × ½ in NPT-PE ADE 4F + 1 × ½ in NPT plug					UP
Others					UZ

## ... Ordering Information

<b>Additional ordering information SensyTemp TSP311 (Continuation)</b>	XX	XX	XX	XX	XX
<b>Display Type</b>					
LCD indicator type AS	L1				
Configurable LCD Indicator type A	L2				
<b>Other Options</b>					
With fastened gasket		PD			
Earth screw internal		PH			
Name plate stainless steel		PV			
Each Thermometer single packed - Polyethylen		PN			
<b>Documentation Language</b>					
German			M1		
English			M5		
Language package Western Europe / Scandinavia (Languages: DA, ES, FR, IT, NL, PT, FI, SV)			MW		
Language package Eastern Europe (Languages: EL, CS, ET, LV, LT, HU, HR, PL, SK, SL, RO, BG)			ME		
<b>Additional TAG Plate</b>					
Stainless steel plate with TAG no.					T1
<b>Additional Identification Plate</b>					
Stainless steel plate with customer specific text					T2
Adhesive label					T3

## SensyTemp TSP321

Base model	TSP321	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX	XX
SensyTemp TSP321 Temperature Sensor, with tubular thermowell, for heavy duty applications														
<b>Explosion Protection / Approvals</b>														
Without		Y0												
Intrinsic Safety ATEX II 1 G Ex ia IIC T6...T1 Ga or II 2 G Ex ib IIC T6...T1 Gb or II 1/2 G Ex ib IIC T6...T1 Ga/Gb		A1												
ATEX Dust Explosion Protection: Zone 20: II 1D Ex ta IIIC T133 ... T400 Da, Zone 20/21: II 1/2 D Ex ta/tb IIIC T133 ... T400 Da/Db		A3*												
ATEX Dust Explosion Protection resp. Intrinsic Safety (IS): Zone 20 / Zone 0: II 1D Ex ta IIIC T133 ... T400 Da resp. II 1 G Ex ia IIC T6...T1 Ga (Not for application in explosive hybrid mixtures)		A4*												
Flameproof enclosure ATEX II 1/2 G Ex db IIC T6/T4 Ga/Gb		A5												
Non-sparking and increased safety as well as dust explosion protection														
ATEX II 3 G Ex nA IIC T6...T1 Gc, ATEX II 3 G Ex ec IIC T6...T1 Gc and ATEX II 3 D Ex tc IIIB T133°C Dc		B1**												
ATEX Dust Explosion Protection resp. Flameproof Enclosure: Zone 20 / Zone 1/0: II 1D Ex ta IIIC T133 ... T400 Da resp. II 1/2 G Ex db IIC T6/T4 Ga/Gb (Not for application in explosive hybrid mixtures)		B5*												
ATEX Dust Explosion Protection: Zone 21: II 2D Ex tb IIIC T133 ... T400 Db		D5***												
ATEX Dust Explosion Protection resp. Intrinsic Safety (IS): Zone 21 / Zone 0: II 2D Ex tb IIIC T133 ... T400 Db resp. II 1 G Ex ia IIC T6...T1 Ga (Not for application in explosive hybrid mixtures)		D6***												
ATEX Dust Explosion Protection resp. Flameproof Enclosure: Zone 21 / Zone 1/0: II 2D Ex tb IIIC T133 ... T400 Db resp. II 1/2 G Ex db IIC T6/T4 Ga/Gb (Not for application in explosive hybrid mixtures)		D8***												
Intrinsic Safety IECEx ia IIC T6...T1 Ga		H1												
Intrinsic Safety IECEx ib IIC T6...T1 Gb or IECEx ib IIC T6...T1 Ga/Gb		H2												
Flameproof enclosure IECEx db IIC T6/T4 Ga/Gb		H5												
IECEx Dust Explosion Protection: Zone 20: Ex ta IIIC T133 ... T400 Da, Zone 20/21: Ex Ta/tb IIIC T133 ... T400 Da/Db		J9*												
IECEx Dust Explosion Protection: Zone 21: Ex tb IIIC T133 ... T400 Db		J5***												
Intrinsic Safety acc. NAMUR NE 24 and ATEX II 1 G Ex ia IIC T6...T1 Ga		N1												
GOST Russia - metrological approval		G1												
GOST Russia - metrological approval and EAC-Ex, Ex i - Zone 0		P2												
GOST Russia - metrological approval and EAC-Ex, Ex d		P3												
GOST Russia - metrological approval and EAC-Ex, dust ignition proof		P4												
GOST Kazakhstan - metrological approval		G3												
GOST Kazakhstan - metrological approval and EAC-Ex, Ex i - Zone 0		T2												
GOST Kazakhstan - metrological approval and EAC-Ex, Ex d		T3												
GOST Kazakhstan - metrological approval and EAC-Ex, dust ignition proof		T4												
* not with TTH300, not with LCD indicator, transmitter with HART protocol only														
** Use in explosive hybrid mixtures (where explosive dusts and gases are present simultaneously) is not currently permitted in accordance with EN 60079-0 and EN 60079-31														
*** transmitter with HART protocol only														

Continued see next page

## ... Ordering Information

Base model	TSP321	XX	XX	XX	XXX	XX							
<b>Explosion Protection / Approvals (Continuation)</b>													
GOST Belarus - metrological approval		M5											
GOST Belarus - metrological approval and EAC-Ex, Ex i - Zone 0		U2											
GOST Belarus - metrological approval and EAC-Ex, Ex d		U3											
GOST Belarus - metrological approval and EAC-Ex, dust ignition proof		U4											
NEPSI Intrinsic Safety type of protection: Ex ia IIC T6 Ga		S1											
NEPSI Flameproof (enclosure) type of protection: Ex db IIC T6/T4 Ga/Gb		S2											
<b>Wetted Thermowell Material</b>													
Stainless Steel ASTM 316L (1.4404)				S1									
Stainless Steel ASTM 316Ti (1.4571)				S2									
Highly heat-resistant stainless steel ASTM A446-1 (1.4749)				H1									
Heat Resistent Steel 1.4762				H2									
Stainless Steel AISI 314 (1.4841)				H3									
Duplex stainless steel (CrNi, 1.4462)				S9									
Stainless steel ASTM 904L (CrNi, 1.4539); (Uranus B6)				S4									
Ni-Alloy Hastelloy C-276 (2.4819)				N1									
Ni-Alloy Hastelloy C-4 (2.4610)				N2									
2.4816 (Inconel 600)				N5									
Others				Z9									
<b>Thermowell Type</b>													
Tubular thermowell with straight shaft (DIN 43772, Form 2)													A1
Flanged tubular thermowell with straight shaft (DIN 43772, Form 2F)													A2
Screwed tubular thermowell with straight shaft (DIN 43772, Form 2G)													A3
Tubular thermowell, stepped tip (ABB Form 2S)													B1
Flanged tubular thermowell, stepped tip (ABB Form 2FS)													B2
Screwed tubular thermowell, stepped tip (ABB Form 2GS)													B3
Tubular thermowell, tapered (DIN 43772, Form 3)													C1
Flanged tubular thermowell, tapered (DIN 43772, Form 3F)													C2
Screwed tubular thermowell, tapered (DIN 43772, Form 3G)													C3
Screwed tubular thermowell without extension, straight shaft (ABB Form 2G0)													A4
Screwed tubular thermowell without extension, stepped tip (ABB Form 2GS0)													B4
Tubular thermowell d= 22mm, stepped tip d= 6mm													B5
Tubular thermowell, stepped tip 9 mm (0.36 in) (ABB Form 2S/9)													K1
Flanged tubular thermowell, stepped tip 9 mm (0.36 in) (ABB Form 2FS/9)													K2
Screwed tubular thermowell, stepped tip 9 mm (0.36 in) (ABB Form 2GS/9)													K3
Others													Z9

Continued see next page

Base model	TSP321	XXX	XX							
<b>Process Connection</b>										
Without process connection		Y00								
Adjustable compression fitting G ½, material 1.4571		A01								
Adjustable compression fitting ½ in NPT, material 1.4571		A02								
Adjustable flange DN 25 PN 10 to PN 40, EN 1092-1, material 1.4571		A03								
Adjustable flange 1 in 150 lbs, ASME B16.5, material 1.4571		A07								
Flange DN 15 PN 10 to PN 40, EN 1092-1		F01								
Flange DN 20 PN 10 to PN 40, EN 1092-1		F02								
Flange DN 25 PN 10 to PN 40, EN 1092-1		F03								
Flange DN 25 PN 63 to PN100, EN 1092-1		F29								
Flange DN 32 PN 16 to PN 40, EN 1092-1		F30								
Flange DN 40 PN 10 to PN 40, EN 1092-1		F04								
Flange DN 40 PN 63 to PN 100, EN 1092-1		F37								
Flange DN 50 PN 6, EN 1092-1		F06								
Flange DN 50 PN 25 to PN 40, EN 1092-1		F05								
Flange DN 50 PN 63, EN 1092-1		F33								
Flange DN 50 PN 100, EN 1092-1		F34								
Flange DN 80 PN 16, EN 1092-1		F35								
Flange DN 100 PN 40, EN 1092-1		F36								
Flange 1 in 150 lbs, ASME B16.5		F07								
Flange 1 in 300 lbs, ASME B16.5		F08								
Flange 1 in 600 lbs, ASME B16.5		F09								
Flange 1-½ in 150 lbs, ASME B16.5		F11								
Flange 1-½ in 300 lbs, ASME B16.5		F12								
Flange 1-½ in 600 lbs, ASME B16.5		F13								
Flange 1-½ in 900 / 1500 lbs, ASME B16.5		F14								
Flange 2 in 150 lbs, ASME B16.5		F15								
Flange 2 in 300 lbs, ASME B16.5		F16								
Flange 2 in 600 lbs, ASME B16.5		F17								
Flange 2 in 900 / 1500 lbs, ASME B16.5		F18								
Cylindrical thread G ¾ A		S15								
Cylindrical thread G ½ A		S01								
Cylindrical thread G ¾ A		S02								
Cylindrical thread G 1 A		S03								
Cylindrical thread M20 × 1.5		S07								
Cylindrical thread M27 × 2		S08								
Conical thread ½ in NPT		S04								
Conical thread ¾ in NPT		S05								
Conical thread 1 in NPT		S06								
Conical thread ½ in BSPT		S09								
Conical thread ¾ in BSPT		S10								
Conical thread 1 in BSPT		S11								
Others		Z99								

Continued see next page

## ... Ordering Information

Base model	TSP321	XX							
<b>Thermowell Diameter</b>									
6 mm × 1 mm		A9							
8 mm × 2 mm		A5							
9 mm × 1 mm		A1							
10 mm × 1,5 mm		A6							
11 mm × 2 mm		A2							
12 mm × 2,5 mm		A3							
13,5 mm × 2,3 mm		B6							
13,7 mm × 2,24 mm		B2							
14 mm × 2,5 mm		A4							
15 mm × 2 mm		A7							
16 mm × 3 mm		A8							
22 mm × 2 mm		B1							
<b>Immersion Length</b>									
Without fixed immersion length					Y0				
U = 100 mm (4 in)					U1				
U = 160 mm (6.3 in)					U3				
U = 250 mm (10 in)					U5				
U = 400 mm (16 in)					U7				
Customer specific length					Z9				
<b>Nominal Length</b>									
N = 230 mm (9.1 in)						N1			
N = 290 mm (11.42 in)						N3			
N = 380 mm (15 in)						N5			
N = 530 mm (20.9 in)						N7			
Customer specific length						Z9			
<b>Measuring Inset Type</b>									
Without measuring inset							Y0		
RTD, TF, Basic application, measuring range -50 to 400 °C (-58 to 752 °F), 10 g							S1		
RTD, TF, Extended vibration resistance, measuring range -50 to 400 °C (-58 to 752 °F), 60 g							S2		
RTD, WW, Extended measuring range -196 to 600 °C (-321 to 1112 °F), 10 g							D1		
RTD, WW, Extended vibration resistance, extended measuring range -196 to 600 °C (-321 to 1112 °F), 60 g							D3		
RTD, adjustable to German calibration regulations, sign of app. 000/308 - without calibration							E1		
RTD, custody preliminary, adjustable to German calibration regulations, sign of app. 000/308 - with calibration -10 °C and +50 °C							E2		
Thermocouple							T1		
Others							Z9		

Continued see next page

Base model	TSP321	XX	XX	XX	XX
<b>Sensor Type and Wiring</b>					
Without measuring inset		Y0			
1 × Pt100, 2-wire		P1			
1 × Pt100, 3-wire		P2			
1 × Pt100, 4-wire		P3			
2 × Pt100, 2-wire		P4			
2 × Pt100, 3-wire		P5			
2 × Pt100, 4-wire (with integrated transmitter only one Pt100 is connected)		P6			
1 × Pt1000, 2-wire		P8			
1 × Pt1000, 3-wire		P7			
1 × Pt1000, 4-wire		P9			
1 × Type K (NiCr-NiAl)		K1			
2 × Type K (NiCr-NiAl)		K2			
3 × Type K (NiCr-NiAl)		K3			
1 × Type J (Fe-CuNi)		J1			
2 × Type J (Fe-CuNi)		J2			
1 × Type L (Fe-CuNi)		L1			
2 × Type L (Fe-CuNi)		L2			
1 × Type N (NiCrSi-NiSi)		N1			
2 × Type N (NiCrSi-NiSi)		N2			
1 × Type T (Cu-CuNi)		T1			
2 × Type T (Cu-CuNi)		T2			
1 × Type E (NiCr-CuNi)		E1			
2 × Type E (NiCr-CuNi)		E2			
1 × Type S (Pt10Rh-Pt)		S1			
2 × Type S (Pt10Rh-Pt)		S2			
Others		Z9			

Continued see next page

## ... Ordering Information

Main ordering information SensyTemp	TSP321	XX	XX	XX
<b>Sensor Accuracy</b>				
Without measuring inset		Y0		
Accuracy Class B, IEC 60751		B2		
Wire Wound, Double, Accuracy Class A, IEC 60751, Range 0 to 250 °C (32 to 482 °F)		D2		
Wire Wound, Accuracy Class A, IEC 60751, Range -100 to 450 °C (-148 to 842 °F)		D1		
Thin Film, Accuracy Class A, IEC 60751, Range -30 to 300 °C (-22 to 572 °F)		S1		
Thin Film, Accuracy Class AA, IEC 60751, Range 0 to 100 °C (32 to 212 °F)		S3		
Thermocouple, Accuracy Class 2, IEC 60584		T2		
Thermocouple, Accuracy Class 1, IEC 60584		T1		
Thermocouple, Standard Accuracy ANSI MC96.1		T4		
Thermocouple, Special Accuracy ANSI MC96.1		T3		
Thermocouple, Accuracy according to DIN 43710		T5		
Others		Z9		
<b>Connection Head Type / Material</b>				
AGL / Aluminium, screwed cover			L1	
AGLH / Aluminium, high cover, screwed			L2	
AGLD / Aluminium, screwed cover with display			L4	
AGS / Stainless steel, screwed cover			S1	
AGSH / Stainless steel, high cover, screwed			S2	
AGSD / Stainless steel, screwed cover with display			S4	
Others			Z9	
<b>Transmitter</b>				
Without transmitter, sensor with ceramic terminal block - spring loaded				Y1
Without transmitter, sensor with flying leads and metal plate - spring loaded				Y2
TTH300-HART, programmable, output signal 4 to 20 mA, dual input				H4
TTH300-HART, Ex version, programmable, output signal 4 to 20 mA, dual input				H5
TTH300-PA, programmable, output PROFIBUS PA, dual input				P6
TTH300-PA, Ex version, programmable, output PROFIBUS PA, dual input				P7
TTH300-FF, programmable, output FOUNDATION Fieldbus H1, dual input				F6
TTH300-FF, Ex version, programmable, output FOUNDATION Fieldbus H1, dual input				F7
TTH200-HART, programmable, output signal 4 to 20 mA				H6
TTH200-HART, Ex version, programmable, output signal 4 to 20 mA				H7

## Additional ordering information SensyTemp TSP321

	XX	XX	XX
<b>Transmitter Measuring Range</b>			
Standard measuring range	A0		
Customer-specific measuring range	AZ		
<b>Declarations and certificates</b>			
Declaration of compliance according EN 10204-2.1, with the order			C4
Test report according EN 10204-2.2, material monitoring for wetted parts			C1
Test report according EN 10204-2.2 for batch values, MIC-TC			C5
Test report according EN 10204-2.2 for measuring of insulaionsresistance at ambient temperature			CN
Inspection certificate according EN 10204-3.1, material monitoring for wetted parts			C2
Inspection certificate according EN 10204-3.1, visual, dimensional and functional test			C6
Inspection certificate according EN 10204-3.1, helium leakage test			C7
Inspection certificate according EN 10204-3.1, dye penetration test			C9
Inspection certificate according EN 10204-3.1, pressure test on thermowell			CB
Inspection certificate according EN 10204-3.1, sensor tolerance			CC
SIL2 declaration of conformity in accordance with IEC 61508 for sensor with integrated transmitter, HART			CS
Inspection certificate according EN 10204-3.1, sensor calibration, single RTD			CD
Inspection certificate according EN 10204-3.1, sensor calibration, double RTD			CE
Inspection certificate according EN 10204-3.1, sensor calibration, single thermocouple			CF
Inspection certificate according EN 10204-3.1, sensor calibration, double thermocouple			CG
DAkKS sensor calibration, single RTD, calibration certificate per thermometer			CH
DAkKS sensor calibration, double RTD, calibration certificate per thermometer			CJ
DAkKS sensor calibration, single thermocouple, calibration certificate per thermometer			CK
DAkKS sensor calibration, double thermocouple, calibration certificate per thermometer			CL
Inspection certificate according EN 10204-3.1, x-ray- test for weldings			CU
Wetted parts according to EC 1935			CX
Others			CZ
<b>Number of Calibration Test Points</b>			
1 point			P1
2 points			P2
3 points			P3
4 points			P4
5 points			P5

## ... Ordering Information

Additional ordering information SensyTemp TSP321 (Continuation)	XX	XX	XX
<b>Temperatures for Sensor Calibration</b>			
Standard calibration: 0 °C (32 °F)	V1		
Standard calibration: 100 °C (212 °F)	V2		
Standard calibration: 400 °C (752 °F)	V3		
Standard calibration: 0 °C and 100 °C (32 °F and 212 °F)	V4		
Standard calibration: 0 °C and 400 °C (32 °F and 752 °F)	V5		
Standard calibration: 0 °C, 100 °C and 200 °C (32 °F, 212 °F and 392 °F)	V7		
Standard calibration: 0 °C, 200 °C and 400 °C (32 °F, 392 °F and 752 °F)	V8		
Standard calibration: Customer specific temperatures	V6		
DAkKS calibration: 0 °C (32 °F)	D1		
DAkKS calibration: 100 °C (212 °F)	D2		
DAkKS calibration: 400 °C (752 °F)	D3		
DAkKS calibration: 0 °C and 100 °C (32 °F and 212 °F)	D4		
DAkKS calibration: 0 °C and 400 °C (32 °F and 752 °F)	D5		
DAkKS calibration: 0 °C, 100 °C and 200 °C (32 °F, 212 °F and 392 °F)	D7		
DAkKS calibration: 0 °C, 200 °C and 400 °C (32 °F, 392 °F and 752 °F)	D8		
DAkKS calibration: Customer specific temperatures	D6		
<b>Thermowell Options</b>			
With additional tantalum sleeve, tantalum sleeve is brazed to the flange in two points		S1	
Thermowell coated with 0.5 mm (0.02 in) E-CTFE / Halar, wetted parts incl. flange surface		S2	
Thermowell coated with 0.5 mm (0.02 in) PFA, wetted parts incl. flange surface		S3	
Thermowell coated with 1 mm (0.04 in) NiCrB / META 43		S4*	
Thermowell coated with 0.5 mm (0.02 in) NiZrO2 / PL1312		S5*	
Thermowell incl. tests and certificates AD-2000 standard for austenitic steel		S6	
Thermowell incl. tests and certificates AD-2000 standard for high temperature steel		S7	
Thermowell clean for oxygen service		S9	
Thermowell stress calculation according Dittrich / Kohler		SD	
Others		SZ	
<b>Flange Connection Options</b>			
Flange raised face form RF, ASME B16.5			F6
Flange raised face form B1 acc. EN 1092-1			F7
Flange raised face form B2 acc. EN 1092-1			F8
Flange facing with tongue form C EN 1092-1			F1
Flange facing with groove form D acc. EN 1092-1			F2
Flange facing with RTJ surface acc. ASME B16.5			F3
Others			FZ

\* Length indicated in mm from thermowell tip.

<b>Additional ordering information SensyTemp TSP321 (Continuation)</b>	XX	XX	XX	XX	XX	XX
<b>Extension Tube Options</b>						
Mounting bracket	N5					
<b>Measuring Inset: Option</b>						
Hot junction grounded		J1				
2 insets paired from 0 to 100 °C (32 to 212 °F), max. deviation 0.1 K		J3				
Improvement Sensor Accuracy to 0.5 Cl. A, 0 to 100°C, U>100 mm		J8				
Improvement Sensor Accuracy to 0.5 Cl. A, 0 to 400°C, U>250 mm		J9				
<b>Measuring Inset: Transmitter Mounted</b>						
Transmitter mounted on inset, without ceramic block			J2			
<b>Measuring Inset: Other Options</b>						
Others				JZ		
<b>Connection Head Options</b>						
Second transmitter mounted in connection head (same type as first one)					H1	
Cover of connection head with chain attached to the lower part					H8	
Connection head with capstan screw for sealing					H9	
Others					HZ	
<b>Cable Entry Options</b>						
1 × M20 × 1.5, without cable gland						U1
1 × ½ in NPT, without cable gland						U2
2 × M20 × 1.5, without cable gland						U4
2 × ½ in NPT, without cable gland						U5
2 × M20 × 1.5, with cable gland skintop, temperature range -40 bis +70 °C (-40 bis +158 °F)						U7
1 × M20 × 1.5, with Ex-d cable gland						UA
2 × M20 × 1.5, with Ex-d cable gland						UC
Harting Han 7D plug and socket connection						UG
Harting Han 8D (8U) plug and socket connection						UH
M12 plug for PROFIBUS PA						UJ
7/8 in plug for FOUNDATION Fieldbus						UK
1 × ½ in NPT-PE ADE 4F Capri Codec						UF
1 × ½ in NPT Capri Codec, with strain relief						UL
1 × ½ in NPT-PE ADE 4F + 1 × ½ in NPT plug						UP
Others						UZ

## ... Ordering Information

Additional ordering information SensyTemp TSP321 (Continuation)	XX	XX	XX	XX	XX
<b>Display Type</b>					
LCD indicator type AS	L1				
Configurable LCD Indicator type A	L2				
<b>Other Options</b>					
Earth screw internal		PH			
Name plate stainless steel		PV			
Each Thermometer single packed - Polyethylen		PN			
<b>Documentation Language</b>					
German			M1		
English			M5		
Language package Western Europe / Scandinavia (Languages: DA, ES, FR, IT, NL, PT, FI, SV)			MW		
Language package Eastern Europe (Languages: EL, CS, ET, LV, LT, HU, HR, PL, SK, SL, RO, BG)			ME		
<b>Additional TAG Plate</b>					
Stainless steel plate with TAG no.					T1
<b>Additional Identification Plate</b>					
Stainless steel plate with customer specific text					T2
Adhesive label					T3

## SensyTemp TSP331

Base model	TSP331	XX	XX	XX	XXX	XX								
SensyTemp TSP331 Temperature Sensor, with drilled thermowell, for heavy duty applications														
<b>Explosion Protection / Approvals</b>														
Without		Y0												
Intrinsic Safety ATEX II 1 G Ex ia IIC T6...T1 Ga or II 2 G Ex ib IIC T6...T1 Gb or II 1/2 G Ex ib IIC T6...T1 Ga/Gb		A1												
ATEX Dust Explosion Protection: Zone 20: II 1D Ex ta IIIC T133 ... T400 Da, Zone 20/21: II 1/2 D Ex ta/tb IIIC T133 ... T400 Da/Db		A3*												
ATEX Dust Explosion Protection resp. Intrinsic Safety (IS): Zone 20 / Zone 0: II 1D Ex ta IIIC T133 ... T400 Da resp. II 1 G Ex ia IIC T6...T1 Ga (Not for application in explosive hybrid mixtures)		A4*												
Flameproof enclosure ATEX II 1/2 G Ex db IIC T6/T4 Ga/Gb		A5												
Non-sparking and increased safety as well as dust explosion protection ATEX II 3 G Ex nA IIC T6...T1 Gc, ATEX II 3 G Ex ec IIC T6...T1 Gc and ATEX II 3 D Ex tc IIIB T133°C Dc		B1**												
ATEX Dust Explosion Protection resp. Flameproof Enclosure: Zone 20 / Zone 1/0: II 1D Ex ta IIIC T133 ... T400 Da resp. II 1/2 G Ex db IIC T6/T4 Ga/Gb (Not for application in explosive hybrid mixtures)		B5*												
ATEX Dust Explosion Protection: Zone 21: II 2D Ex tb IIIC T133 ... T400 Db		D5***												
ATEX Dust Explosion Protection resp. Intrinsic Safety (IS): Zone 21 / Zone 0: II 2D Ex tb IIIC T133 ... T400 Db resp. II 1 G Ex ia IIC T6...T1 Ga (Not for application in explosive hybrid mixtures)		D6***												
ATEX Dust Explosion Protection resp. Flameproof Enclosure: Zone 21 / Zone 1/0: II 2D Ex tb IIIC T133 ... T400 Db resp. II 1/2 G Ex db IIC T6/T4 Ga/Gb (Not for application in explosive hybrid mixtures)		D8***												
Intrinsic Safety IECEx ia IIC T6...T1 Ga		H1												
Intrinsic Safety IECEx ib IIC T6...T1 Gb or IECEx ib IIC T6...T1 Ga/Gb		H5												
Flameproof enclosure IECEx db IIC T6/T4 Ga/Gb		H5												
IECEx Dust Explosion Protection: Zone 20: Ex ta IIIC T133 ... T400 Da, Zone 20/21: Ex Ta/tb IIIC T133 ... T400 Da/Db		J9*												
IECEx Dust Explosion Protection: Zone 21: Ex tb IIIC T133 ... T400 Db		J5***												
Intrinsic Safety acc. NAMUR NE 24 and ATEX II 1 G Ex ia IIC T6...T1 Ga		N1												
GOST Russia - metrological approval		G1												
GOST Russia - metrological approval and EAC-Ex, Ex i - Zone 0		P2												
GOST Russia - metrological approval and EAC-Ex, Ex d		P3												
GOST Russia - metrological approval and EAC-Ex, dust ignition proof		P4												
GOST Kazakhstan - metrological approval		G3												
GOST Kazakhstan - metrological approval and EAC-Ex, Ex i - Zone 0		T2												
GOST Kazakhstan - metrological approval and EAC-Ex, Ex d		T3												
GOST Kazakhstan - metrological approval and EAC-Ex, dust ignition proof		T4												

\* not with TTH300, not with LCD indicator, transmitter with HART protocol only

\*\* Use in explosive hybrid mixtures (where explosive dusts and gases are present simultaneously) is not currently permitted in accordance with EN 60079-0 and EN 60079-31

\*\*\* transmitter with HART protocol only

Continued see next page

## ... Ordering Information

Base model	TSP331	XX	XX	XX	XXX	XX								
<b>Explosion Protection / Approvals (Continuation)</b>														
GOST Belarus - metrological approval		M5												
GOST Belarus - metrological approval and EAC-Ex, Ex i - Zone 0		U2												
GOST Belarus - metrological approval and EAC-Ex, Ex d		U3												
GOST Belarus - metrological approval and EAC-Ex, dust ignition proof		U4												
NEPSI Intrinsic Safety type of protection: Ex ia IIC T6 Ga		S1												
NEPSI Flameproof (enclosure) type of protection: Ex db IIC T6/T4 Ga/Gb		S2												
<b>Wetted Thermowell Material</b>														
Stainless steel ASTM 316L (1.4404)		S1												
Stainless steel ASTM 316Ti (1.4571)		S2												
Heat-resistant stainless steel ASTM A182 F12 (1.7335)		W1												
Heat-resistant stainless steel ASTM A182 F22 (1.7380)		W2												
Heat-resistant stainless steel ASTM A182 F1 (1.5415)		W3												
Highly heat-resistant stainless steel ASTM A347 H (1.4961)		W4												
Highly heat-resistant stainless steel ASTM A446-1 (1.4749)		H1												
Heat resistant steel ASTM A446 (1.4762)		H2												
Heat resistant steel ASTM A314 (CrNi, 1.4841)		H3												
Duplex stainless steel (CrNi, 1.4462)		S9												
Stainless steel ASTM 904L (CrNi, 1.4539); (Uranus B6)		S4												
Ni-Alloy Hastelloy C-276 (2.4819)		N1												
Ni-Alloy Hastelloy C-4 (2.4610)		N2												
NiCu-Alloy Monel 400 (2.4360)		N4												
Ni-Alloy Incoloy 800 (1.4876)		H4												
Highly heat-resistant stainless steel, Ni-Alloy Inconel 600 (2.4816)		N5												
2.4816 (Inconel 600)		W5												
Stainless steel ASTM 304 (CrNi, 1.4301)		S5												
Stainless steel ASTM 321 (CrNi, 1.4541)		S6												
Carbon steel ASTM A105 (1.0460)		C1												
Others		Z9												
<b>Thermowell Type</b>														
Weld-in thermowell from bar stock material, diameter F2 = 24 mm (0.95 in), (DIN 43772, Form 4)														D1
Weld-in thermowell from bar stock material, diameter F2 = 18 mm (0.71 in), (DIN 43772, Form 4)														D2
Flanged thermowell from bar stock material, diameter F2 = 24 mm (0.95 in), (DIN 43772, Form 4F)														D3
Flanged thermowell from bar stock material, diameter F2 = 18 mm (0.71 in), (ABB-Form 4FS)														D4
Weld-in thermowell from bar stock material, diameter F2 = 26 mm (1.02 in), (DIN 43772, Form 4)														D5
Flanged thermowell from bar stock material, diameter F2 = 26 mm (1.02 in), (DIN 43772, Form 4F)														D6
Weld-in thermowell from bar stock material, (ABB, Form DR)														R1
Flanged thermowell from bar stock material, (ABB, Form DRF)														R2
Weld-in thermowell from bar stock material, (ABB, Form RD)														R3
Flanged thermowell from bar stock material, (ABB, Form RDF)														R4
Weld-in thermowell from bar stock material, (ABB, Form PW)														P1
Flanged thermowell from bar stock material, (ABB, Form PF)														P2
Screwed thermowell from bar stock material, tapered tip, (ABB, Form PS)														P3
Screwed tubular thermowell from bar stock material, straight shaft (DIN 43772, Form 6)														S1
Others														Z9

Continued see next page

Base model	TSP331	XXX	XX								
<b>Process Connection</b>											
Without process connection		Y00									
Flange DN 25 PN 10 to PN 40, EN 1092-1		F03									
Flange DN 25 PN 63 to PN100, EN 1092-1		F29									
Flange DN 32 PN 16 to PN 40, EN 1092-1		F30									
Flange DN 40 PN 10 to PN 40, EN 1092-1		F04									
Flange DN 40 PN 63 to PN 100, EN 1092-1		F37									
Flange DN 50 PN 6, EN 1092-1		F06									
Flange DN 50 PN 25 to PN 40, EN 1092-1		F05									
Flange DN 50 PN 63, EN 1092-1		F33									
Flange DN 50 PN 100, EN 1092-1		F34									
Flange DN 80 PN 16, EN 1092-1		F35									
Flange DN 100 PN 40, EN 1092-1		F36									
Flange 1 in 150 lbs, ASME B16.5		F07									
Flange 1 in 300 lbs, ASME B16.5		F08									
Flange 1 in 600 lbs, ASME B16.5		F09									
Flange 1-½ in 150 lbs, ASME B16.5		F11									
Flange 1-½ in 300 lbs, ASME B16.5		F12									
Flange 1-½ in 600 lbs, ASME B16.5		F13									
Flange 1-½ in 900 / 1500 lbs, ASME B16.5		F14									
Flange 2 in 150 lbs, ASME B16.5		F15									
Flange 2 in 300 lbs, ASME B16.5		F16									
Flange 2 in 600 lbs, ASME B16.5		F17									
Flange 2 in 900 / 1500 lbs, ASME B16.5		F18									
Conical thread ½ in NPT		S04									
Conical thread ¾ in NPT		S05									
Conical thread 1 in NPT		S06									
Others		Z99									

Continued see next page

## ... Ordering Information

Base model	TSP331	XX								
<b>Extension Tube Length</b>										
K = 150 mm (6 in)		K1								
Customer specific length		Z9								
<b>Thermowell Connection</b>										
Extension tube with Cylindrical thread G ½ A				G1						
Extension tube with Cylindrical thread G ¾ A				G2						
Extension tube with Cylindrical thread G ⅝ A				G3						
Extension tube with Cylindrical thread M14 × 1,5				M1						
Extension tube with Cylindrical thread M18 × 1,5				M2						
Extension tube with Cylindrical thread M20 × 1,5				M3						
Extension tube with Cylindrical thread M24 × 1,5				M4						
Extension tube with conycal thread ½ in NPT				N1						
Nipple / ½ in NPT / ½ in NPT				N2						
Nipple-Union / ½ in NPT / Union ½ in NPT				N3						
Nipple - Union - Nipple / ½ in NPT / ½ in NPT				N4						
Extension with Male nut, thread G ½ in				U6						
Others				Z9						
<b>Immersion Length</b>										
Without fixed immersion length				Y0						
U = 130 mm (5.2 in)				D1						
U = 190 mm (7.5 in)				D2						
U = 340 mm (13.4 in)				D3						
U = 100 mm (4 in)				P1						
U = 150 mm (6 in)				P2						
U = 200 mm (8 in)				P3						
U = 250 mm (10 in)				P4						
U = 300 mm (12 in)				P5						
U = 350 mm (14 in)				P6						
Customer specific length				Z9						

Continued see next page

Base model	TSP331	XX	XX	XX	XX	XX	XX
<b>Thermowell Length</b>							
L = 110 mm (4.4 in), C = 65 mm (2.5 in)		D1					
L = 115 mm (4.6 in), C = 40 mm (1.5 in)		D2					
L = 140 mm (5.6 in), C = 65 mm (2.5 in)		D3					
L = 200 mm (8 in), C = 65 mm (2.5 in)		D4					
L = 200 mm (8 in), C = 125 mm (5 in)		D5					
L = 260 mm (10.3 in), C = 125 mm (5 in)		D6					
L = 410 mm (16.2 in), C = 275 mm (10.9 in)		D7					
L = 146 mm (5.8 in)		R1					
L = 175 mm (6.9 in)		R2					
L = 265 mm (10.5 in)		R3					
L = 415 mm (16.4 in)		R4					
L = U + 65 mm (2.5 in) - ABB-standard		P1					
Acc. customer specification		D9					
Customer specific length		Z9					
<b>Measuring Inset Type</b>							
Without measuring inset			Y0				
RTD, TF, Basic application, measuring range -50 to 400 °C (-58 to 752 °F), 10 g			S1				
RTD, TF, Extended vibration resistance, measuring range -50 to 400 °C (-58 to 752 °F), 60 g			S2				
RTD, WW, Extended measuring range -196 to 600 °C (-321 to 1112 °F), 10 g			D1				
RTD, WW, Extended vibration resistance, extended measuring range -196 to 600 °C (-321 to 1112 °F), 60 g			D3				
RTD, adjustable to German calibration regulations, sign of app. 000/308 - without calibration			E1				
RTD, custody preliminary, adjustable to German calibration regulations, sign of app. 000/308 - with calibration -10 °C and +50 °C			E2				
Thermocouple			T1				
Others			Z9				

Continued see next page

## ... Ordering Information

Base model	TSP331	XX	XX	XX	XX
<b>Sensor Type and Wiring</b>					
Without measuring inset		Y0			
1 × Pt100, 2-wire		P1			
1 × Pt100, 3-wire		P2			
1 × Pt100, 4-wire		P3			
2 × Pt100, 2-wire		P4			
2 × Pt100, 3-wire		P5			
2 × Pt100, 4-wire (with integrated transmitter only one Pt100 is connected)		P6			
1 × Pt1000, 2-wire		P8			
1 × Pt1000, 3-wire		P7			
1 × Pt1000, 4-wire		P9			
1 × Type K (NiCr-NiAl)		K1			
2 × Type K (NiCr-NiAl)		K2			
3 × Type K (NiCr-NiAl)		K3			
1 × Type J (Fe-CuNi)		J1			
2 × Type J (Fe-CuNi)		J2			
1 × Type L (Fe-CuNi)		L1			
2 × Type L (Fe-CuNi)		L2			
1 × Type N (NiCrSi-NiSi)		N1			
2 × Type N (NiCrSi-NiSi)		N2			
1 × Type T (Cu-CuNi)		T1			
2 × Type T (Cu-CuNi)		T2			
1 × Type E (NiCr-CuNi)		E1			
2 × Type E (NiCr-CuNi)		E2			
1 × Type S (Pt10Rh-Pt)		S1			
2 × Type S (Pt10Rh-Pt)		S2			
Others		Z9			
<b>Sensor Accuracy</b>					
Without measuring inset		Y0			
Accuracy Class B, IEC 60751		B2			
Wire Wound, Double, Accuracy Class A, IEC 60751, Range 0 to 250 °C (32 to 482 °F)		D2			
Wire Wound, Accuracy Class A, IEC 60751, Range -100 to 450 °C (-148 to 842 °F)		D1			
Thin Film, Accuracy Class A, IEC 60751, Range -30 to 300 °C (-22 to 572 °F)		S1			
Thin Film, Accuracy Class AA, IEC 60751, Range 0 to 100 °C (32 to 212 °F)		S3			
Thermocouple, Accuracy Class 2, IEC 60584		T2			
Thermocouple, Accuracy Class 1, IEC 60584		T1			
Thermocouple, Standard Accuracy ANSI MC96.1		T4			
Thermocouple, Special Accuracy ANSI MC96.1		T3			
Thermocouple, Accuracy according to DIN 43710		T5			
Others		Z9			

Continued see next page

Base model	TSP331	XX	XX
<b>Connection Head Type / Material</b>			
AGL / Aluminium, screwed cover		L1	
AGLH / Aluminium, high cover, screwed		L2	
AGLD / Aluminium, screwed cover with display		L4	
AGS / Stainless steel, screwed cover		S1	
AGSH / Stainless steel, high cover, screwed		S2	
AGSD / Stainless steel, screwed cover with display		S4	
Others		Z9	
<b>Transmitter</b>			
Without transmitter, sensor with ceramic terminal block - spring loaded			Y1
Without transmitter, sensor with flying leads and metal plate - spring loaded			Y2
TTH300-HART, programmable, output signal 4 to 20 mA, dual input			H4
TTH300-HART, Ex version, programmable, output signal 4 to 20 mA, dual input			H5
TTH300-PA, programmable, output PROFIBUS PA, dual input			P6
TTH300-PA, Ex version, programmable, output PROFIBUS PA, dual input			P7
TTH300-FF, programmable, output FOUNDATION Fieldbus H1, dual input			F6
TTH300-FF, Ex version, programmable, output FOUNDATION Fieldbus H1, dual input			F7
TTH200-HART, programmable, output signal 4 to 20 mA			H6
TTH200-HART, Ex version, programmable, output signal 4 to 20 mA			H7

## ... Ordering Information

### Additional ordering information SensyTemp TSP331

	XX	XX	XX
<b>Transmitter Measuring Range</b>			
Standard measuring range	A0		
Customer-specific measuring range	AZ		
<b>Declarations and certificates</b>			
Declaration of compliance according EN 10204-2.1, with the order			C4
Test report according EN 10204-2.2, material monitoring for wetted parts			C1
Test report according EN 10204-2.2 for batch values, MIC-TC			C5
Test report according EN 10204-2.2 for measuring of insulaionsresistance at ambient temperature			CN
Inspection certificate according EN 10204-3.1, material monitoring for wetted parts			C2
Inspection certificate according EN 10204-3.2, material monitoring for wetted parts			C3
Inspection certificate according EN 10204-3.1, visual, dimensional and functional test			C6
Inspection certificate according EN 10204-3.1, helium leakage test			C7
Inspection certificate according EN 10204-3.1, dye penetration test			C9
Inspection certificate according EN 10204-3.1, Positive Material Identification (PMI)			CA
Inspection certificate according EN 10204-3.1, pressure test on thermowell			CB
Inspection certificate according EN 10204-3.1, sensor tolerance			CC
SIL2 declaration of conformity in accordance with IEC 61508 for sensor with integrated transmitter, HART			CS
Inspection certificate according EN 10204-3.1, sensor calibration, single RTD			CD
Inspection certificate according EN 10204-3.1, sensor calibration, double RTD			CE
Inspection certificate according EN 10204-3.1, sensor calibration, single thermocouple			CF
Inspection certificate according EN 10204-3.1, sensor calibration, double thermocouple			CG
DAkKS sensor calibration, single RTD, calibration certificate per thermometer			CH
DAkKS sensor calibration, double RTD, calibration certificate per thermometer			CJ
DAkKS sensor calibration, single thermocouple, calibration certificate per thermometer			CK
DAkKS sensor calibration, double thermocouple, calibration certificate per thermometer			CL
Inspection certificate according EN 10204-3.1, x-ray- test for weldings			CU
Inspection certificate according EN 10204-3.1, x-ray- test for bore concentricity			CV
Inspection certificate according EN 10204-3.1, ultrasonic- test for bore concentricity			CW
Wetted parts according to EC 1935			CX
Others			CZ
<b>Number of Calibration Test Points</b>			
1 point			P1
2 points			P2
3 points			P3
4 points			P4
5 points			P5

Additional ordering information SensyTemp TSP331 (Continuation)	XX	XX	XX
<b>Temperatures for Sensor Calibration</b>			
Standard calibration: 0 °C (32 °F)	V1		
Standard calibration: 100 °C (212 °F)	V2		
Standard calibration: 400 °C (752 °F)	V3		
Standard calibration: 0 °C and 100 °C (32 °F and 212 °F)	V4		
Standard calibration: 0 °C and 400 °C (32 °F and 752 °F)	V5		
Standard calibration: 0 °C, 100 °C and 200 °C (32 °F, 212 °F and 392 °F)	V7		
Standard calibration: 0 °C, 200 °C and 400 °C (32 °F, 392 °F and 752 °F)	V8		
Standard calibration: Customer specific temperatures	V6		
DAkKS calibration: 0 °C (32 °F)	D1		
DAkKS calibration: 100 °C (212 °F)	D2		
DAkKS calibration: 400 °C (752 °F)	D3		
DAkKS calibration: 0 °C and 100 °C (32 °F and 212 °F)	D4		
DAkKS calibration: 0 °C and 400 °C (32 °F and 752 °F)	D5		
DAkKS calibration: 0 °C, 100 °C and 200 °C (32 °F, 212 °F and 392 °F)	D7		
DAkKS calibration: 0 °C, 200 °C and 400 °C (32 °F, 392 °F and 752 °F)	D8		
DAkKS calibration: Customer specific temperatures	D6		
<b>Thermowell Options</b>			
With additional tantalum sleeve, tantalum sleeve is brazed to the flange in two points		S1	
Thermowell coated with 0.5 mm (0.02 in) E-CTFE / Halar, wetted parts incl. flange surface		S2	
Thermowell coated with 0.5 mm (0.02 in) PFA, wetted parts incl. flange surface		S3	
Thermowell coated with 1 mm (0.04 in) NiCrB / META 43		S4*	
Thermowell coated with 0.5 mm (0.02 in) NiZrO2 / PL1312		S5*	
Thermowell incl. tests and certificates AD-2000 standard for austenitic steel		S6	
Thermowell incl. tests and certificates AD-2000 standard for high temperature steel		S7	
Thermowell incl. tests and certificates NACE MR 01-75		S8	
Thermowell clean for oxygen service		S9	
Thermowell stress calculation according ASME 19.3-TW 2010 (Murdock)		SM	
Thermowell with plug, gasket and chain		SP	
Thermowell with plug and gasket		SR	
Others		SZ	
<b>Flange Connection Options</b>			
Flange raised face form RF, ASME B16.5			F6
Flange raised face form B1 acc. EN 1092-1			F7
Flange raised face form B2 acc. EN 1092-1			F8
Flange facing with tongue form C EN 1092-1			F1
Flange facing with groove form D acc. EN 1092-1			F2
Flange facing with RTJ surface acc. ASME B16.5			F3
Flange full penetration welded			F4
Others			FZ

\* Specify length from thermowell tip in mm.

## ... Ordering Information

Additional ordering information SensyTemp TSP331 (Continuation)	XX						
<b>Extension Tube Options</b>							
Extension tube welded with measuring inset, gas tight	N3						
<b>Measuring Inset: Option</b>							
Hot junction grounded		J1					
2 insets paired from 0 to 100 °C (32 to 212 °F), max. deviation 0.1 K		J3					
Improvement Sensor Accuracy to 0.5 Cl. A, 0 to 100°C, U>100 mm		J8					
Improvement Sensor Accuracy to 0.5 Cl. A, 0 to 400°C, U>250 mm		J9					
<b>Measuring Inset: Transmitter Mounted</b>							
Transmitter mounted on inset, without ceramic block			J2				
<b>Measuring Inset: Other Options</b>							
Others				JZ			
<b>Connection Head Options</b>							
Second transmitter mounted in connection head (same type as first one)						H1	
Cover of connection head with chain attached to the lower part						H8	
Connetion head with capstan screw for sealing						H9	
Others						HZ	
<b>Cable Entry Options</b>							
1 × M20 × 1.5, without cable gland							U1
1 × ½ in NPT, without cable gland							U2
2 × M20 × 1.5, without cable gland							U4
2 × ½ in NPT, without cable gland							U5
2 × M20 × 1.5, with cable gland skintop, temperature range -40 bis +70 °C (-40 bis +158 °F)							U7
1 × M20 × 1.5, with Ex-d cable gland							UA
2 × M20 × 1.5, with Ex-d cable gland							UC
Harting Han 7D plug and socket connection							UG
Harting Han 8D (8U) plug and socket connection							UH
M12 plug for PROFIBUS PA							UJ
7/8 in plug for FOUNDATION Fieldbus							UK
1 × ½ in NPT-PE ADE 4F Capri Codec							UF
1 × ½ in NPT Capri Codec, with strain relief							UL
1 × ½ in NPT-PE ADE 4F + 1 × ½ in NPT plug							UP
Others							UZ
<b>Display Type</b>							
LCD indicator type AS							L1
Configurable LCD Indicator type A							L2

Additional ordering information SensyTemp TSP331 (Continuation)	XX	XX	XX	XX
<b>Other Options</b>				
Earth screw internal	PH			
Name plate stainless steel	PV			
Each Thermometer single packed - Polyethylen	PN			
<b>Documentation Language</b>				
German		M1		
English		M5		
Language package Western Europe / Scandinavia (Languages: DA, ES, FR, IT, NL, PT, FI, SV)		MW		
Language package Eastern Europe (Languages: EL, CS, ET, LV, LT, HU, HR, PL, SK, SL, RO, BG)		ME		
<b>Additional TAG Plate</b>				
Stainless steel plate with TAG no.			T1	
<b>Additional Identification Plate</b>				
Stainless steel plate with customer specific text				T2
Adhesive label				T3

Accessories	Ordering number
TSP commissioning instruction, German	3KXT161001R4403
TSP commissioning instruction, English	3KXT161001R4401
TSP commissioning instruction, language package Western Europe / Scandinavia	3KXT161001R4493
TSP commissioning instruction, language package Eastern Europe	3KXT161001R4494

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